WAR SURGERY AND MEDICINE

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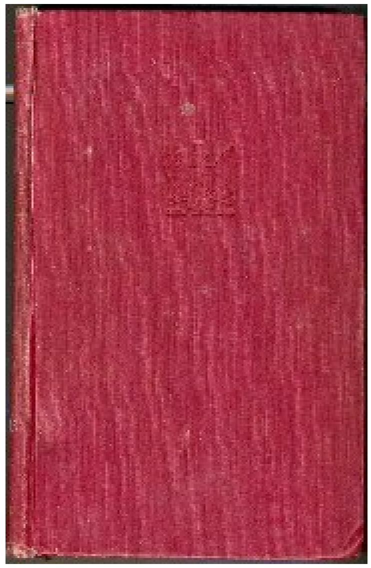

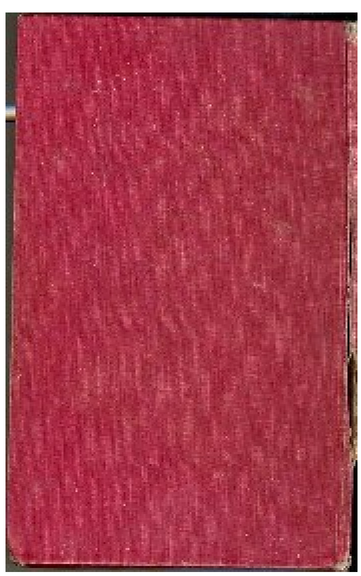

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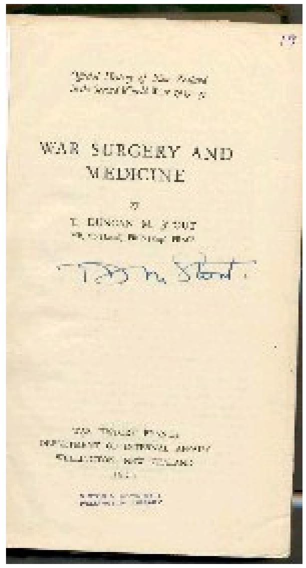
WAR SURGERY AND
MEDICINE
T. DUNCAN M. STOUT

Official History of New Zealand in the Second World War 1939–45

WAR SURGERY AND MEDICINE

T. DUNCAN M. STOUT MB, MS (Lond), FRCS (Eng), FRACS

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WAR SURGERY AND MEDICINE

FOREWORD

Foreword

BY MAJOR-GENERAL SIR HENEAGE OGILVIE, KBE, DM, M CH, FRCS

Consultant Surgeon to the Middle East Force, 1942–43

IT was at the battle of Alam Haifa in August 1942, that I met a group of New Zealand forward surgeons for the first time, and began an association that lasted till the invasion of Italy. This volume records the happy co-operation that existed in the Second World War between the New Zealand Medical Corps and the Royal Army Medical Corps, a co-operation that was fruitful in advancing the standard of war surgery, in putting to a practical test many new methods, and in alleviating immeasurably the lot of the sick and wounded. Collaboration was constant, and to the mutual advantage of both. The administrative heads and the consultants of both services were in close touch. During battles the New Zealand medical units were often called upon to deal with large numbers of casualties from the British and other Commonwealth forces, and New Zealand patients were admitted to British units. In Tunisia in 1943 at 1 NZ CCS, which was augmented by special British units, including a neurosurgical unit, the principle of forward treatment of head injuries by teams of experts was first worked out.

The fighting in the Western Desert was the testing ground in which the principles of wound treatment learned in the First World War were re-established, in which methods applicable to the fresh conditions of mechanised and highly mobile war were worked out, and in which many surgical methods introduced since 1918, and others discovered during the first years of the war, were first given practical trial. The campaign in Europe in 1940 and the Abyssinian campaign in 1941 were too hurried for the purpose. In the Desert blood was first used in quantities that are now considered adequate; chemotherapy, undergoing tentative trial in 1939, was used on a large scale, first with the sulphonamides, later with penicillin; the use of gastric suction, intravenous medication, and exteriorisation of wounds of the large intestine, combined with the transfer of patients to forward surgical centres able to nurse them and retain them till their condition was stabilised, led to a recovery rate more than twice that in Flanders in 1918, even though the type of injury being treated was, on the average, more severe; gas gangrene, the terror of the First World War, was almost abolished by early surgery and transfusion; and methods of immobilisation suited to transport along lines of evacuation that might extend to a thousand miles, the Tobruk splint for the lower limb and the thoraco-brachial plaster for the upper, were evolved.

In Italy the forward surgical units were pushed close to the fighting and advanced base units were sited a few hours farther back. Delayed primary suture of soft-tissue wounds, from three to five days after injury, became the rule. Air transport, seldom possible till the mastery of the air is assured, was exploited, and cases were transferred to specialist centres at the base within a short period of wounding. Penicillin initiated a fresh policy in gunshot fractures, enabling many to be closed by delayed primary suture, and in wounds of the chest, where early and repeated tapping of haemothoraces with penicillin instillation went far to abolish late deaths from sepsis.

The surgeons of 2 NZEF made a valuable contribution to the surgical potential of the Eighth Army, just as administrators and physicians helped to preserve the health of the 2 NZEF in the Middle East and the Pacific. Their service, along with that of their British and Dominion colleagues, was such that it can be claimed that the soldiers, sailors, and airmen of the British Commonwealth were better cared for in this last world conflict than any fighting men in the history of warfare.

W. H. Ogilvie

September 1953

WAR SURGERY AND MEDICINE

PREFACE

Preface

IN this clinical volume, the first of three volumes of the Medical History of New Zealand in the Second World War, is recorded the most important aspects of the clinical work and experience of the New Zealand Medical Corps. Some subjects which did not figure prominently in our New Zealand experience will be covered by the Medical War Histories of the Commonwealth and the United States, which histories have been co-ordinated by the meetings of the Liaison Committee of Official Medical War Historians. The volumes produced by the various countries will together cover the whole field of war medicine and surgery.

In this, our New Zealand record, no attempt has been made to write clinical articles such as would be appropriate to a medical journal or a textbook. Subjects have in the main been dealt with chronologically, linking the First World War with the Second World War, and stating and evaluating developments in the course of the war. The short reviews of our experience in the First World War are useful because no New Zealand clinical history was written at that time, and they also serve to emphasize the importance of cardinal principles, especially in war surgery, and to show how similar problems arise in every war. With articles built up in chronological order there is inevitably some repetition and lack of clarity, but this approach was adopted deliberately with some subjects in order to give the reader a mental picture of what was happening at important periods during the war; for instance, how the wounded were treated in our Field Ambulances during the Libyan campaign or at the Battle of Alamein, Summaries of surgical treatment have been made for reasons of emphasis and ready reference. Statistics, some of them compiled with great difficulty, have been incorporated to illustrate the comparative magnitude of the problems, and War Pensions' experience has been drawn upon to help place the problems in proper perspective.

The articles are centred on the 2 NZEF in the Middle East and Italy, where most of our experience lay, but clinical work in the Army and Air Force in the Pacific theatre is covered where possible. In the Middle East and Italy we had a force which grew from 6000 in February 1940 to 36,000 in October 1941 and remained around the 30,000 mark until August 1945; during this period 2 NZ Division served in the early campaigns in Greece and Crete and in all campaigns of the Eighth Army except Sicily. Its wounded totalled 16,456, apart from wounded who were taken prisoner (1326), and its sick over 100,000, although the sickness rate was low. The Pacific forces were smaller and served for shorter periods; the wounded in 3 NZ Division totalled only 227, but there were special problems relating to tropical diseases.

The New Zealand Medical Corps carried out its work in the Middle East under the overall administration of the Royal Army Medical Corps, and always in close association with other forces as far as clinical work was concerned, so that any advances in treatment were immediately available to us. It fell to our lot to care for very many casualties from other forces of the Commonwealth, and many of our own men were treated in other medical units, especially in British General Hospitals.

The clinical work of the NZMC reached a high standard in conformity with that of the British Army medical service, of which our Corps was a small but energetic part. It is of interest to note that in the New Zealand casualties the proportion of killed and died of wounds to wounded who recovered steadily fell from 2:5 in Greece and Crete and 1:2 in Libya to 1:5 in the advance from the Senio in the final stages of the war in Europe. The personnel of our Corps were all civilians recruited for service during the war. Only a few senior medical officers had seen service in the First World War and so had some experience of war medicine and surgery. The quality of our clinical work therefore depended on the training and ability of our civilian medical and nursing professions. Our nursing sisters did magnificent work throughout the war and our voluntary aids and orderlies gave excellent service. There was a relative shortage of specialists in New Zealand in the fields of neurosurgery, plastic surgery, chest surgery, anaesthesia, and, to a lesser extent, orthopaedic surgery., This rendered it necessary to rely on the RAMC to some extent for these services, and special British units were often invaluable to us. (It is satisfactory to note that there has been a marked development of these specialties in New Zealand since the war, and it is hoped that this will enable the medical services of any future expeditionary force to be self-sufficient.)

The development of specialist units overseas brought about a steady improvement in treatment, and field surgical and field transfusion units were invaluable in forward surgery. The introduction of sulphonamides and penicillin and the adoption of delayed primary suture brought about marked advances in wound healing. In the treatment of, disease the sulphonamides and penicillin proved also of the greatest value, while in the preventive field, inoculations against tetanus, typhus and the enteric fevers, the use of mepacrine as a suppressive of malaria, and the use of the insecticide DDT limited disease and conserved manpower. All these developments and many others are elaborated in the appropriate articles.

Short lists of references have been appended to some of the articles when information has been obtained from medical journals. Most of the articles, however, have been written almost entirely from our own experience and from what information we have found in reports filed during the war. One wishes that more of our officers had recorded their experience in the form of surveys and special studies, and that an attempt had been made during the war to collect clinical photographs and drawings.

The articles have been written almost entirely by the Medical Editor with the help of his assistant, J. B. McKinney, but a few very valuable articles have been written in whole or in part by distinguished members of the Medical Corps-among them G. R. Kirk (Infective Hepatitis); E. G. Sayers (Malaria); J. E. Caughey (Q Fever); R. A. Elliott (Ear, Nose and Throat disabilities); H. V. Coverdale (Ophthalmology); W. M. Manchester (Plastic Surgery); W. M. Platts (Venereal Disease); J. Borrie (Clinical work among Prisoners of War); and D. T. Stewart (Work of a General Hospital laboratory overseas); and G. H. Gilbert, New Zealand Dental Corps (Plastic Surgery).

Other senior members of the Corps have helped by reading and giving valuable criticism of some of the articles and some have furnished fresh data. Among those we thank for this co-operation are M. Falconer, E. L. Button, A. W. Douglas, J. K. Elliott, M. Williams, H. K. Christie, K. B. Bridge, W. E. Henley, R. G. Park, W. H. B. Bull, J. R. Boyd, D. D. McKenzie, C. G. Riley, D. P. Kennedy, G. F. V. Anson, and T. W. Harrison.

A very important contribution has been made by D. Macdonald Wilson, who has supplied information and statistics from the War Pensions Branch which have enabled us to follow up the after-history relating to many of the important

disabilities, and has also written the article on Essential Hypertension.

It is hoped that this volume, apart from its value as an historical record of the excellent work done by the New Zealand Medical Corps, will be of some service to future generations if New Zealand ever has the misfortune to be involved in another war.

T. D. M. Stout

WELLINGTON 1952

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WAR SURGERY AND MEDICINE

[SECTION]

BEFORE dealing with the methods employed during the 1939–45 War in the treatment of war wounds, it will be necessary to give a short account of the measures adopted in the two preceding wars, the First World War of 1914–18 and the Spanish Civil War.

FIRST WORLD WAR

First World War

At the beginning of the war wound treatment consisted of the removal of foreign bodies, of loose bone, and the institution of drainage. Aseptic dressings were utilised. Numerous antiseptics were employed for wound dressings, the most popular being acriflavine, others being the coal-tar dyes, Di-Chloramine T and Chloralamide. Later came the development of the technique of the thorough excision of the wound, with the removal of the contaminated area of the soft tissues, except naturally the vessels and nerves. At first, excision was restricted to wounds operated on within eight hours of infliction, and the wound was then primarily sutured. This proved generally unsatisfactory, and later the wound was left wide open and drainage instituted as required. Then the common occurrence of gas gangrene, and the realisation that dead muscle was the main culture medium in the wound for the anaerobic organisms, brought about the radical removal of devitalised muscle.

At first dressings were done frequently, with the consequent difficulty arising from shortage of staff. Sir Almroth Wright suggested the application of the principles of osmosis to produce adequate drainage, and further suggested that the wound be packed with dressings saturated in salt, tablets of salt being employed for the purpose. The wound was not dressed for about ten days after the original operation and packing. This treatment had great success in providing rest for the patient and adequate drainage of serum, but produced some difficulty in observation and did not combat anaerobic infection.

Then Carrel carried out his experiments, and advised the hypochlorites as a wound irrigation to combat infection. This became the standard method of treatment throughout the British Army. The wound was radically excised; then small rubber tubes with lateral holes were inserted freely into the wound, and gauze placed over it. The wound was not drained, but left like an open trough so that the Dakin's solution could lie in the wound and get longer contact with the tissues. Drainage was instituted only if abscess formation developed apart from the wound proper. Dakin's solution was then introduced into the tubes four-hourly by means of a syringe and allowed to be absorbed into the dressings. In large wounds trays were placed under the limb to catch the overflow. Later continuous slow drip irrigation was arranged by means of large glass containers suspended above the bed by wood or metal stands, with rubber tubes, and interposed drip taps, leading to the small tubes in the wound to which glass connections were attached.

Morison of Newcastle developed another technique for primary treatment of the wound. Excision of the wound was carried out and then the wound was packed with gauze impregnated with BIPP. [1] This acted as a bacteriostatic and also encouraged lymph drainage of the wound, with generally satisfactory end-results. The method was also employed in the secondary suture of wounds. Apart from some lymph oozing, this method was very successful.

The preparation of the wound for secondary suture was the normal process of wound treatment at the end of the war. Bacteriological examinations were carried out to determine the quantitative infection present, and also to determine the nature of the infection. A scale was compiled showing the number of organisms present which normally would not interfere with satisfactory healing, and the scale was consulted in determining the advisability of operation. At operation the growing edges of the skin were gently excised so as to leave a raw area. The rest of the wound was dealt with by removing any dense scarred area that may have formed over the muscular and subcutaneous areas, and freeing the fascial layer. BIPP was generally rubbed lightly into the wound after its re-excision, and then any excess of the BIPP removed, so that only a thin staining remained. The wound was sutured by means of figure-of-eight sutures of strong silk which had been impregnated with BIPP. The sutures passed through the skin and the fascial layer at intervals of not less than half an inch. The tightening of the suture first brought the fascial layer together firmly, and then the skin. Slight oozing generally occurred between the stitches, but this did not interfere with very satisfactory healing. The BIPPed stitches could be left in for a long time without any irritation to the skin. Some surgeons did not use BIPP, and others employed a simple suture of the wound without re-excision. The bringing together of the fascial layer, however, had many advantages, especially in the elimination of muscle hernia. Generally, even in very large wounds, the wound could be brought together without great tension because of the wasting of the limb that had occurred since the injury. In cases of difficulty the skin and subcutaneous tissues were widely freed at either side of the wound, and small cuts were made in the skin parallel to the wound after suture, when there seemed to be danger of sloughing of the skin. The cuts relieved both tension and any venous congestion that might be present, and so preserved the vitality of the skin. In cases with marked loss of skin it was a usual preliminary measure to draw the wound together and then attempt suture later. In more serious cases skin grafting or pedicle flaps were utilised. Simple wounds and also compound fractures were dealt with in this way.

The French treated wounds, including wounds of joints and fractures, by excision of the wound (ébridement), by the use of large rubber tubes for dependent drainage and plaster splints for immobilisation. The splints were kept on for weeks, the resultant smell being relieved by the spraying of scent. As a rule, the temperature rapidly subsided, and the progress of the patients was generally satisfactory. Except for drainage the treatment resembled in many ways the Winnett Orr or Trueta treatment.

Most surgeons employed the Carrel-Dakin treatment as a means of controlling infection originally, and many utilised BIPP at the time of secondary suture.

Undoubtedly the Carrel-Dakin system produced excellent results, though it involved considerable nursing attention and somewhat elaborate appliances as methods of continuous irrigation were developed to obviate the four-hourly routine.

There were attempts made at the end of the war to carry out primary suture of wounds when conditions were suitable, and, in many cases, with success. The idea of primary suture was ever before the surgeon, but it was realised that, under ordinary conditions of warfare, the ideal was unattainable.

After the war the techniques of excision of wounds, of Carrel-Dakin treatment, and of Morison's BIPP treatment were all utilised in civilian practice, especially in the treatment of serious accidental injuries.

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[1] Bismuth iodoform paraffin paste.

SPANISH CIVIL WAR

Spanish Civil War

The Spaniards developed the Winnett Orr treatment of closed plaster for war wounds, and it became the recognised treatment for all limb wounds.

It depended for its success on complete immobilisation of the limb by encasing it in plaster, joint or muscle movement thus being prevented. The wound was excised and freely opened up, vaseline gauze and then a complete plaster splint was applied, and the limb was left undressed for ten days or more, when a fresh dressing and fresh plaster splint were applied It was found that severe infections rarely occurred, and that the wound became clean and slowly healed under the plaster. There was a great saving of nursing and dressings. The treatment was well written up by Trueta and Jolly, and knowledge of its benefits was widespread at the beginning of the Second World War. The Carrel-Dakin treatment had been displaced.

WAR SURGERY AND MEDICINE

SECOND WORLD WAR

SECOND WORLD WAR

At the beginning of the Second World War the technique of primary wound treatment laid down during the 1914–18 War, and continued in the treatment of civilian injuries afterwards, was carried out by the army surgeons. After the surgical cleansing of the wound the closed plaster treatment as developed during the Spanish Civil War was utilised. Very soon the sulphonamides were employed as bacteriostatics, both locally to the wound and parenterally by the mouth and later intravenously and intra-abdominally.

The antibiotic penicillin, when introduced in the later half of 1943, gradually displaced the sulphonamides and with its help the regular delayed primary suture of wounds was introduced. The primary efficient surgical treatment of the wound remained, however, the essential element in wound treatment.

It is necessary to survey the nature of the wounds produced by the different missiles, and the special problems involved in injuries to different parts of the body, before proceeding to discuss the development of wound treatment during the war in some detail, both in regard to the various aspects and also as a chronological account of the conditions present in the different campaigns in which the 2 NZEF fought.

Wounds Produced by Different Missiles

There was a marked difference in the type and severity of the wounds produced by shells, mines, and bullets. Very severe wounds, often multiple, were often caused by shells, mortars, mines, grenades, and booby traps. Unless it struck bone, the rifle bullet was generally less severe in its effect. Fortunately, shell splinters more often caused numerous small wounds rather than severe wounds. Mine wounds were particularly severe and multiple, frequently involving the face as well as destroying the feet.

Types of Wound

The nature of the wound varied a good deal according to the region of the body involved, and especially as to the amount of muscular tissue present.

In the head the penetration of the skull and involvement of the brain called for special equipment, and treatment by personnel trained in neurosurgery. Injuries to the face, apart from the involvement of the eyes, were of importance with regard to the prevention of disfigurement and the associated fracture of the jaw. The neck injuries were often associated with injuries to the large vessels and to the larynx and trachea. Wounds of the thorax were often associated with lethal injuries to the heart and blood vessels, and the sucking wounds presented symptoms demanding immediate relief. The accumulation of blood in the pleural cavity not only interfered with respiration, but also acted as a nidus for infection.

The abdominal wounds were of special importance because of the injuries to the viscera, particularly the hollow viscera, but bleeding in the retro-peritoneal tissues and muscle injury were also of importance.

The buttock and perineum were dangerous areas because of the liability to abdominal, especially to rectal, injuries, and also because of the mass of muscle tissue particularly liable to anaerobic infection.

As regards the limbs, where the bulk of the uncomplicated wounds occurred, the thighs and calves with the bulk of muscle were again prone to serious infection; and vascular injuries were of special importance, especially in the thighs, because of the danger of gangrene.

Injury to bone and joint produced added risk of sepsis and prolonged disability.

Injuries of the larger nerves, though of no importance as regards wound healing, led to the longest period of disability and demanded prolonged treatment.

Traumatic amputation of the limb produced by gross injury proved to be of considerable importance because of the profound and continued shock associated with the extensive tissue damage.

The depth and the extent of the wound naturally varied enormously in degree from a small abrasion to a devastating tissue destruction, and from a perforating wound with two small perforations of the skin, with no swelling of the limb, to a large blowout of skin and muscle leaving a huge hole in a limb or, as commonly occurred, in the buttock.

In uncomplicated wounds the depth and the extent were important factors, but the amount of muscle involvement was of cardinal importance as it was in damaged muscle that infection, especially dangerous anaerobic infection, was especially prone to occur.

In addition to the missile itself producing in the wound damaged non-vital tissue, there was introduced into the wound foreign bodies of different kinds including dirt, clothing, and portions of the missile itself, all of which acted as irritants to the tissues and potential foci of infection.

The treatment of the wound had to be such as to take all these factors into consideration.

Treatment of the Wound

Before the wound could be dealt with it was necessary to remove any overlying clothing and expose the wound itself and a considerable area around, generally the whole limb in a limb injury, and sometimes the whole body. This exposure was necessitated not only to enable the wound to be adequately treated, but also to ensure that no other wounds were present. Exposure of one area at a time was generally necessary because of the shocked condition of the patient. (The methods of prior resuscitation will be described later.) The skin around the wound was then thoroughly cleansed over a very wide area by soap and hot water and shaved when any hair was present, also shaving a limb on which plaster extension was to be applied. The limb was then dried and painted with iodine solution or other skin antiseptic, and guards adjusted. In ordinary wound operations mackintosh guards were generally utilised in the forward areas so as to save washing.

The surgical cleansing of the wound was then proceeded with according, to a great extent, to the interval that had elapsed since wounding.

Except in the case of wounds operated on very late, and in septic wounds, the thinnest possible slice was taken off the cut surfaces of the skin, and the wound freely enlarged longitudinally so as to open up thoroughly the deeper parts of the wounds. The deep fascia was opened up in the same way and, if necessary, also the muscle planes.

All seriously traumatised tissue was now removed from the internal wound surface either by knife or scissors. Special attention was given to muscles, all avascular discoloured muscle being removed so that a fresh bleeding surface was presented. Tags of fascia and damaged subcutaneous tissue were removed, and all foreign tissue such as dirt and clothing were removed by instruments, wiping, and washing. All bleeding was stopped, the suction apparatus being of great value in the catching of the bleeding points and also in removing blood and clot from the wound. Blood vessels and nerves were preserved, as was bone. The extent of the removal of tissue would depend on the amount of tissue damage and partly on the interval since wounding.

At first in North Africa the removal of skin was excessive, so much so at times as to interfere with the subsequent healing of the wound. It was then stressed that skin was a very vital tissue which was seldom the site of infection, and excessive removal was discontinued.

The extent of removal of tissue in the deeper parts of the wound also varied during the different periods. This was especially so when the scene changed from the relatively non-infective terrain of North Africa to Italy, where more severe wound infection was noted and more radical wound toilet was called for.

Great tension in the wound was found at times, especially in the thigh and sometimes in the calf. This was relieved by free incision in skin and especially in the deep fascia, which was, if necessary, divided transversely.

After all the wound had been cleansed, tension relieved, bleeding dealt with and the wound surface dried, the whole surface was lightly covered with powder, at first sulphanilamide and later penicillin in a sulphanilamide base.

Gauze dressings were then applied so as to keep the wound open without plugging. At first sterile vaseline gauze or tulle gras was used so as to ensure an atraumatic dressing, which would not produce pain and trauma on redressing. In Italy, when delayed primary suture became the routine, plain gauze was substituted for the vaseline gauze as it was found that this dressing left a healthier surface for suture, and as the gauze was removed under the anaesthetic the question of pain did not arise. Cotton wool, gamgee, etc., were used as outer dressings.

In all fracture cases and in all large limb wounds splints were applied, in the great majority of cases of plaster, or with plaster incorporated with a Thomas or Kramer splint.

Removal of Foreign Body

Foreign bodies were removed if located during the process of wound cleansing, or if their position was known and the foreign body was large enough to warrant the exploration. It was seldom that X-rays were taken for this purpose, and in the Field Ambulances X-ray was not available. Hunting for foreign bodies in the seriously shocked cases was in general not warranted, especially if this entailed the opening up of fresh tissue planes. It was recognised, however, that the removal of foreign bodies was desirable, and a much larger proportion were removed during the latter part of the war. The smooth bullet was less prone to produce sepsis than the jagged pieces of shell which often introduced clothing.

Drainage

The wound, as already stated, was always left wide open and kept open by a gauze dressing, and this ensured some wound drainage. In large wounds of the thigh and often of the calf dependent drainage was generally instituted by making incision in the back of the limb, especially in the earlier period of the war. and before penicillin became available. When sepsis developed, free drainage was provided by large incisions.

Closed Plaster Treatment

At the beginning of the war the closed plaster technique was adopted practically universally and all limb wounds were treated in this way. The wound treatment as described was employed for all large wounds. Vaselined gauze was then applied to the cleansed and enlarged wound and the limb enclosed in plaster. The results were very good. The patients travelled comfortably. The temperature tended to subside satisfactorily, and little toxaemia was present in the majority of the cases. There was little strain on the staffs of the hospitals as dressings were infrequent.

Certain disadvantages were evident, and these became more obvious as time went on, but the treatment had obtained such a grip on the imagination of the medical officers that the disadvantages were prone to be overlooked, especially in those who had had no previous experience of war wounds. The first disadvantage noted was that there was a grave danger of interfering with the blood supply of the limb if a closed plaster was applied, without padding, shortly after wounding. Some limbs were lost because of this. Instructions were then issued by Army that padding should always be used for the primary plaster, and that the plaster should also be split before the case was transferred to another unit.

The second disadvantage was that the plasters became very stained by the secretion from the wound, and also very offensive. Much ingenuity was displayed to obviate this, and carbon dressings and deodorants applied, but without much success.

The most important disadvantage, however, was the long period generally required to promote healing, with the resultant serious wasting of the limb and loss of functional activity. This was naturally noticed only as time went on. It was also noted that secondary infections arose, notably by B. Pyocyaneus. Finally it was agreed that the principle of primary immobilisation of the wounded limb was sound, but that, after the first ten days, further complete immobilisation was unnecessary and undesirable in the majority of the non-fracture cases, and that more rapid healing and return of function should be aimed at. Changes were soon made in attempts to clean up the wounds more rapidly and close them by secondary suture. Many methods were utilised, including the Carrel-Dakin method, but generally simple dressings with acriflavine and other antiseptics were used. Comparatively little was done in 2 NZEF, however, as our policy of evacuating the seriously wounded to New Zealand as soon as a hospital ship was available removed the patients from our hospitals in the Middle East before their wounds were ready for suture. This was contrary to what occurred during the First World War, when it was the routine procedure to hold cases in England till after the wounds had been sutured and healed. The closed plaster technique, however, continued to be utilised throughout the war in the treatment of below-knee fractures till delayed primary suture of wounds was carried out in all suitable cases, the plaster splint being reapplied after suture. The same applied generally to the treatment of arm fractures.

SULPHONAMIDES

SULPHONAMIDES

The sulphonamides were used as a means of combating infection in wounds during the early periods in the Middle East Forces, but it was some time before the treatment was organised and made universal.

As far as the New Zealand forces operating in the Greek and Cretan campaigns were concerned, the sulphonamides were only utilised in some of the serious cases by giving doses of sulphonamides by the mouth for the first forty-eight hours.

During the second Libyan campaign sulphanilamide was applied locally to the wound and the drug was also given orally four-hourly for at least forty-eight hours. Sulphanilamide powder was supplied to the Field Ambulances at this period. The local application was continued during the subsequent treatment at the Base, especially for the cleaner wounds.

Sometimes the sulphanilamide was mixed with oil, but absorption appeared unsatisfactory. It was noted that too much powder was often introduced locally so that at the base hospitals large lumps were often seen in the wound, thereby acting as foreign bodies.

It was generally thought that septic wounds did not benefit at all from local application.

Difficulties in ensuring the adequate and regular administration of sulphonamide tablets by the mouth led to some units instituting a special sulphonamide chart so that dosage, especially in the forward areas, could be recorded and checked. This was started during the second Libyan campaign and soon became universal, and it brought about a marked improvement in the administration of the drug. In spite of this, however, it was found that in the bustle of evacuation, and the priority that had to be given to the treatment of the seriously wounded, more often than not the giving of sulphonamides was forgotten and men got only minimal and erratic doses. This caused many to give larger doses twice daily instead of the small dose four-hourly. The Australians carried out this routine with success.

The value of the drug as a bacteriostatic was stressed, with the obvious inference that it had to be given in the first twenty-four hours to be of the maximum use.

In May 1942 Major-General Monro, the Consultant Surgeon MEF, advised the supply of suitable pepper-pot tins to every Field Ambulance and every RMO so as to make the application of the powder more satisfactory.

Sulphonamides orally were utilised for later sepsis, but it was found at this stage that they had to be used with great caution because of their destructive effect on the leucocytes, and their use was controlled by repeated blood counts. Although it was held to have been conclusively proved that sulphonamides were of great value in preventing severe infection and combating early infection, there was doubt of their value in established infection. In our main hospitals in Egypt there was from the beginning some doubt as to the efficacy of the sulphonamides in controlling wound infection, as large numbers of cases had been observed during the first Libyan campaign with little or no wound treatment, yet with little resultant sepsis. And in the second Libyan campaign many of the smaller perforating and penetrating wounds healed satisfactorily with no operative treatment and no sulphonamide. This produced a natural scepticism of the vaunted value of the new drugs. The British surgeons, however, with greater experience of the more serious cases, were satisfied that the treatment was really of great value, and the utilisation of the sulphonamides, both locally and orally, became standardised and the dosage chart universal.

The Consultant Pathologist MEF laid down approved details of the administration of sulphonamides at the first Cairo surgical conference held in February 1942 as follows:

Given in lemon; immediate primary dosage of 2 grammes, then 1 gramme 4 hourly for 48 hours. Then M & B (Sulphathiazole) 20–24 grammes in 4 days.

At the Alamein period, October 1942, the use of sulphonamides had become more widespread. Apart from the regular use locally in the wound, and orally by means of tablets, sulphadiazine was being used intravenously for anaerobic infection, and also used intra-abdominally. The usual dose given for gas gangrene was 60 grammes in forty-eight hours, or 15 grammes intravenously daily.

At the surgical conference held in Cairo in July 1943 an evaluation of sulphonamides as used locally in the wound showed that:

1. There was undue absorption from large wounds.
2. Clumps of powder acting as a foreign body were often seen.
3. There was a lack of continuous application.
4. Toxic skin and other reactions were often seen.

The toxic skin reactions were stressed by Lieutenant-Colonel R. Park, NZMC, skin specialist at 1 NZ General Hospital, who read a special paper on the subject at the conference. As a result, the continued local treatment by sulphonamides was largely given up in ordinary wound treatment.

It was considered that local sulphonamide treatment was of little use in septic cases, and that the sensitisation produced by its continued use would be a serious matter for any patient developing such infections as pneumonia and, because of the sensitisation, debarred from treatment by sulphonamides. Some serious cases of renal disturbance with anuria also occurred, and at post-mortem sulphonamide crystals were found blocking the urinary tubules.

This led to the discontinuance of prolonged sulphonamide therapy for septic wounds. Administration, except as a primary preventative measure, was thereafter restricted to cases of acute types of infection such as that due to the streptococcus. The dosage and period were also strictly limited and blood tests made in any doubtful cases.

The amount of sulphanilamide used locally was also strictly limited to 5 grammes, and this prevented any undue absorption.

Thereafter sulphonamide treatment was continued as a preventative locally and systemically till it was gradually displaced by penicillin, but it retained its place in the treatment of head wounds, where sulphadiazine was given in conjunction with penicillin, of eye wounds, and of penicillin-resistant infections.

PENICILLIN

PENICILLIN

The discovery of penicillin and its use in the treatment of war wounds produced a revolutionary change and stimulated the surgeons to carry out the early suture of wounds, which, with the control of infection by penicillin, led to a marked improvement in wound healing and a marked diminution in hospitalisation. The first experience of 2 NZEF with the new antibiotic was in Cairo, where Pulvertaft of 15 Scottish Hospital produced some penicillin and made a small supply available to our hospitals for the treatment of special cases.

Tripoli Conference

Then in August 1943 there was held at Tripoli an epoch-making conference, when Professor Florey and Brigadier Cairns came out from England to superintend experiments and evaluate the results of penicillin treatment of wounded from the Sicilian campaign.

Professor Florey described the following results of his experiments at Oxford:

Penicillin had been introduced through small tubes in the wound every 8 hours for 4–5 days. It had been found that there was consistent eradication of the streptococcus and staphylococcus, but no effect on the gram negative bacilli, such as the pyocyaneus and B. Coli. The wounds had healed well in spite of continuing gram-negative infection. Osteomyelitis had been cured by large doses of intravenous penicillin.

Professor Florey drew attention to the presence of resistant strains of staphylococci, and also to the fact that bacteria can become artificially resistant following administration of penicillin, so that adequate dosage should be given at once as was done in the case of the sulphonamides. He stated that fractures with longstanding infection had not been improved by penicillin.

The experimental treatment of the wounded from Sicily was carried out in two

British hospitals and 3 NZ General Hospital in the Tripoli area. For the experiments penicillin was available as a calcium salt for local application, and as a sodium salt for parenteral use. The calcium salt was mixed with sulphanilamide to secure a penicillin content of three strengths—5000 units, 2000 units, and 500 units per gramme. The 5000-unit strength was used in a small number of cases when a single application was given prior to suture without tubes, while the 2000-unit strength was used as the routine wound application, and the 500 strength was prepared for use as a daily surface application for burns. It was also prepared in a solution of 250 units per cubic centimetre which was instilled into the wound through tubes, at first eight-hourly and later twice daily, the standard total dosage advised being 50,000 units.

The sodium salt was made into a solution containing 5000 units per cubic centimetre, and 500,000 units was given in doses of 15,000 units, intramuscularly or intravenously every three hours, for wounds with associated fracture of the long bones.

Results in Soft-tissue Wounds

In a series of 171 soft-tissue wounds from Sicily most cases healed well with early closure and the use of penicillin, in spite of the presence of gram-negative pus. Some cases had wound toilet in Sicily; others arrived in North Africa without treatment and then the wounds were excised. At Sousse and Tripoli most wounds were sutured after the application of penicillin powder and then irrigated with penicillin solution introduced through small tubes into the wounds for some days afterwards.

Results in Fracture Cases

Fracture cases were dealt with in several different ways. The majority were given primary surgical treatment in Sicily; in a few cases penicillin was applied locally to the wound, but most had no penicillin. The cases were all sutured after arrival at Tripoli when the condition of the wound permitted mechanical closure, penicillin being applied locally. Parenteral penicillin was then given either intramuscularly or intravenously in dosages of 400,000 to 500,000 units over five days.

In the early cases some of the wounds were closed under considerable tension and the wounds broke down. Later the centre of the wound was left open whenever tension was great or a dead space was unavoidable. Constant inspection of the wounds was found to lead to fresh infection. Of the main group of twenty-three cases, twelve were wholly successful, five partially so, and six were failures, with one amputation. The humerus cases were more successful than the femurs.

Altogether the results were not such as to warrant the adoption of primary suture of fractures, or immediate suture on arrival at Base Hospital without previous penicillin treatment. Some very septic cases were observed, and drainage was necessary in the majority of cases. The results showed, however, that in the majority of cases infection had been satisfactorily controlled, and that with a larger amount of penicillin administered parenterally over a longer period better results could be hoped for.

Bacteriological Investigations

Cultures taken from the wounds in Sicily showed infection by staphylococci in 23 per cent, haemolytic streptococci in 47 per cent, and claustridia in 30 per cent. Welchii was the predominant anaerobic organism.

Cultures taken at different periods from the wounds investigated in Tripoli showed that staphylococcus aureus was present in 53 per cent of the wounds, and streptococcus haemolyticus in 12 per cent. The streptococci were nearly always associated with staphylo-cocci. It was the exception for the wound to be free of cocci, though it might not be clinically septic. After wound treatment with penicillin the gram-positive organisms were got rid of in seven days, sometimes in two to three days. Pyocyaneus was very common, and its lack of pathogenity was doubted by the bacteriologist. Resistant strains of staphylococci, but not of streptococci, were encountered. In the cases of chronic infection seen at Algiers the organisms were nearly all streptococci.

Discussion on Results

In subsequent discussion Professor Florey summed up the opinion of the conference by stating that whereas the results in the treatment of simple flesh wounds had been satisfactory on the whole a larger dosage of penicillin intramuscularly over a longer period was necessary in the treatment of fractures, for which he suggested partial suture of the wound with drainage. The Consultant Surgeon MEF, Major-General Ogilvie, counselled concentration on the fracture cases as long as penicillin was in short supply. It was noted generally that gram-negative infections, especially of the pyocyaneus, were commonly present when the gram-positive organisms had been largely eliminated by penicillin. Profuse discharge was often noted, but there were no general ill-effects and no marked interference with the healing of the wound. Penicillin, besides preventing and dampening down acute infection, had produced a feeling of better health.

For the treatment of fractures it was recommended that sodium penicillin should be given continuously for a minimum of five days, either by three-hourly intramuscular injections or in continuous glucose saline drip infusion. The five-day course, totalling 500,000 units, was considered sufficient for fractures of the upper extremity, but for fractures of the femur and tibia a course lasting seven to ten days (700,000 to 1,000,000 units) was advised. These figures referred to severe comminuted fractures. An incomplete facture, or a fracture in other than the long bones, did not usually require more than 300,000 units, and calcium penicillin applied locally sometimes sufficed. Looking back it was clear that the length of the course (five days) for the experiments had been too arbitrarily fixed and was not related closely enough to the severity of the fracture. (Later in the war it became the custom to give much longer courses for the severe cases.)

The Consultant Surgeon 2 NZEF suggested at the conference that the better technique might be the delayed suture of wounds, following wound and intramuscular injection with penicillin, the wounds having previously been excised. Certain wounds, such as the large buttock wound, where severe infection from contamination would almost certainly follow if the wound were left open, might be primarily sutured and tubes for instillation of penicillin inserted. When tension was great, suturing was not advisable, especially in the lower third of the leg. Deep retained stitches could be obviated by employing a figure-of-eight stitch, and fairly thick silk drawn through sulphonamide paste might be used instead of silkworm gut; and stitches were better if not close together. The sooner a wound was closed the better, as infection was inevitable in every open wound. Fracture cases did not seem to be suitable for primary suture, but penicillin powder and penicillin fluid could be used to clean the wound for possible early secondary suture. In penicillin there was a powerful method of eradicating gram-positive organisms. With an adequate supply and improved technique a marked advance in the treatment of war wounds was likely to eventuate.

The New Zealand Medical Corps had been privileged to take part in these important and historical investigations and in the conference itself, and this, fortunately, made our Corps penicillin-minded and eager to adopt the new line of treatment. A complete resume was written by the Consultant Surgeon and sent to all our units, with full details of suggested forms of treatment.

Experiences in Italy

Further trials with penicillin were carried out in Italy. Lieutenant-Colonel J. S. Jeffrey, who was Surgical Divisional Officer in the main British hospital in Tripoli, had been appointed to superintend the supply and application of penicillin, and, as both our CCS and 3 NZ General Hospital had first-hand knowledge of the experiments in Tripoli, our hospitals were utilised in the further experiments.

From December 1943 the method employed in the wound treatment by penicillin was:

1. Spraying penicillin sulphathiazole powder in the primarily trimmed wounds.
2. Evacuating the patient to the Base, in a plaster splint if deemed necessary, without disturbance of dressing.
3. Carrying out a delayed primary suture on arrival at a base hospital, and
4. (a) Spraying penicillin sulphathiazole powder on the wound with or without small stab drains, or
   (b) Putting in small rubber tubes through stab holes at the side of the wound, and instilling penicillin solution twice daily for five days.

With regard to fractures, the same primary treatment was given, and again suture performed at the Base, but

(a) The wound was not entirely sutured, a gap being left in the centre for drainage and relief of tension.

(Sodium penicillin was injected intramuscularly three-hourly in doses of

b) 15,000 units for five or more days.

(c) The limb was- put in plaster or other splints and left untouched for three weeks unless there was some indication of complication.

At first in the Italian campaign penicillin was available in such small quantities that its use was restricted to wounds in the early stages, but the supplies increased steadily. By May 1944 full courses of parenteral penicillin were being given to severe burns, and in July most of the seriously infected wounds had at least one course of intramuscular penicillin, which led to a marked improvement in the general condition of the patient even if the infection did not clear up. By August sufficient penicillin was available for all purposes, and all serious cases were being given parenteral injections for the first forty-eight hours right from the time of wounding, and the sulphonamides had been displaced. Later came the administration of penicillin by continuous drip into the vastus externus from a glass container marked with bands showing the dosage for six-hour periods.

Established infection remained a difficult condition to deal with, and bacteriological investigation demonstrated the common presence of penicillin-resistant strains, especially of the staphylococcus, but penicillin was of great value in the treatment of streptococcal and anaerobic infections. Obviously penicillin was not as efficient bacteriologically as it was clinically, or else the suture of wounds could be successfully carried out in spite of the presence of pathogenic bacteria. Secondary suture was done more frequently following preparation by spraying with penicillin for several days.

In chest cases sodium penicillin, at first used intramuscularly with temporary success, was introduced into the pleural cavity, after the tapping of haemothoraces, with marked success. Penicillin was given by lumbar or cisternal puncture, 10 c.c. every four hours, to septic complications of cerebral wounds, and was also effective in meningeal infection. In head wounds sepsis was definitely reduced—in Italy it was responsible for only 34 per cent mortality as against 65 per cent at the beginning of the war. Abdominal cases were given parenteral penicillin during the final campaign in Italy with very definite reduction of intra-peritoneal infection and improved wound healing. In fracture cases parenteral penicillin was given just before, and for several days after, suture, and in much larger doses in the serious cases.

In general, very little infection was noted at the base hospitals at the close of the Italian campaign. The introduction of penicillin was largely responsible for the saving of many lives and for the adoption of the delayed primary suture of wounds, with resultant marked reduction of hospitalisation and disability.

OTHER ASPECTS OF WOUND TREATMENT

Blood Transfusion

The story of the development of the Blood Transfusion Service is given elsewhere, but it is necessary to stress the great importance of blood, plasma, and serum in the resuscitation of the wounded man and in wound repair.

There was a very severe loss of blood in many large wounds, especially of the limb. Lieutenant-Colonel Grant, RAMC, estimated that a loss of 50 per cent of the total blood volume was common in such injuries, so that up to five pints of blood was required to make up the loss.

At first the use of blood was confined to the primary treatment of the severely wounded man, in order to replace blood loss and so sustain the general circulation and combat shock. This led to the direct saving of many lives and enabled operative treatment to be safely undertaken. Later, blood was used at the base hospitals to combat the Secondary anaemia which was almost invariably present, often to a marked degree, in patients with severely infected wounds. Often haemoglobin was down to 50 per cent or less, and the red cells to 3,000,000 or under in these cases. As much as three pints of blood was often required to bring the haemoglobin and red cells up to a satisfactory level. Fresh blood carefully cross-typed had to be used and given slowly, as severe reactions were common, especially in those cases who had already been transfused in the forward areas.

As the war progressed it was realised that a marked protein deficiency was present in all severe casualties, and that blood plasma or serum transfusions were of great value in counteracting it. It was realised that biochemical changes had a very great effect on wound infection and healing. During the latter half of the war, not only protein deficiency but deficiency of chemicals and vitamins were recognised as being of the utmost importance. It was recognised that the wound healing depended on the general metabolism of the body and that adequate food, particularly those foods of high protein content, and adequate fluid were necessary, especially in the presence of infection.

Plasma and serum were of particular value in all cases of protein deficiency and were generally given as a daily routine in the early stages of the most serious cases.

Effect of Transportation on Wound Healing

The evacuation of wounded men from the forward areas shortly after or without operation was found to interfere seriously with wound healing. This was especially marked following transport over the roadless desert, but even on good road surfaces ambulance transport was harmful, and swelling of the limb often occurred. If primary suture had been undertaken, this swelling led to tension and tearing of the stitches. Plaster splints caused dangerous constriction of the swollen limb, and this led to the padding and splitting up of the splints in the forward areas.

Treatment of the Wound after Primary Operation

At the beginning of the war, when the closed plaster treatment was carried out for all the large wounds, the original plaster with its underlying vaseline gauze dressing remained untouched for a period generally of two to three weeks. The plaster was then removed and the dressing and plaster changed, still using vaseline gauze unless frank sepsis called for different treatment. When sulphanilamide was adopted as an application to the surface of the wound it was reapplied when the original plaster dressing was removed. Later it was ascertained that the local application of sulphonamides to the wound often led to the patient becoming sensitised to sulphonamide, and also that the sulphonamide locally had little effect on ingrained infection. In consequence, the local application of the sulphonamides was discontinued, reliance being placed on the administration of sulphonamides by mouth for the first five to seven days after wounding, and later for the treatment of sulphonamide-sensitive infections such as that due to the streptococcus, with strictly regulated dosage for a limited period.

During this period, if definite sepsis arose it was countered by methods of treatment for infection as ordinarily applied in the pre-sulphonamide period. Drainage has been mentioned, and associated with that was the free opening up of the infected area by incision and the removal of any slough or gangrenous or avascular muscle, as well as the evacuation of any collection of pus. Treatment was instituted by antiseptic lotions such as the electrolytic hypochlorites, which were often instilled into the wound following the methods of the First World War. Acriflavine was also used, as was dichloramine T. Saline baths were sometimes used.

When penicillin was available it was applied locally in a sulphanilamide base at the original treatment of the wound, and thereafter was applied locally by instillation into the wound, and in addition it was given parenterally. For infection which was resistant to penicillin the older methods of treatment were again resorted to. The treatment of established sepsis depended on the type of infection and on the organisms responsible.

INFECTION

INFECTION

Types of Infection

The most common organisms found in the septic wounds were the gram-positive streptococci and staphylococci. The gram-negative organisms were less common, though they tended to occur as secondary infections, but they interfered less with wound healing. Anaerobic infection was serious but less common. Diphtheritic infection occurred intermittently.

(a) Streptococcal: The streptococcus was commonly present in gunshot wounds, giving rise to inflammatory changes in the tissues with marked general symptoms of pyrexia and toxaemia, and destroying the growing edge of the skin, thus delaying healing. Fortunately the streptococcus was susceptible to the sulphonamides, and still more so to penicillin. The local application of the sulphonamides had satisfactory results, as was demonstrated by Major Rank, AAMC, in Palestine, in his preparation of large raw burnt areas for skin grafting by saline baths and local sulphonamide. Local rest as obtained by splints was still of great value. Anaerobic Streptococcal infections were met with and produced extensive inflammation of muscle associated with gas formation, but without gangrene or the profound toxaemia associated with the gram-negative anaerobes. Free incision of the tissues without excision was indicated.

(b) Staphylococcal: The sulphonamides did not have as much effect on the Staphylococcal infections, but did have a beneficial preventive action. In established infection they were not so effective. Penicillin was a more powerful agent, though some resistant strains of staphylococci were recognised early in the experiments with penicillin. The evacuation of pus, the removal of sloughs, and the provision of drainage were called for in established infection.

(c) Anaerobic: This infection was of considerable importance, and many cases of gas gangrene were seen and many deaths occurred from it in all theatres of war. It was mainly in association with damage to the main vessels of the limbs that actual gangrene of a limb occurred, the other cases generally being localised to individual muscles or groups of muscles. The basis of primary wound treatment was the prevention of anaerobic infection by the removal of the devitalised tissue, without which the anaerobes could not establish themselves. If established, the infection was dealt with by the ruthless removal of dead muscle

—either a portion of muscle or a whole muscle or a muscle group, and, when massive gangrene occurred, by amputation. Apart from surgery, which was established as the most important preventive and curative treatment of anaerobic infection, the only treatment which was held to have a marked effect on the infection was the parenteral administration of penicillin. Sulphonamides were given until penicillin was available, but they seemed to have very little definite effect on the course of the infection. Anti-bacterial serum was given, both as a preventative and curative agent, but it did not seem to have any definite effect, though it was still persisted with. Alteration of the composition of the serum by the inclusion of more of the serum of malignant oedema was thought to have brought about better results, but finally reliance was placed first on surgery and then on penicillin given early and in large doses. Fulminating cases did not seem to derive much benefit from treatment.

Blood transfusion, usually of two pints, was given, but in some cases of haemo-concentration serum was given instead. The general effect of the transfusion was held to be of definite value as very anaemic patients were thought to be very prone to develop the infection.

A report on three hundred cases of gas gangrene was submitted to the Rome conference in February 1945. It showed a mortality of 43 per cent. Gas was noted to be present in 93 per cent, and pain in 17 per cent of the cases. The organisms present were B. Welchii 66 per cent, Vibrio Septique 14 per cent, Malignant Oedema 9 per cent. B. Oedematiens was the most toxic organism and the least susceptible to penicillin. The report confirmed the opinion that surgery and penicillin were the only measures that were definitely of great benefit in treatment, but that blood transfusion was also valuable.

An opinion was expressed that the incidence of gas gangrene was similar to that experienced in the First World War, an opinion quite contrary to that held by our officers who had served in both wars. In our experience of the Second World War gas gangrene had been uncommon and very few cases of serious infection had been met with, apart from those associated with damage to the main arteries of the limb. And our deaths had been very few. Our opinion was very definitely that the problem had been a relatively unimportant one, quite different from the ever-present anxiety experienced in the First World War. Contrary opinion could only be held by one without personal experience of large numbers of wounded men in both wars.

Other Infections

Infection by the Pyocyaneus was often seen at a later stage in wound healing, and often following the clearing up of the gram-positive infection. This caused little or no general reaction or symptoms, but interfered with the proper healing of the wound. Five per cent acetic acid solution proved the most satisfactory method of eradication. Coli infections were sometimes seen, often associated with other organisms.

Diphtheria

This produced very serious wound infection as well as generalised effects such as severe toxaemia or paralysis in some cases. Locally the wound showed a very unhealthy condition, with indolent, thick, grey sloughs, and there was serious delay in healing. Anti-diphtheritic serum in large doses was indicated and brought relief, but the wounds took a long time to heal. Cases were noted in Egypt at different times, but the most marked epidemic was in Italy at 1 NZ General Hospital in the winter of 1944, when several wounds were seriously affected. The outbreak coincided with an epidemic of faucial diphtheria in the civilian population.

Cross Infection

It was realised in the early part of the war in North Africa that the frequent dressing of wounds, especially during the period of evacuation to the Base, led to an increase in wound infection, though the use of the closed plaster treatment for the major wounds, including the fractures, acted as a safeguard, as no dressings were changed in these cases for at least ten days.

At the first Surgical Congress in Cairo in February 1942 the danger of cross infection occurring during wound dressing was recognised, and recommendation was made to leave all wounds alone during transit, except when some definite indications for inspection, such as bleeding or infection, were present.

At the base hospitals the problem was recognised at the pre- Alamein period, and it was found that cross infection was very common in the wards, and that infection was spread both from other wounded cases and by the staff of the hospitals acting as carriers, especially from infective foci in the naso-pharynx. It was also demonstrated that infection could be easily spread by dust from the floors, and also from bedclothes, especially blankets.

This was countered at first by increased ward cleanliness, especially by the control of dust by doing ward dressing at times when there was least movement in the wards, and by insistence on all members of the staff wearing face masks during the dressing periods. Instruments were sterilised before each dressing, strict aseptic technique instituted, and extra staff employed. Gloves were provided for use when dressing the wounds. Later special dressing rooms were utilised, where as many as possible of the patients were taken from the wards to have their dressings performed; and the rooms were well equipped to ensure asepsis. It was realised that infection was inevitable in every open wound, and that each dressing constituted a serious danger. ' Every open wound sooner or later is an infected wound.' The only safeguard was the closure of the wound.

The type of fresh infection varied as one would expect, but streptococcal infection was common.

Injection at Different Periods

There were marked differences in the incidence of infection in wounds at different periods of the war, and in the different terrains in which the battles were fought.

In the desert campaigns in general infection was not severe and the smaller wounds generally healed without becoming infected, even when no operation of wound cleansing had been undertaken. This was particularly noticeable in the first Libyan campaign, when the facilities for forward surgery had not been developed.

In Greece and Crete infection was marked, especially in Crete, where wound treatment suffered from the disorganisation brought about by the retreat and the capture of most of the seriously wounded. Tetanus was noted for the first time, and a Maori died from it after evacuation to Greece. Gas gangrene was also seen.

During the second Libyan campaign there was more sepsis, though again it was remarked by Major Furkert of the Mobile Surgical Unit that ' the absence of highly pathogenic bacteria minimised the seriousness of delay in admitting the cases for operations, and few fulminating infections were seen '.

Infection, however, was much more marked in cases seen at the Base, due undoubtedly to the delay in primary operation, the lack of water and adequate diet, and the prolonged and rough evacuation.

There was less sepsis noted in the pre- Alamein and Alamein periods. The facilities for forward surgery had improved considerably, the surgeons were more experienced, the lines of evacuation much shortened, and patients could be sent back to the base hospitals by train, road, and air. Sulphonamides were being given regularly following wounding. The Tunisian campaign was fought under very satisfactory conditions, and little sepsis was seen except in cases where operations had been seriously delayed. At the Base, however, serious sepsis was still seen in fracture cases, and it was realised that sulphonamides at that stage were not of any avail and resort was made to older methods of treatment.

During the Italian campaign the incidence and severity of infection was more marked, and this added interest to the penicillin experiments in wound treatment carried out at Tripoli, which led to the introduction of penicillin as a substitute for the sulphonamides in the prevention of wound infection. The increased infection also led to the more thorough cleansing of the wound.

This increase in infection was, however, successfully countered by the steadily increased use of penicillin, and the introduction of the technique of delayed primary suture of wounds when the cases arrived at the base hospital at about the fourth day led to the marked diminution of infection and the satisfactory healing of the wound in about 90 per cent of the cases. The penicillin had prevented the development of infection by the common gram-positive organisms, especially the streptococcus, and the closure of the wound had prevented subsequent infection of the wound.

The only dressing in the ordinary wound after the primary operation took place in the operating theatre of the base hospital, where the dressings were removed prior to the suture of the wound and under full aseptic techniques.

WOUND REPAIR

WOUND REPAIR

Primary Suture of Wounds

This was attempted during the First World War and met with some success in the latter part of the war under certain ideal conditions. Under ordinary conditions of warfare in France, however, it was not successful, and the routine treatment was to leave the wound open, counteracting infection by the Carrel-Dakin method until the wound was fit for secondary suture at the Base.

During the Second World War, in the early period in North Africa, primary suture was carried out on abdominal and head wounds, usually with the introduction of temporary drains. Face wounds were at first sutured in the forward areas, but later any large wound was left to be sutured at a facio-maxillary centre at Base, as primary suture had often produced unsatisfactory cosmetic results. During the second Libyan campaign amputations carried out at the sites of election were primarily sutured by some of the forward surgeons, especially in Tobruk, but the results at Base were found to be unsatisfactory and the practice was discontinued. Suture of sucking chest wounds was also performed as a primary operation, but gave place to delayed primary suture for skin, although muscle suture was carried out at the primary operation. Primary suture of wounds of the scrotum was often undertaken to protect the testes and to prevent contamination.

Generally, however, primary suture was discouraged, as under war conditions it proved unsatisfactory. Late in the war in northern Italy success attended an experiment in which lesser wounds were referred to a CCS for primary suture during a quiet period when the patients could be held until the wounds were healed, with a resultant saving of much time in convalescence. In the future it should be possible to undertake primary suture in a large proportion of uncomplicated wounds when casualties can be rapidly evacuated to hospitals, where the patients can be held, and where there are sufficient surgeons to attend to the minor, as well as the serious, wounds. Careful wound cleansing, together with administration of antibiotics from the earliest opportunity after wounding, and the provision of rest to the injured area should ensure that primary suture will be successful.

Delayed Primary Suture

During the First World War the French reported successful suture on the fourth day after wounding. The use of the closed plaster technique precluded early suture at the beginning of the Second World War. The penicillin trials in Tripoli proved that in many cases wound suture could be successfully carried out within a few days of wounding with the help of penicillin.

In Italy careful wound toilet in the forward areas, and the application of penicillin powder in a base of sulphanilamide to the wound surface, enabled the wound to be successfully sutured on the fourth or fifth day at the base hospital when the original splint and dressing were removed. Later when penicillin became available in ample quantity it was administered parenterally from the earliest opportunity after wounding until delayed primary suture was undertaken, and generally for several days afterwards. This ensured success in the great majority of cases and greatly improved the results in fracture cases. The early healing of the wound prevented secondary infection with its associated serious illness, and greatly shortened the period of hospitalisation and convalescence. It was proved conclusively that with adequate primary surgery, under suitable conditions, and with the use of penicillin, early wound suture was not only practicable but also highly successful.

The technique of suture consisted in freshening the skin edges, applying penicillin powder, and the simple drawing together of the wound surfaces by deeply placed skin sutures of either salmon gut or silk at about half-inch intervals.

Secondary Suture

Suture of a wound after the first week or ten days has been described as secondary suture. This was the routine procedure at the end of the First World War, when the Carrel-Dakin treatment was used to render the large wounds fit for suture. The operative technique often entailed the removal of the granulating area of the wound, the freshening of the skin edges, and the freeing of tissue layers, which could then be brought together separately by figure-of-eight silk skin sutures.

A relatively small number of cases were dealt with by secondary suture in the Second World War. This was due to the use of the closed plaster technique under which the wound was allowed to heal slowly without suture, and also to the early evacuation of the heavy cases to New Zealand. In the latter part of the war the success of delayed primary suture rendered secondary suture unnecessary in most cases, but it was performed on a few cases after their treatment in saline baths or by the hypochlorites or other antiseptics.

Plastic Repair

This was carried out by the plastic surgeons in certain large wounds which could not be sutured, and in which it was important to obtain a covering of solid skin. This particularly concerned fracture cases with bare bone exposed in the wound, injured areas on the flexor aspects of the elbow and knee where tissue contraction was to be feared, and areas on which pressure was exerted such as knee, elbow, and heel. Sliding and pedicle grafts were used.

Skin Grafting

This was more commonly adopted as the war progressed. The techniques were developed especially to deal with the raw areas so common in burns cases, but were frequently used for the healing of gunshot wounds. Early grafting was done in special areas such as the face and fingers, but on the large wounds grafting was at first performed at a comparatively late stage to bring about skin cover when suturing was impossible. When delayed primary suture became established as the routine method of treatment for wounds, skin grafting was carried out at the same time (on the fourth day) to cover any raw areas which could not be dealt with by suture.

Skin grafting was often employed as a temporary dressing to prevent infection and contraction or to facilitate a final repair of the wound by suture or more permanent grafting later. The dermatome proved invaluable when any large area of skin was required for grafting.

EXPERIENCE OF NEW ZEALAND MEDICAL CORPS DURING THE DIFFERENT CAMPAIGNS

EXPERIENCE OF NEW ZEALAND MEDICAL CORPS DURING THE DIFFERENT CAMPAIGNS

First Libyan Campaign

Our Division was not involved in this campaign, but our Medical Corps had the privilege of treating a considerable number of Australian and other casualties in the Helwan hospital. The wound treatment carried out was the surgical ébridement of the wound, followed by the closed plaster treatment. It was noted that there was little serious infection and that the smaller perforating and penetrating wounds generally healed satisfactorily.

The majority of the larger wounds also showed little serious infection, though the treatment was prolonged and necessitated much changing of plaster splints. Pyocyaneus infection was common and many of the wounds sluggish in healing in consequence. The smell of the stained plasters was objectionable and was aggravated by the heat of Egypt.

Greece and Crete

Comparatively little wound treatment was carried out by our units in Greece, except simple primary treatment in the forward areas by the RMOs and the Field Ambulances. Some surgical treatment was possible, however, at the Thermopylae line, where the closed plaster technique was used and sulphonamides given orally to serious cases.

In Crete more surgical work was done by our Field Ambulances and by our surgical team attached to British units, though the conditions and some lack of supplies made adequate treatment extremely difficult. Infection was marked in many cases and drainage was much utilised. Nearly all seriously wounded men became prisoners of war and were later evacuated to Greece by the Germans. One case of tetanus occurred in our force and the patient died at Athens, and gas gangrene was also seen.

Second Libyan Campaign

In this campaign our Division experienced serious casualties. The majority of the wounded were captured by the enemy while they were in the main dressing stations and were not relieved for ten days. During this time they suffered from serious lack of water and also from restricted rations.

Wound treatment had to be undertaken often at the ADS when out of contact with the MDS. Excision of wounds, drainage of infected wounds, and removal of obvious foreign bodies was carried out at one ADS in addition to the control of bleeding, the amputation of shattered limbs, and the suture of sucking chests. Acriflavine was used for the primary dressing. It was noted that the majority of deaths were associated with severe loss of blood. The main wound treatment was undertaken by our Field Ambulance MDSs, and also by the very well equipped and staffed Sims Mobile Surgical Unit. All types of cases were operated on by this unit, including abdomens, chests, and heads, but lack of water during the period of captivity rendered sterilisation difficult and the provision of sterile gowns and towels wellnigh impossible. Still more serious was the severe lack of drinking water and fluid for transfusion, which made it impossible to counteract the marked dehydration present in all cases, and particularly in the abdominal cases. Major Furkert, OC Mobile Surgical Unit, reported that ' By this time the water and food situation was desperate and patients began to die rapidly from dehydration.'

Furkert wrote a very clear account of the conditions of the wounded in this campaign and their treatment. He stated that hardly any of the casualties reached the unit within twenty-four hours of injury and many wounds were over three days old. The absence of highly pathogenic bacteria minimised the seriousness of this delay and few fulminating infections were seen, though severe infection was noted in many cases. There were serious deficiencies in supplies of all kinds—particularly ether, morphia, and plaster-of-paris. The shortage of water was desperate, and no patient was washed in any way for eleven days. Wound treatment consisted of excision with gauze lightly packed in the wound and plaster splints.

Observation of cases at the Base in Egypt showed that sulphanilamide powder was almost a universal wound treatment and that gauze dressings were used. Plaster was extensively used in the treatment of severe wounds, and fractures of the leg and forearm were universally treated in enclosed plasters. The fractured femurs were treated in Thomas splints, and cases from Tobruk were in the Tobruk splint, a combination of plaster and Thomas splint. Fractured humerus cases were mostly treated by posterior slab splints and simple slings, sometimes by Kramer wire splints and at times in abduction plasters. Severe sepsis was present in many wounds, and secondary haemorrhage and amputations were relatively common in the base hospitals. Gas gangrene, however, was infrequent. The conditions of the campaign had prevented adequate wound treatment and especially early and rapid evacuation. Sepsis had in consequence been marked in contrast to that seen in the first Libyan campaign, and this stressed the importance of early and adequate forward surgery. No gas gangrene was seen in our New Zealand base hospitals. The gangrene seen was in every case due to damage of the main vessels of the limb.

The saline bath treatment, as introduced for burns, was adopted for the treatment of chronic infections in limb wounds, in conjunction with both local and general sulphonamides. An elaborate bath unit, the only one in the Middle East, had been installed at our Helwan hospital, where there was a plastic surgeon.

At a conference held in Cairo in February 1942 in the quiet period following the second Libyan campaign, there was agreement on the value of the surgical cleansing of the wound of all devitalised tissue and on the importance of the removal of devitalised muscle.

The necessity of adequate incision to permit both proper inspection of the wound and subsequent drainage was recognised. Small perforating wounds had in the great majority of cases healed satisfactorily without any surgical treatment.

Dressings had consisted of vaselined gauze laid loosely in the wound. The poor results of plugging wounds with gauze were commented upon. The immobilisation of limb wounds in plaster without further dressing of the wound for ten days was the normal line of treatment, but later dressings of hypochlorite and other antiseptics were being utilised in conjunction with the plaster splinting. The Pyocyaneus infection, so often an aftermath of the closed plaster treatment, proved difficult to eradicate, and acetic acid was being used in its treatment.

Pre-Alamein Battles, June-October 1942

The lessons learned from the second Libyan campaign had borne fruit. There were better facilities for surgery, and more experienced surgeons were available. The lines of evacuation for the casualties were considerably shorter. Much less sepsis was seen in the wounds, this being due, it was stated, to earlier operative treatment and more efficient local sulphonamide therapy, especially to the wound. The sulphanilamide sprinklers had been issued to all field units, and sulphonamide tablets were given regularly. Closed plaster technique was still utilised and the splinting of fractures had improved, especially with regard to fracture of the femur. Our New Zealand technique of a combination of Thomas splint and plaster bandaging, a modification of the Tobruk method, had been introduced with great success. The utilisation of a plaster table for the application of spicas and shoulder casts was discussed, as difficulty in applying such casts was being met with, especially as plaster spicas were being utilised for large buttock wounds.

The plaster spica proved unsatisfactory when long evacuation was necessary, especially over the rough surface of the desert. Pressure sores were almost inevitable under those conditions unless very careful padding was carried out. No other splintage, however, was available for the hip and buttock cases.

Alamein Battle, October-November 1942

The surgical set-up for the Alamein battle had been arranged carefully beforehand, with the result that there was a satisfactory distribution of the operative work and more efficient evacuation, which was, of course, facilitated by the close proximity of the front line to Alexandria.

The normal wound treatment had become stabilised at this time. Surgical cleansing of the wound was understood by all the operating surgeons. Sulphanilamide powder was sprinkled on the wound as a fine dust. Vaseline gauze or tulle gras dressings were applied without plugging, and the limb put up in an enclosed plaster. Sulphonamide tablets were given regularly, and dosage cards affixed to the field medical cards. Blood was available in ample quantity, even up to the RAP, and was liberally given. Field transfusion units were attached to the operating units.

An order had been issued some time prior to the battle that all plasters must be split, but the order was not always carried out, and extra work was given to our CCS in splitting the overtight plaster splints and some limbs saved by the relief of tension. Fracture cases were efficiently splinted, mostly in plaster, the femur being splinted in the standardised New Zealand method.

Tunisian Campaign, Early 1943

During this period our New Zealand medical services had exceptional facilities both to observe and perform forward surgery. Our CCS was privileged to be the most forward CCS during the whole campaign, and had attached to it British specialist personnel of excellent ability as special neurosurgical, ophthalmic, field surgical and transfusion units. Probably 50 per cent of all casualties passed through our CCS during the campaign. Our Field Ambulances were also very active, well equipped, and very well staffed, and they carried out a great deal of major forward surgery. At one stage in the campaign some casualties were first seen a considerable time after being wounded. The wounds were generally very septic, even small penetrating wounds without any serious muscle damage. This tended to show that our lack of sepsis was definitely due to the surgical treatment, and not, as happened in the first Libyan campaign, due to a real absence of primary infection. Blood-transfusion arrangements were now functioning perfectly, and two to three pints were given to the individual case when required. Wet serum was also available and was often given to supplement the whole blood.

Review at End of North African Campaign

It was noted at this period that there was very little sepsis in our New Zealand cases at the base hospitals, and only a very few septic fracture cases, and little or no sepsis in the knee-joint cases. The head, chest, and abdominal cases had done very well, and secondary haemorrhage and late amputation had been very uncommon, a sure sign of absence of infection. Skin grafting was being commonly carried out, and very large flesh wounds complicating infected compound fractures were successfully grafted, with great improvement in the general condition of the patient, as well as more rapid return of local function.

The wound treatment at that time consisted of cleansing the skin of the limb with plain soap and water, and with shaving, not only for cleanliness, but preparatory to the application of elastoplast for extension. Iodine was then applied to the skin. The removal of skin had been restricted to the minimum, only definitely damaged devascularised edges being excised. The same applied to all the wounded area. Muscular excision was carefully carried out so that all avascular and badly traumatised muscle was removed. Only definitely loose fragments of bone were ever removed. Free, and if possible dependent, drainage was provided in all large wounds associated with much muscle or bone damage.

Generally the nerves were not dealt with, but were closely inspected to ascertain whether they were damaged or not, and clear notes written for the information of surgeons at the Base. Sometimes divided ends were sutured to facilitate operative repair later.

The treatment of wounds of the joints was conservative, it having been found that small perforating and penetrating wounds of the joints did not cause trouble if adequate splintage was applied. For large wounds the practice was adequate excision and, if possible, removal of large foreign bodies, and again adequate splinting by means of plaster.

Wounds of the head were treated by careful excision and primary suture with stab drainage. Foreign bodies and bone fragments were carefully removed by suction and sulphonamide drugs administered locally and parenterally. Plaster caps were applied to ensure that the dressings remained in place, and diagrams of the wound and essential particulars were written on the plaster. Small chest wounds were left alone. Large ones were surgically cleaned and, if sucking was present, a vaseline gauze pack was sutured in position as a tamponage. Abdominal wounds were carefully cleansed and sutured and sulphadiazine was introduced into the abdomen at the end of the operation.

At our base hospitals very little infection was seen, and secondary haemorrhage rarely met with. The wound healing was improving steadily, though no routine secondary suture was being undertaken. The fractures were doing well, and large numbers of abdominal cases survived. There was distinct advance in every way, and war surgery had reached a uniformly high standard.

Chronically infected fracture cases were, however, still to be seen in the larger British hospitals where the serious cases were congregated. A ward full of infected fractures of the femur seen on one occasion showed that the problem of the control of infection had been in no way solved.

Advances in Treatment in Italy

Delayed primary suture became the routine treatment of all cases deemed suitable for suturing, whether simple wounds or those complicated by fracture-not always with perfect success, but never with any disastrous infection supervening. At times penicillin was not available at the base hospital, and in its absence suture was still carried out with success.

The wounds were arriving at 2 NZ General Hospital at Caserta early in 1944 in such excellent condition that suture was done in practically all cases on arrival, and there were very few patients with unhealed wounds sent on to 3 NZ General Hospital at Bari, except the fractured femurs purposely sent there without treatment at Caserta.

Fractures of the upper extremity were also routinely sutured at our hospital at Caserta; the leg fractures, causing difficulty because of the tension of the wound, were only occasionally sutured.

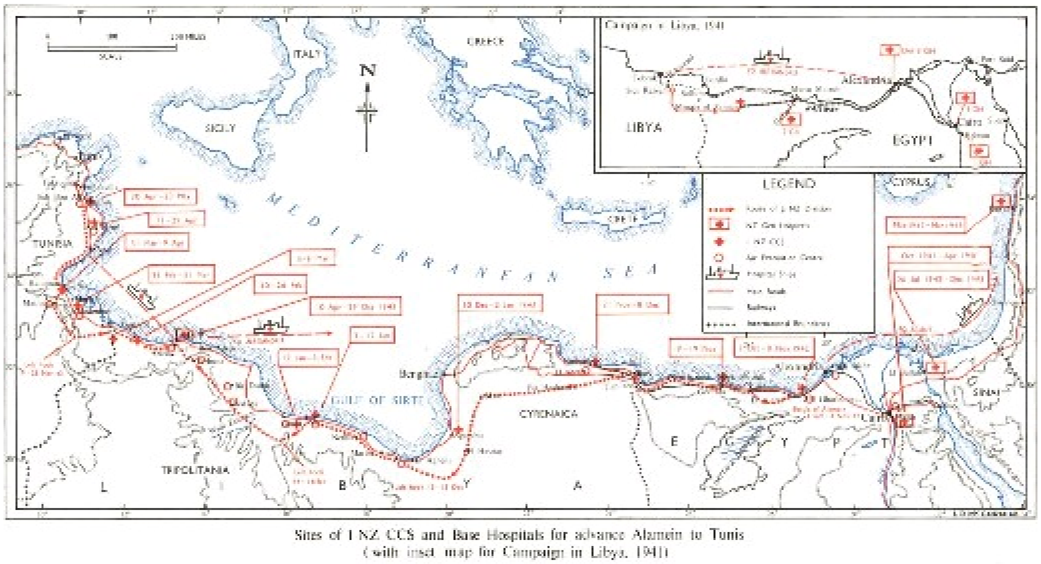
The most difficult wounds were those involving the hip joint, where sepsis was difficult to combat without the ability to give large doses of intramuscular penicillin.

In May 1944 a clinical meeting was held behind the Cassino front at 1 British CCS and forward surgery discussed. The progress in wound treatment was illustrated by the treatment of a case of severe trauma of the scapula, and scapular muscles, with anaerobic infection, which cleared up well after the primary operation, with the aid of parenteral penicillin, and delayed primary suture was carried out with success. The necessity to perform early amputation in the case of shattered limbs was being appreciated more and more, and recommendations were made for this to be done as a first priority, along with the control of severe bleeding. In mangled limbs, if amputation could not be immediately carried out, the application of a tourniquet just above the damaged area prevented further bleeding and the often serious deterioration seen in these cases, possibly due to toxic absorption. The dramatic improvement often produced in a patient's condition immediately a mangled limb was removed was vouched for by many experienced surgeons. This was in some ways comparable to the improvement in gas gangrene cases brought about by the efficient removal of the affected muscle groups. The amputation in these cases had to be done through healthy tissue above the devitalised area, as it was in the amputations through the injured area that our worst septic cases had arisen.

Flap amputation was the rule, and delayed primary suture was generally quite satisfactory. At the primary amputation only sufficient stitches to prevent retraction were allowable, and any packing had not to be tight. Badly injured feet generally required amputation, but with early penicillin treatment, and the prevention of sepsis, more were now saved. It was then noted that the results of wound treatment were so much better that the level of amputation could be reconsidered. Amputation, especially in the lower leg, could with benefit be performed at a level which would render re-amputation unnecessary.

Knee joints even with retained foreign bodies were doing well with intrasynovial penicillin and adequate splintage. Infected cases still required drainage occasionally and, unfortunately, amputations were still at times necessary.

During the advance to Florence an adjustment of the treatment of the wounded was made by the alteration of priorities. Ordinary wounds, either with or without fracture, were dealt with at the MDS, and the heavier cases, including the abdominal and chest cases, if fit to travel, were sent back to the CCS. (The head, jaw, and eye cases were sent still further back to a British CCS, to which special centres were attached.) The alteration in attitude was brought about by the realisation that, in the case of the abdominals, recovery from shock was essential before operation was carried out, and that urgent operation was unnecessary, and indeed undesirable. The concentration on the flesh wounds at the MDS at an early stage ensured the wounds being in a satisfactory condition for the performance of delayed primary suture when the cases reached the General Hospital.



Sites of 1 NZ CCS and Base Hospitals for advance Alamein to Tunis (with inset map for Campaign in Libya, 1941)

As reported at the Rome conference, the majority of the fracture cases had been sutured with success, but about 20 per cent were thought to be unsuitable for suture. The plating of compound fractures had not, on the whole, been satisfactory, and a more conservative view was being adopted in this regard by the surgeons who had carried out experiments in this form of treatment.

The Consultant Surgeon 2 NZEF had for some time counselled against the removal of bone in fracture cases, especially large pieces, and in the humerus where non-union was so prone to occur. This view was supported at the conference by one of the younger surgeons, and this support established this line of treatment in our units. The utilisation of bone chips in the repair of bony defects of the jaw, and of the skull, seemed to make the removal of clean bone from a clean wound an absurdity, and as the very large majority of our fracture cases were progressing well on a straightforward course of primary wound treatment, followed by delayed primary suture, we considered no bone, loose or not, should be removed, and we had no cause to regret our changed procedure.

At the time of the Po battle the working MDS carried out some of the minor surgery, while the CCS did the abdomens and chests and the major urgent surgery. No. 1 NZ General Hospital in Northern Italy did some primary surgery and the bulk of the delayed primary suture of the wounds. No. 3 NZ General Hospital in Southern Italy dealt with some primary surgery and some delayed primary suture of wounds, and a large proportion of the heavier cases had been sent direct by air from the CCS for base hospital treatment. The marked improvement in the surgical technique in the treatment of war wounds had enabled this to be done.

In April 1945 the Consultant Surgeon 2 NZEF wrote:

We can comment that the treatment of war casualties at the end of the European war has reached a very high level of efficiency, both in the saving of life, and particularly in the freedom from sepsis, and in the rapid repair of wounds. To this progress, the NZ Medical Corps has contributed its share and has rapidly adopted any progressive developments in treatment. Our young medical officers in the forward areas have especially distinguished themselves by their painstaking and skilled work.

A table reproduced at the end of this chapter shows the types of wounds which led to invaliding from base hospitals to New Zealand, and compares the figures for 1 NZEF in France with those for 2 NZEF.

Pacific Experience

The forward surgery for 3 NZ Division in the Pacific was carried out by field surgical units attached to Field Ambulances and by the Field Ambulances themselves, but it was limited as there were few casualties in the division in the island assaults from October 1943 to February 1944. Lieutenant-Colonel S. L. Wilson, a forward surgeon with 2 NZ Division, was transferred to the Pacific, and wrote a short directive on war surgery which was circulated to all medical officers.

The wound treatment consisted of surgical cleansing, light packing and dressing with vaseline gauze or tulle gras, while plaster splints were used for fractures and large wounds following the Trueta technique. Primary operation was often much delayed by the difficulties of evacuation from the jungle. Sulphonamides were used both locally and by mouth. Penicillin was only available in small quantity at the end of the campaign. Infection was not marked, but some anaerobic infection with gas gangrene was seen. Secondary suture was carried out at the CCS in some cases. There were no special difficulties encountered in wound healing.

REVIEW OF POSITION AT END OF WAR

The position as regards the treatment of war wounds at the end of the war may be summarised as follows:

The technique of surgical cleansing [1] was by no means an excision of the wound. Little or no skin was removed, and then only if ingrained with dirt and devitalised. The same held true with regard to the subcutaneous tissue and fascial layers, but fatty tissue was more freely excised. The nerves and vessels were left intact except when smaller vessels were implicated in the removal of muscle. All dirty and devitalised muscle was removed, leaving only bleeding and fresh coloured muscle. If muscle groups were seriously devitalised and any evidence of anaerobic infection existed, then whole muscle groups were removed. Bone was not removed unless it was dirty and lying quite separate, and not of sufficient size to render non-union or marked weakness of the bone structure probable. The wound was freely enlarged longitudinally to the limb and the fascia opened up to expose the whole depth of the wound, and divided transversely if any tension was present. If necessary counter incisions were made. The wound now being wide open and cleansed of all foreign and devitalised tissue, penicillin powder was dusted over the whole inner surface of the

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[1] The words 'surgical cleansing' have been deliberately chosen because of the obscurity of meaning attached to the name excision, and, to a lesser extent, to the French word ébridement.

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wound and gauze placed over it and used also to keep the surfaces lightly apart. The gauze was either plain or vaselined, or tulle gras could be utilised. The limb, unless the wound was of minor degree, was then encased in a padded plaster which was split after application so as to ensure no interference with the vascularity of the limb during evacuation. Parenteral penicillin was then given four-hourly for a minimum of forty-eight hours, and in all large wounds and fractures for a longer period. Blood transfusion was given to all seriously wounded men according to blood loss and shock. Serum was generally given as well in the proportion of one pint of serum to two of blood. In cases of burns blood serum alone was given, and frequently several pints were necessary to combat the haemo-concentration present.

Appropriate splinting was applied to all fracture cases, plaster being used in all fractures except those of the femur, when a Thomas splint with plaster strengthening was utilised. The casualty was then evacuated to a General Hospital either by ambulance train, hospital ship, or by air, and given a short period of rest. On about the fourth day, and frequently earlier, the patient was taken to the operating theatre, no dressing having been attemDted since the original operation in the forward areas, the plaster and dressing removed, and, unless definite infection had occurred, the wound was again dusted with penicillin powder and sutured, either by simple salmon gut stitches, taking a deep bite of the tissues, or by figure-of-eight silk stitches. Parenteral intramuscular penicillin was then given for a few days after suture in all severe wounds. No dressings were carried out for from a week to ten days, when at dressing the stitches were removed. Splints were applied to all severe wounds as at the original operation. By this technique about 80–90 per cent of all wounds healed satisfactorily.

If infection of any severity occurred the wound was opened, penicillin tubes inserted, penicillin instilled twice daily, and parenteral penicillin continued. In the rare septic case further blood transfusions were given to combat the associated secondary anaemia which usually developed in these cases. When fractures were present the same routine was carried out, but the penicillin was continued longer, for at least a week after suture of the wound. If sepsis arose, drainage of the wound was often carried out. For those cases in which sepsis contra-indicated delayed primary suture, parenteral and local penicillin was continued till the wound became healthy and allowed of secondary suture, and at times other measures such as the instillation of the hypochlorites were utilised in the penicillin-resistant infections. In the forward areas primary suture of the wound was not attempted, except in certain parts such as the scalp and face. The performance of delayed primary suture was simple and efficient, and, besides being safer, it brought about a satisfactory distribution of the operative work between the forward and base units. The ideal of primary suture seemed hardly justifiable under the conditions of active warfare, partly because the transportation of the patient would naturally militate against the healing of the wound.

If any loss of tissue had occurred, and especially in burns on the hands, skin grafting was carried out at the very earliest period, and that meant at the time when delayed primary suture was done. If gas gangrene eventuated, radical removal of muscle was called for and a full course of penicillin parenterally. Amputation was necessary only if actual gangrene of the limb itself set in. Diphtheritic infection of wounds, by no means uncommon, was combated by the institution of serum. As a wound application the sulphonamides, except as a medium for the administration of penicillin, had faded from the picture though sulphonamides given by the mouth were still utilised in head cases and in penicillin-resistant infection.

The story of the treatment of war wounds during the 1939–45 War is one of great interest, showing as it does the gradual development of ideas and knowledge till a selected and trained medical personnel was able to devise a technique, with the aid of new antiseptics and antibiotics, that was both simple and very efficient.

The development from the closed plaster technique to the use of the sulphonamides, and finally to the employment of penicillin, and the very early complete closure of the wound, was a triumph for British surgery in which our New Zealand Medical Corps was honoured to be able to participate. The great lesson that was learnt was that no stereotyped method, however hailed as a panacea, should blind one to the truth that there is no finality in medicine, and that we cannot be content till we reach as near perfection as possible.

The closed plaster technique was accepted too readily by out younger surgeons at the beginning of the war, when it really was producing poorer results in many ways than were being obtained at the end of the First World War. Sulphonamides again were expected to do too much to assist the surgeon, and it was not till the dramatic discovery of the remarkable bacteriostatic effects of penicillin on wound organisms that surgeons would turn their attention to the early closure of wounds, and thus approach, and finally improve on, the results actually attained in the First World War. The principles of the removal of soiled and devitalised tissue from the wound, the relief of tension, the provision of rest to the tissues and the individual, the replacement of lost fluid and blood, the protection of the wound from contamination and finally its complete closure to prevent that contamination and allow of early restoration of function, were not new or strange. They were relearnt slowly, and sometimes laboriously, by a new generation of surgeons. They will have to be learnt again possibly by another generation of surgeons who may have more powerful bacteriostatics and possibly improved techniques in other ways, but the cardinal principles will remain. We can but hope that eventually it will be possible to close wounds completely and safely at the original operation shortly after the wound has been sustained, and thus save subsequent dressing and subsequent infection with so much relief to the patient, and with much lower mortality and morbidity. The severity of the injury may at any time cause death, but if we can ensure the rapid and aseptic healing of the wounds themselves we will save some lives. Undoubtedly many lives were saved in the 1939–45 War by the determined and persistent progress of wound treatment in the British Army, of which we were proud to be an intimate part.

Invalids Evacuated to New Zealand or Discharged in United Kingdom

	Wounds in Action	
	2 NZEF 1940–45 [1]	1 NZEF May 1916– Dec 1918
Head	276	440
Eye	216	172
Chest	297	616
Abdomen	202	268
Amputations, leg	307	195
Amputations, arm	80	159
Spine	53	91
Nerve lesions	622	
Knee joint	85	
Shoulder joint	45	
Burns	24	
Vascular	55	
Fractured feet	245	
Fractured jaw	86	
Fractured femur	346	
Fractured tibia and fibula	481	
Fractured humerus	350	

Fractured forearm	360	
Ear	120	
Pelvis and hip	100	
Other	259	364
Other wounds of back		174
Perineum		50
Other wounds of arm		2300
Other wounds of leg		2683
Multiple wounds		79
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TOTAL	4609	7591
Total wounded for period	16,456	36,516
Also wounded taken PW	1,326	

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[1] 2 NZEF (IP) not included.

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CHAPTER 2 — FORWARD SURGERY

Contents

WAR SURGERY AND MEDICINE

[SECTION]

IN war the severe injuries sustained as the result of wounding by shell, mortar, bombs, and bullets demand surgical treatment, and the mortality rate, as well as the degree of individual disability, depends to a great extent on the efficiency of that treatment.

FIRST WORLD WAR

First World War

During the 1914–18 War there was a very marked development in war surgery, particularly in surgery in the battle areas. In France war became static trench warfare, and medical units remained at the one site for considerable periods and were stabilised in well-planned hutments. Only the minimum of surgery was carried out in the Field Ambulances, which acted as evacuating units, arranging only for the first-aid dressing of wounds and preliminary splintage, with active bleeding as the only indication for surgical treatment.

The forward surgical work was concentrated in the CCSs though the New Zealand Stationary Hospital at times acted in the same capacity. A grouping of CCSs often took place behind an active battlefront such as the Somme. The normal establishment of the CCS was found to be insufficient to cope with periods of activity and extra surgeons and surgical teams were attached when necessary. These teams were generally supplied by the base hospitals sited in France and once constituted they as a rule continued till the end of the war. A surgical team consisted of a surgeon, an anaesthetist, a sister, and an orderly, an ambulance being generally utilised for transport. The team was dependent on its host unit for all equipment and supplies.

Nursing sisters were regularly attached to the CCS, both in the operating theatres and in the wards. Evacuation to the Base was generally by ambulance train.

Within the CCS there was often a segregation of cases, such as abdominal injuries, under certain surgeons. There was also segregation of cases to certain CCSs. The New Zealand Stationary Hospital took over from two British CCSs at Hazebrouck for the Messines battle. One of the two CCSs was functioning as the Head Centre for the 2nd Army and our New Zealand hospital continued as the Head Centre. Gask developed chest surgery at a CCS behind the Somme, and chest cases were steered to his unit. The presence of gas casualties seriously complicated the administration of the operating centre as these cases had to be decontaminated and the chest symptoms relieved. The frequency of anaerobic infection also tended to disrupt ordinary routine as even small wounds would thereby be converted into major problems. At first the wound treatment consisted mainly of incision, removal of foreign bodies, and drainage. The need became apparent for the removal of traumatised tissue, especially muscle, as this acted as a nidus for anaerobic infection. Then followed the ruthless removal of damaged and soiled tissue, especially of muscle, which was cut back till fresh bleeding took place irrespective of destruction of function. The wound was left wide open and drained. Loose bone was removed. Various antiseptic dressings were applied, and salt packs to produce osmosis were used. The hypochlorites were eventually most popular, and the Carrel-Dakin treatment of constant or regular wound irrigation was well established during the latter part of the war. BIPP as a wound treatment was also much utilised for its bacteriostatic effect. In wounds of the head primary suture of the wound was the routine, following careful wound excision, removal of bone fragments, and irrigation of the brain track.

Chest wounds were at first treated conservatively till Gask developed a radical operative approach, including treatment of the lung itself.

Following South African War experience, abdominal surgery was at first not considered advisable, but the younger surgeons quickly demonstrated the possibilities of forward surgery in these cases and they became first priority cases.

Amputations were very frequent, due to the gas infection; and the guillotine type of operation was usually carried out. Extension was applied to the skin to prevent retraction, and short Thomas-type splints were utilised for this. Joint sepsis was severe and drainage was frequently instituted. Transfusions of salines and glucose salines, and at times gum arabic, were used freely for the treatment of shock. Blood was used to some extent towards the end of the war, but only in small quantities, rarely more than a pint.

Anaesthesia was generally in the form of chloroform and ether mixtures, open ether, and gas and oxygen. Shipway's apparatus in some form was popular, as was Boyle's apparatus.

X-ray was not generally available at the CCS level. It will thus be seen that fairly adequate provision had been made for forward surgery in the CCS, and that good accommodation and nursing were available, as well as surgeons. The mobile surgical team acted as a satisfactory reinforcement to the regular staff of the unit. Casualties were very heavy at times and the battles at periods were almost continuous, giving little rest to the staffs.

SECOND WORLD WAR

The units responsible for the surgical treatment of the battle casualties in the forward areas at the beginning of the war were the Field Ambulance and the CCS. First-aid treatment was given by the stretcher-bearers and the RMO in the RAP, and this was continued in the ADS. Evacuation then took place to the MDS, which acted as a staging post, and then to the CCS, where the main surgical treatment was to be carried out.

In the Greek campaign this plan was carried out and the major forward surgical treatment was performed at the CCS level, though some operations were done in the Field Ambulances.

In Crete some surgery was carried out at the Field Ambulances, but most was done at 7 British General Hospital and at other improvised hospitals to which cases from the Field Ambulances were evacuated.

In the early desert campaigns, however, the remarkable mobility of the battle actions, with the alternating success of the opposing armies, impeded the functioning of forward medical units and made the performance of forward surgery difficult.

It was impossible to get the wounded back to the CCS within the optimum period for operation, and the immobilised CCS lost contact with the advanced formations. The CCS as a stable stationary unit was found quite unsuitable. It was too cumbersome and had no transport, so could not keep up with the constantly moving army. This led first to the utilisation of the Field Ambulances as forward operating units, and then to the conversion of some of the CCSs into mobile units equipped with their own transport. The MDSs of the Field Ambulances of 2 NZ Division were provided with extra equipment to enable them to carry out efficient surgery, and with extra personnel to strengthen them from the surgical aspect. At least one surgeon capable of performing major surgery was posted to each Field

Ambulance.

To strengthen the Field Ambulances, surgical teams, as supplied to the CCS during the First World War, were chosen from the medical officers of the base hospitals best qualified by surgical experience and age to perform forward surgery. The relative lack of surgical equipment in the Field Ambulance rendered it necessary for these teams to take such equipment with them. The teams also took their own tentage for personnel and operating theatre, but otherwise lived as saphrophytes on the Field Ambulance. The usual arrangement was for one team to be attached to an Ambulance. A surgical team of a surgeon and an anaesthetist, with some surgical instruments, was seconded from 1 NZ General Hospital for duty with the Field Ambulances in Greece and Crete.

In 2 NZEF no provision had been made for a CCS, and this naturally led still more to the use of our MDS to take its place. The provision of a mobile surgical unit for our force, a generous gift of Mr (later Sir) Arthur Sims, filled the gap to some extent, and proved invaluable during the second Libyan campaign. This unit was organised and elaborately equipped in England and Egypt and had a special establishment approved in the Middle East Force. It was completely self-contained and mobile, and was equipped to deal with all types of forward surgery, including heads and chests, and it could hold and nurse its patients. It was a pity that it had to be broken up in 1942 on the formation of 1 NZ CCS, though it largely persisted as the Light Section of the CCS.

The British surgical teams from base units, having proved their great worth in the second Libyan campaign, were continued as definite army units, the FSUs, with an army establishment of personnel, equipment, and transport, though there was no rigidity as far as equipment was concerned. They were freely transferred so as always to be attached to the active MDS of a Field Ambulance or to an active CCS.

This simple unit of few personnel, minimal surgical equipment, tentage, and transport, was able to join an MDS and thereby form an efficient field operation centre for small numbers of casualties. Two or three FSUs could be joined to one MDS, and thus be able to cope satisfactorily with a rush of casualties. This arrangement enabled forward surgery to be carried out successfully under the peculiar conditions of desert warfare.

British units were attached to our Field Ambulances in the Alamein line in 1942, but New Zealand teams were sent forward later from the NZ CCS and from one of our base hospitals in September 1942. (This latter team was officially constituted 1 NZ FSU in June 1944.)

The CCSs, some of which, including the NZ CCS, had been provided with transport and so converted into mobile units, then began to assume more their original role as far as the British Army was concerned, although our Field Ambulances still continued to carry out much major surgery. In the period just before Alamein Field Surgical Units and Field Transfusion Units were functioning both with the Field Ambulances and the CCSs. A Blood Transfusion Service with its base in Cairo had been well organised to supply whole blood, plasma, serum, and transfusion fluids to the FTUs in the battle areas.

At the battle of Alamein the organisation of forward surgery was very efficient. Units were well staffed and casualties were smoothly evacuated to the forward surgical centres at the Field Ambulances, and then to grouped CCSs. Air evacuation to the Base was used to some extent, but there were few ambulance planes and unprotected transport planes were subject to enemy attack. Nursing sisters had been attached to the CCSs, and beds had been made available to the Field Ambulances and FSUs to enable abdominal cases to be held and nursed after operation, as early evacuation of these cases by air had proved calamitous.

During the long advance to Tunis there were relatively few casualties till the battle of Mareth, and air evacuation was used freely on the 'left hooks' as we held complete dominance in the air at that period. The Field Ambulances continued to be strengthened by extra surgical staff, and CCSs were still grouped at times and forward surgery was well stabilised.

In Italy forward surgical units were housed at times in buildings because of weather conditions, but tents were still frequently used. The destruction of the railways and the deterioration of the roads sometimes made evacuation very difficult, especially from the Sangro. Under the better evacuation conditions at Cassino an important change in priorities was made. Abdominal cases had been proved to do better after a longer period of resuscitation and were referred to the CCS, while early operation had proved best for traumatic amputation cases and large muscle wounds so these were operated on in the Field Ambulances. More of the lesser wounds were also dealt with at the Field Ambulances so that delayed primary suture could be carried out at the base hospitals with a better chance of success.

Specialist units—neurosurgical, ophthalmological, and facio-maxillary—then had forward sections sited close to the CCSs, and patients could be sent direct to them from the Field Ambulances.

In the final period in Italy evacuation by air was a special feature, and some casualties even had their primary operative treatment carried out at the base hospitals. The war ended in Italy with the organisation of forward surgery in a high state of efficiency. Our only difficulty was the supply of young surgeons with adequate training, owing to the depletion caused by the return of experienced surgeons to New Zealand.

DEVELOPMENT OF THE FIELD SURGICAL UNIT

It has already been stated that during the First World War surgical teams, consisting of a surgeon, an anaesthetist, an-orderly, and sometimes a sister, were constantly used at the CCS to supplement the surgical staff of those units. There was no regular army establishment for these teams, so that at the beginning of the Second World War they were not provided. Early in the desert campaigns, however, the need for such reinforcement was realised. A surgical team was sent up from the Base to 4 NZ Field Ambulance in September 1940.

The Consultant Surgeon Middle East Force, Major-General Monro, RAMC, quickly realised the importance of surgical reinforcement in the forward areas, especially under desert warfare conditions. During the first Libyan campaign in 1940 great difficulties arose owing to the rapidity of movement and the impossibility of moving the CCS, itself devoid of transport. Surgical teams similar to those employed in the First World War were sent from the base hospitals, but lack of transport and equipment limited their usefulness. The Field Ambulances to which they were at first attached had no surplus of transport, and certainly no surplus of surgical equipment as they were not normally equipped to perform major surgery, which was the function of the CCS. It was found necessary for the teams to take their own minimal surgical equipment, such as surgical instruments and appliances and theatre requisites, and sufficient transport for their own conveyance. Each team collected what it could and what it thought necessary from its own base hospital, and gradually satisfactory equipment of all kinds was provided. The Field Ambulances did not have any spare tentage available, either for operating theatres or personnel, so that had to be obtained in various ways by the teams. Healthy rivalry and initiative were shown by the different teams in getting their supplies, and this demonstrated to the authorities what was essential and minimal in the equipment of these teams.

On 28 February 1941 a conference with New Zealand representation was held at General Headquarters, Cairo, to discuss the problem of forward surgery, and it was agreed that a mobile surgical service was necessary in the desert, and that a series of surgical teams should be established, based on a CCS. They should be available to move forward to suitable locations, but should be independent of Field Ambulances so as to prevent these becoming immobilised.

Following this conference arrangements were made to set up equipped surgical teams, and two were attached to Field Ambulances in Greece, one of them being a New Zealand team. During the second Libyan campaign a team was attached to a South African Field Ambulance near Maddalena, and our Mobile Surgical Unit acted as part of the New Zealand Division's medical services.

After the campaign the teams were further developed and increased in number, and their equipment added to. The teams then became stabilised as Field Surgical Units, with an official establishment of personnel, transport, tentage, and equipment, but no rigid uniformity was insisted on. For instance, there was considerable diversity in the operating theatres of the different units. Some operated in special theatres built on lorries, some in tarpaulin shelters, the majority in EPIP tents. All units accumulated equipment in excess of the minimal establishment to suit the individual surgeon. Beds were later provided for all units to enable abdominal and chest cases to be more satisfactorily nursed, and also to be held in the units for a period, generally of ten days. The staff consisted of one surgeon, one anaesthetist, two ORAs (Operating Room Assistants), one clerk, and two drivers (ASC).

The equipment included operating-room furniture and equipment, including surgical instruments, theatre linen and dressings, and emergency lighting. Tentage for personnel was also carried, and sufficient transport for the equipment and personnel was provided. There was no provision for cooking, and none for the housing and nursing of patients, and lighting was generally provided by the mother unit.

The unit was essentially set up to provide extra operating facilities for the host unit, be that a Field Ambulance or a CCS. This constituted a distinct weakness in comparison with the Mobile Surgical Unit as set up in 2 NZEF. The units were formed essentially to deal with the more serious types of casualties such as the abdomens, and skilled surgeons were provided, but after operation there was no skilled nursing available. This was of particular importance when the FSUs were attached to a MDS of a Field Ambulance, where no nursing sisters were available. The nursing orderlies of our Field Ambulances did become very proficient and were given preliminary training in the base hospitals, but they could not be expected to give the same service as a trained nurse. The CCS with its staff of six sisters had naturally great advantages in this respect. The increasing emphasis placed on post-operative nursing and the longer retention of patients at the Forward Operating Centre made the question of nursing of much more importance.

As reinforcements of operating potential, however, the units were eminently successful, and the staffs were very carefully, selected. The posts were looked upon as prizes of great honour by the staffs of the base hospitals.

Their simplicity with the minimal equipment not only made their formation easy, but allowed their rapid transfer from one host unit to another, as circumstances demanded. This applied particularly when a unit was attached to a Field Ambulance, which did not as a rule act for long as a forward surgical unit, the MDSs of our three ambulances generally taking it in turns to deal with the major casualties. With regard to the CCS, however, a unit remaining active for a considerable period and generally throughout a campaign, an FSU was often attached for a long time, so that it became a smooth-working part of the machine.

The New Zealand Field Ambulances had surgical teams attached during the pre-Alamein period, first British teams and then teams from our CCS and our own Base Hospital at Helwan. From then to the end of the war our own FSU was regularly attached, generally to the Field Ambulance, and sometimes to the CCS. We also had RAMC FSUs, often with FTUs as well, attached to us for considerable periods, both with the Field Ambulances and the CCS. The CCS in particular was seldom without an attached British FSU of excellent quality. The personnel of these units worked in the utmost harmony with us, and brought with them a freshness and breadth of outlook in itself of great value to our own units. Our New Zealand force during the period of the war in the Middle East and in Italy relied a great deal on the RAMC for FSUs and FTUs in our forward units. This was partly due to the prominent position given to our units, which were servicing other than our own troops. It was also due to shortage of young surgeons in the NZMC suited to the work, as well as to the somewhat rigid retention of personnel in our base units. There was no reason why each of our three base hospitals should not have formed a surgical team and sent it forward to help in the rush periods, withdrawing it to the base unit as soon as the rush was over. We were very well served by the attached British units and could hardly have done without them, but we should have been able to pull our weight better, especially as we contributed practically nothing to the common pool of administrative medical personnel.

Reserve Unequipped Surgical Teams

These were utilised occasionally to supplement the equipped teams, the FSUs. In times of stress these teams were able to spell the overworked surgeons. With no equipment they could be rapidly transported, often by air, and could walk straight into a working operating theatre. Our CCS was thus reinforced during the battle of Mareth by teams supplied by 3 NZ General Hospital, then located at Tripoli. The benefit was considerable both to the CCS and the personnel from the hospital. Unfortunately, with the dwindling staffs of the hospitals this was not repeated, but 2 NZ General Hospital sent up a medical detachment from Caserta to the forward areas during the final Po battles.

Method of Employment of Surgical Teams and FSUs

The employment of FSUs was the logical method of supplying extra and well-trained surgeons for forward surgery, but the method of their employment was at times open to criticism. The fluid battle conditions in the early desert campaigns led to the surgical teams being attached to the Field Ambulances. It was normal at first for only one team to be attached to a Field Ambulance, and there were not many teams available. As casualties often occurred in one particular area it thus led to a concentration of work on one team. This team worked till it was exhausted as there was no possible relief, and serious cases naturally banked up awaiting operation. The surgeon could not give of his best, and treatment for the control of bleeding and the prevention of infection was delayed. The lone team could only handle efficiently relatively few casualties, and could be fully justified only in positions separated a considerable distance from the main battle area. The desire of senior combatant officers of brigades to have a competent surgeon available for their men irrespective of the likely number of casualties, though displaying a keen appreciation of medical needs, proved often an embarrassment to the medical administration. It was found necessary to concentrate the medical units responsible for forward surgery in one centre, so as to have available for the care of the wounded the maximum number of surgeons, thus enabling distribution of work and spelling of personnel. The operating theatre assistants needed rest just as much as, and even more than, the surgeons. There were many methods of arranging the reliefs of surgical teams, but it was recognised that no surgeon should operate normally for more than sixteen hours in any twenty-four, and that no more than 12–16 operations of magnitude per team in any day was desirable. There were other duties of importance besides operating, and the surgeon had to keep a watch on the post-operative treatment of his patients, while a pre-operative knowledge of them was also helpful.

The realisation of the evils of the deficiencies of the lone team led to the attachment of two or more teams to the active MDS and, with an FTU also added as a normal part of the operating centre, large numbers of casualties could be adequately dealt with by operation. The evils of the lone operator were seen more in the RAMC Field Ambulances than in our own. Provision had been made in our units for surgical work, both by the provision of extra equipment and, especially, by the appointment of at least one medical officer in each ambulance capable of performing major surgery. This ensured one surgical team from the Field Ambulance's own staff, so that any attached team was not working on its own. In addition, the surgeons of the inactive Field Ambulances were frequently utilised in the active MDS to form extra surgical teams. The surgical work was apportioned so that the surgeons of the attached FSU, or at times of the Light Section of the CCS, dealt with the major cases such as the abdomens, whilst the Field Ambulance teams operated on the less serious cases.

THE DEVELOPMENT OF THE AIDS IN 2 NZEF

It has been pointed out that in the 1914–18 War the Field Ambulance was solely concerned with first aid and the evacuation of the wounded to the Casualty Clearing Station. This position held at the beginning of the Second World War, and it had been decided by the DGMS in New Zealand that a separate CCS was not required for 2 NZEF. This must have influenced the Field Ambulances considerably in their outlook on forward surgery. They accumulated extra equipment and were enabled to do some surgical work in Greece and Crete. In the desert campaigns the immobility of the CCS forced the Field Ambulances to undertake forward surgery, though this did interfere to some extent with their primary functions. However, the position was met by the appointment of surgeons to the Field Ambulance staff and then by the attachment of surgical teams and Field Surgical Units from base hospitals.

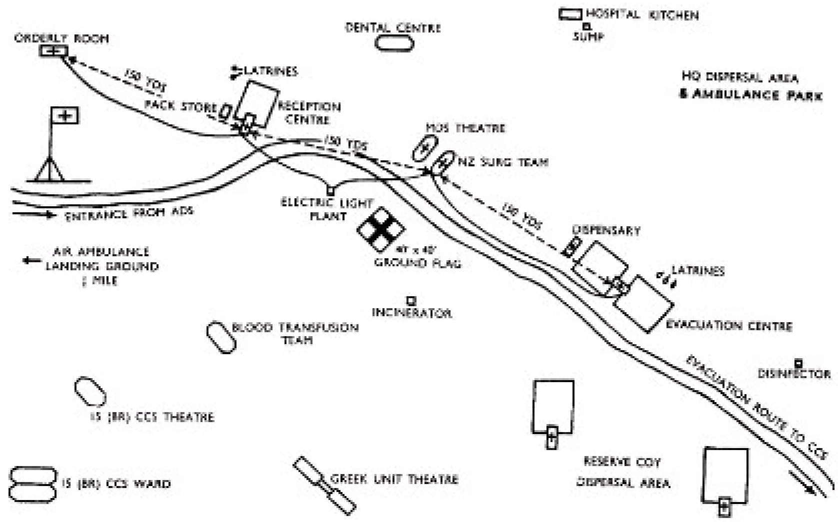
As already stated, it was at first only possible to attach single teams to a Field Ambulance, but later two or more were attached providing adequate surgical personnel. Later Field Transfusion Units were set up and these added tremendously to the efficiency of the treatment. Hospital beds were also added to Field Ambulances during the pre- Alamein period, so that abdominal cases in particular could be held and nursed after operation.

Our New Zealand MDS was, from late 1942, when fully staffed with extra personnel, an efficient surgical unit. There was commonly attached:

(a) The light section of 1 NZ CCS with two MOs, ORAs (operating room assistants), and nursing orderlies, with full equipment for operating and nursing facilities, including hospital beds.

(b) NZ FSU with surgeon and anaesthetist, ORAs, and operating tent, but no nursing orderlies or nursing facilities.

(c) NZ Field Transfusion Unit with full equipment and personnel.



LAYOUT OF MDS OF 6 NZ FIELD AMBULANCE, ALAMEIN LINE, JULY 1942

LAYOUT OF MDS OF 6 NZ FIELD AMBULANCE, ALAMEIN LINE, JULY 1942

The attachment of the light section of the CCS was invaluable as this contained well-trained nursing orderlies, as well as tentage and hospital beds, and other equipment for the nursing of the seriously wounded men. The equipment, a heritage from the MSU, was exceptionally good, and the surgical van supplied lighting and suction and autoclaves, as well as elaborate theatre furniture. Still missing, however, were nursing sisters and an X-ray unit. The 2nd NZEF retained the MDS as a unit for forward surgery throughout the war, and did not establish an FDS to take its place, as a mother unit for FSUs and FTUs, as did some British formations.

THE DEVELOPMENT OF THE CCS

As already stated, the CCS was originally too cumbersome and without transport. It was then altered by providing transport for a certain number of the units, which were then attached to corps. These were called Mobile CCSs, and followed closely behind the Army during the advance from Alamein to Tunis. Our 1 NZ CCS functioned from Alamein onwards and was one of the first to be made mobile, and it rapidly developed the facility to change camp. The individual wards were made independent units by basing them on a 3–ton truck, in which all tentage and equipment and staff were transported from one site to another. With a stabilised plan of layout of the camp, the ward lorry was able to be driven to its exact location in any new camp. If the CCS was holding patients unsuited for evacuation, a detachment was left behind when it went forward, and if large numbers were being held arrangements were made for another CCS to leapfrog ahead and leave the full CCS stationary till it had dealt with its serious cases. The equipment of the CCS was altered to suit the new function. The newly formed FSUs were attached to an active CCS to strengthen its surgical potential and FTUs were also attached. Nursing sisters were also added to the establishment, six being attached to our CCS at Alamein, and they remained attached throughout the war. They were even attached to the active MDS when conditions warranted this on the Sangro front.

The CCS was the unit best equipped to carry out the major forward surgery, and, if it was mobile, was able to be placed so that casualties could reach it in adequate time. If that was impossible, then the light section could be pushed forward either to join an MDS or an FDS. The most important aspect was the holding of the serious cases—any unit operating on this type of case must be so constituted and located that it could hold them. The name of the unit and its exact establishment was immaterial.

In Italy there was not quite the same necessity for the CCS to be mobile as generally it was not shifted so often or so far, but it still generally remained a tented unit. The attachment of one or more FSUs and an FTU became the routine whenever the CCS was actively employed to deal with casualties. A dentist was also attached to take charge of fractured jaws. A physician was also added to the unit for general purposes and also to look after chest cases. Thus the CCS became a mobile unit, very well staffed to deal with serious casualties.

SPECIALIST SURGERY

Apart from the Field Surgical Units, which were normally attached to Field Ambulances and Casualty Clearing Stations, provision was made for the performance of specialist surgery in the forward areas by sections of neurosurgical, ophthalmological, and facio-maxillary units.

During the advance from Alamein part of 4 British Neurosurgical Unit under Captain K. Eden, and also an Ophthalmological Unit, were attached to our CCS.

In Italy at first the specialist work was centred at the CCS, but during the latter part of the war hospitals of 200–400 beds were set up, just behind the CCS area, to deal with specialist types of casualties. Here were grouped the neuro-surgeon, maxillo-facial surgeon, and ophthalmologist,' the Trinity,' and to here were diverted from the normal channel of evacuation all the neuro-surgical, plastic, and eye cases. A dentist well qualified in fracture work was also attached, as was a fully qualified general surgical team so that cases of severe multiple injuries could be adequately dealt with. This type of hospital, placed at the foremost convergence of evacuation lines, made it possible to supply specialist treatment in these cases at the earliest moment. Special equipment and extra nursing facilities were provided. The specialist units could not cope with all the cases, partly because of the rush during periods of great activity, partly because of the multiplicity of wounds, and partly because of local conditions rendering it impossible to send all the special cases to the centre. It was therefore held desirable to train a small number of general surgeons in the technique recommended by the special units by attaching them for short periods to these units before appointing them as forward surgeons.

With any future New Zealand force this specialised training will be essential as there will always be a shortage of specialists in these fields, where the civilian needs are insufficient to employ more than a minimum of personnel. New Zealand has only two neurosurgical centres and very few plastic surgery centres. If there was another war and an expeditionary force was sent overseas, there would be insufficient specialised personnel to supply the needs of the overseas force as well as the civilian needs. Arrangements should be made for the training of reserves in these special branches for emergencies of this kind. It should be part of the general defence policy.

OTHER IMPORTANT ASPECTS

Time Factor

At first it was advised as an ideal that excision should be carried out within eight hours of wounding. It was held that if infection had spread beyond the surface of the wound excision of the infected tissue was impracticable and likely to be injurious by spreading the infection still further by breaking down any resistance already set up by the tissues. The time limit, however, was never rigidly fixed by the Army, but a twelve-hour period was deemed satisfactory by many surgeons. Later it was held that wound toilet could be carried out with benefit up to twenty-four hours, and even much later in the ordinary case.

The whole question is vitiated by the use of the term 'wound excision', and the original idea that prompted the technique during the First World War. It was believed then that a complete excision of the wound, removing a continuous layer involving all structures, would remove all infected tissue and all organisms. This radical procedure proved impracticable and was obviously a danger to important structures, and the technique was modified to the removal of devitalised tissues, particularly of muscle. It was realised that if all infection could not be eradicated by surgery devitalised tissue which encouraged infection, especially anaerobic infection, could still be removed with benefit. This removal of devitalised tissue could be carried out at any time, and in the case of anaerobic infection its removal was the only satisfactory method of treatment.

In grossly infected wounds the main objective is generally drainage, but even in those cases any dead tissue such as sloughing fascia should be removed. It was reported at the Rome conference in 1945 that very infected wounds seen at a late stage in Yugoslav patients had been much benefited by removal of devitalised tissue, and that no harm had arisen by spread of infection.

Our outlook on the problem must therefore be revised. The time factor must now be held still to be of considerable importance, because the sooner the devitalised tissue is removed from a wound the less chance there is for infection to arise. There can, however, be no time limit for wound toilet as the removal of dead tissue from the wound is always desirable, though the extent of removal will naturally depend on the condition of the wound. In a patently septic wound little can be done except removal of muscle for anaerobic infection. In the recent wound the operative treatment is a preventive measure, so careful wound toilet is of prime importance, and on this depends the success of wound suture later. This success will to a large extent depend on the period which has elapsed between the infliction of the wound and the toilet, and also on the thoroughness of the operation.

It has been proved beyond doubt that the success of wound treatment depends essentially on the original wound toilet, and that air other measures such as the application of sulphonamides or penicillin are subsidiary.

The time factor in operation was modified by the condition of the patient and also by the nature of the injury. It was found that in patients suffering from shock resuscitation generally had to take precedence, and that time must be allowed for the treatment of shock before operation was carried out. This particularly referred to the abdominal cases. In some cases, however, shock could not be relieved except by operation. This was well marked in cases of traumatic amputation and massive muscle injury, as well as in open chest wounds and the bleeding abdomen. In these cases it was of the utmost importance to transport the patient with the minimum of delay to a Forward Operating Centre, be it MDS, FDS, or CCS, and not to waste time by stopping at staging posts on the way.

Evacuation in the Forward Areas to the Forward Operating Centre

It was well realised that time was an important factor in the evacuation of wounded men from the field of battle and that every effort had to be made to get them quickly to a Forward Operating Centre. At times great difficulties arose and long and arduous stretcher carrying had to be carried out, sometimes in hilly country, as in Greece, Crete, and parts of Italy. Whenever possible motor transport was utilised, and in the desert campaigns motor ambulances and Bren carriers were used, being driven with great courage on the battlefield; and this hastened the arrival of casualties at an operating centre. Special arrangements had to be made for the clearance of casualties through minefields.

In Italy both the jeep and the Bren carrier were used, both being fitted to carry two stretchers. The jeep proved particularly valuable under very adverse conditions, its power and four-wheel drive enabling it to go practically anywhere. Ambulance cars with four-wheel drive were much more useful than those with two-wheel drive. There were occasional delays at bridges and rivers, as at the Sangro.

Between the RAP and the ADS motor ambulances were generally used, and from the ADS to the MDS and back to the CCS motor ambulance convoys were always available. In the desert the rough and uneven surface made evacuation by ambulance a trying ordeal for the patient, especially if the journey was a long one, and this also applied in Italy where the roads in the forward areas were sometimes very rough, especially in the winter.

Classification of Cases for Forivard Surgery

This consisted first of the sorting out of cases into those (i) definitely requiring surgery or resuscitation, (ii) possibly requiring surgery and further investigation, (iii) not requiring surgery.

This was best carried out at the ADS so as to obviate any further disturbance of the wounded man till he was admitted to the Field Ambulance or the CCS where the operative procedures were to be carried out. The casualty should not have to pass through any intermediate medical unit. The position was aptly illustrated by a Norwegian surgeon in Italy who said that in New Zealand a patient being sent by ambulance from the country to hospital would not stop at every doctor's surgery on the way.

The second sorting was done according to the priority of operation in those cases requiring surgical treatment. This was carried out at the operating centre to which the casualty was first admitted, which was in our force generally the MDS of a Field Ambulance.

At the beginning of the war the operative priorities were:

1. Bleeders.

2. Sucking chests.
3. Abdomens.
4. Serious wounds and traumatic amputations.
5. Heads.
6. Light wounds.

This degree of urgency in the performance of operative treatment decided to a great extent where the operation should be carried out. The lack of mobility of the CCS in the desert campaigns rendered it necessary to deal with the first three priorities at the MDS. The priorities were recorded on the Field Medical Card, generally by writing the essential diagnosis in large letters and by underlining.

Special centres were later established by the RAMC, and arrangements were made to classify the cases in the forward areas and arrange evacuation to the special centres as soon as possible. The special centres formed were Head, Facio-maxillary, Ophthalmic, Orthopaedic, and Chest. Special coloured stickers were produced to designate each of these, and these were affixed to the envelope of the Field Medical Card.

Operation at MDS or CCS?

The distribution of the surgical work between the MDS and the CCS was always a difficult problem, and one on which there was at times considerable difference of opinion. As has been stated, at the beginning in 2 NZ Division the greater part of the work was carried out in the MDS. This established a precedent in the NZMC, and for the whole period of the war it was the custom to carry out a part, and often the greater part, of the major forward surgery in the MDS. There was a differentiation between the work of the MDS and the CCS according to the terrain and the type of warfare. At times the MDS did the major part of the work; at other times the work was concentrated in the CCS, and again there was often a very satisfactory division of the work between the two units. The priorities of the different types of casualties with regard to operation altered during the war, and this led to an adjustment of the work of the units, Initially the abdominals were first priority, but later, at Cassino. this was changed and severe limb wounds and traumatic amputations became first priority, and abdominals were placed lower in the list and considered more suitable for operative treatment at the CCS. In Italy, except at the Sangro, less surgery of a major type was carried out at the MDS. The Field Dressing Station as instituted in the British Army to take the place of the MDS was never utilised by 2 NZEF, our well-equipped and buttressed MDSs and our mobile CCS supplying all our needs.

The RAMC did not utilise the MDS to the same extent, and the consultant surgeons to the British Army generally did not approve of the MDSs functioning in this manner.

Although a great deal depended on the local and military position, and also on the quality of the staff available, points in favour of operation at the MDS were:

1. The cases could be operated on earlier and after less exhausting travel.
2. The earlier operation led to less infection and also the saving of some lives among the seriously shocked casualties.
3. With FSUs available and also FTUs, the conditions could at times be made very suitable. Beds were available both in the FSU and the light section of the CCS.

As the great aim in forward surgery is to operate and excise the wound before infection has become ingrained, it would seem that operation at the MDS would save much sepsis and some lives.

The points against operation at the MDS and in favour of the CCS level were:

1. If no undue delay occurred at the dressing posts it was possible in ordinary circumstances to evacuate the casualties speedily to the CCS to ensure timely excision of the wounds there.
2. The patients were removed from the danger and noise of the battle area and the staff had more rest.
3. The conditions at the CCS were normally superior so that operation could be carried out more satisfactorily, and more relieving staff was available.
4. The facilities for, and standards of, nursing were definitely superior. Nursing sisters were available and their presence alone made a vast difference.
5. The patients could generally be held as long as necessary. This was of great importance to many cases, especially abdomens. If the CCS had to move up it could do so in sections.
6. Sterilising was better. X-ray was available.

It was the opinion of every unbiased surgeon of experience that the CCS was normally the best place to carry out the major forward surgery. In such circumstances as the Mareth battle, however, when 2 NZ Division was out of contact with the CCS and casualties could not be evacuated readily, then the surgery rightly was carried out in the MDS, the cases being held there and evacuated later. At other times the work was split up between the two units, partly according to priority and partly according to the severity of the necessary operative procedures. Finally, during the Po battles the forward surgery was performed by the MDS, by the CCS, and also by the base hospitals, a condition of affairs rendered possible by excellent arrangements for evacuation. With air evacuation some of the work could be left to the base hospital, where no further shifting of the patient was required.

From the experience gained during the war it can be concluded that the decision as to the units in which forward surgery of different types should be performed must be made according to the circumstances at the time. The advice of the consultant surgeon of the area would be invaluable in this regard.

Staffing was, of course, the most important aspect of the forward surgical problem.

The Field Surgeon

The ideal forward surgeon was a young man in his early thirties who had had a sound training in surgery under capable seniors in a first-grade hospital. He had to be physically very fit and able to undergo severe strain and work long hours. (Forward surgeons often needed spelling at the Base after a period of six to twelve months in the forward area.) He had to be temperamentally stable and optimistic. He had to have initiative and the ability to improvise. He gained experience and training invaluable for the future. A sense of true values was obtained with judgment, decision, and courage, and a knowledge of serious illness, shock, and sepsis which was of great value in later life. Many men of this type were always available in the profession, and New Zealand had many of them.

Surgeons in the Field Ambulance

Arrangements were made to have at least one medical officer in each ambulance capable of performing major surgery. When the MDS of the Field Ambulance was utilised to carry out the major part of the work, the light section of the CCS (with its excellent equipment and experienced surgeon) was attached to it, and, at times, also another field surgical team sent forward from a base hospital. With one or two teams made up from the Field Ambulance staff to do the less serious cases, a considerable amount of work could be accomplished.

Surgeons in ihe CCS

Young surgeons were selected for the CCS, at least two being normally available, so that the CCS itself could provide two surgical teams. In times of activity, however, extra surgical personnel were essential, and FSUs, often British, were attached.

Transfusion Officers

The pre-operative resuscitation was generally carried out by an attached FTU, and the selection of cases for operation was done by co-operation between the FTU and the surgeons concerned. Post-operative care as required was also given by the FTU. The Field Transfusion Officers in the Middle East were carefully selected young medical officers, trained by Lieutenant-Colonel Buttle at the Base Transfusion Unit attached to 15 Scottish Hospital in Cairo. They were a new development of the war and gave the greatest service, displaying initiative, energy, and judgment of a high degree. One unit was normally attached to each active forward surgical unit. In our own New Zealand force the officers were first chosen from pathologists and bacteriologists, and these proved eminently suitable. It would have been profitable to have increased the number of transfusion units and especially transfusion officers. An active CCS could have usefully employed two transfusion officers.

Anaesthetists

The anaesthetists attached to the FSUs were called upon to assume heavy responsibilities as so many of the wounded were suffering from profound shock. In the British units specialist or graded specialist anaesthetists were utilised, and these proved of great value. In 2 NZEF we were deficient in specialists and none were available for this purpose, though some training was given to young officers undertaking this work. The value of a highly experienced anaesthetist was seen by us when we had attached to our CCS Major Cope, a British specialist of high standing. He proved invaluable not only as an anaesthetist, but in consultation on post-operative complications and in the training of our own officers.

Orderlies

The orderlies had to be carefully chosen as they had, in the Field Ambulances, to do all the work in the operating theatre and also to nurse the patients, as no nursing sisters were available. Even in the CCS they carried out very responsible work.

Senior Surgeon

At the CCS a senior surgeon was especially valuable in deciding on the necessity and urgency of operation and resuscitation. In our CCS during the war the COs were all senior men with surgical experience, well capable of fulfilling this function. Our consulting surgeon who was attached to the CCS during a major part of its rush periods always worked in the pre-operative ward helping in the diagnosis and the decision as to operation, and being available for advice and help to the FTU and the surgeons. It was felt that units which did not have a senior surgeon available for this work were severely handicapped, and an unfair burden was placed on a transfusion officer when he was called upon to do the work himself. A senior surgeon—in our relatively small force the consulting surgeon was the obvious choice—should be utilised in the CCS not only in the pre-operative ward, but as adviser in the theatre and in the wards. There was no work more important in the whole of war surgery measured in the opportunity of saving life and disability.

General Control of Surgical Staffing in 2 NZEF

The reinforcement of the surgical potential of the Field Ambulances and the CCS depended largely on the field surgical units and teams which were attached when the forward units were active. Unequipped surgical teams from the base hospitals were occasionally used.

There was a definite lack of fluidity in the utilisation of surgical personnel during the war, due to many reasons. The main reason was the rigidity of the unit establishments, which caused many difficulties. This prevented the recognition of any specialist, officer or man, not included in the list. It tended to fix the staffs of the medical units according to the establishment and not according to the work to be performed. It at first led to the waste of skilled medical officers' time in the performance of routine military duties. The officer commanding a medical unit tended to demand his full establishment, even if at the time this was not essential. He also held on to personnel lest, when the unit became busy, he should find himself shorthanded. He also naturally did not like to have the best of his staff transferred to other units when he was doubtful of their return. The forward areas were often a long way from the Base. The OC was responsible for the efficiency of his unit and especially for the quality of the medical work done in his unit, so he could not but be anxious to have a full and well-qualified staff.

British FSUs and FTUs were commonly utilised by our forward units. It would have been possible for surgical teams to have been shifted from our base hospitals to the forward surgical centres for short spells during periods of high activity, and then shifted back again to the base hospitals when the acute phase was over. This would have enabled our men to get valuable training in forward surgery and also would have given relief to the overworked forward surgeons. The war was fought in short spells, and a concentration of all available surgical talent should have been brought about first at the front and later at the Base. This would have saved medical personnel and given everybody fuller employment. The medical personnel should never again be kept in watertight compartments. They should be used as fluid reserves to shift as the senior officers consider advisable.

Role of a Consultant

The responsibility for surgery should be given to the consultant surgeon as it was in other forces. Even in our small force this was the best arrangement. The consultant himself should be in the thick of the surgical fray, where his services would be of most value and where he could observe every activity and all surgical staff. He must be ever active and know his staff intimately and be ever ready to give counsel and advice and practical help. There was a tendency to retain him at the Base for administrative matters such as boarding and approving of medical boards. At times there was a feeling of jealousy by senior officers at the Base when the consulting surgeon attached himself to the forward units during periods of activity. This could only have arisen through ignorance of the true function of a consultant and the necessity to have him in the position where he could be of the maximum use to the wounded men. He should have been expected to be in the forward operating units as his first duty and expected to take his part in the work of the unit in whatever position he thought best. This would undoubtedly be in the pre-operation ward assisting in the diagnosis and sorting of cases, and at times assisting in the theatre or spelling the surgeons. The RAMC appointed consultant surgeons to the forward areas as well as to the Base, and they proved invaluable. They were a great help to all forward surgeons, including our own. For our small New Zealand force naturally one surgical consultant was sufficient, and he was able to alternate between the forward areas and the Base acting as a useful liaison officer.

THE EQUIPMENT OF A FIELD OPERATING UNIT

Field Surgical Unit

The equipment accumulated by the different units was generally quite ample and surgical instruments were simple in type. A pedicle clamp suitable for use in clamping the renal or splenic vessels, skull forceps such as a De Vilbis, malleable abdominal retractors and a strong rib spreader were found to be useful additions.

A suction apparatus of simple form, often made from a tyre pump, was found essential, and many different types were constructed. A lighting set proved of the greatest value, and several of the units utilised a very compact and efficient Italian lighting set. Although the unit was normally supplied with electric lighting from its mother unit, independent lighting was much to be preferred. Lighting by petrol or kerosene lamps was undesirable in the operating theatre when ether was being administered.

Main Dressing Station

This unit had an electric unit sufficient to provide light for all the main activities. A suction apparatus and the surgical instruments mentioned with regard to the FSU were also required by the MDS.

Our New Zealand Field Ambulances were equipped with extra surgical instruments and appliances both from Army and Red Cross sources to enable them to carry out forward surgery.

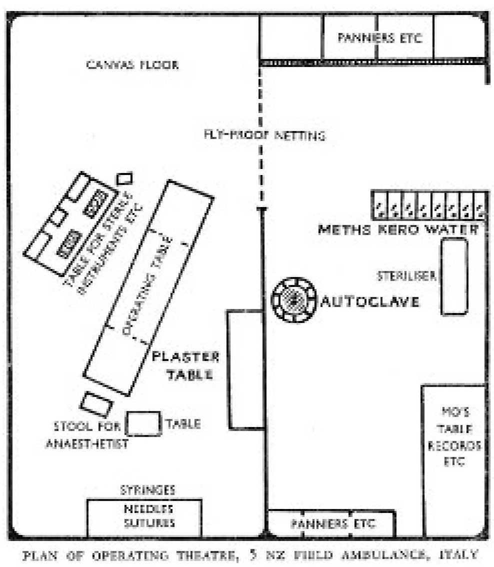
Casualty Clearing Station

This unit also had extra equipment supplied and had benefited greatly from the handing on of part of the elaborate equipment of the MSU. The light section in particular inherited a great part of the special equipment, including the special van and its fittings, a lighting set and powerful suction plant. It had sets of head and chest instruments as well as an extra supply for routine surgery.

Operating Theatres used for Forward Surgery

Tents were usually provided for this purpose. The most satisfactory tent utilised in the desert campaigns was the EPIP, and the combination of two of these tents, one to act as the actual theatre and the other to act as a shelter for patients awaiting operation and for storing the theatre supplies, was quite sufficient. Originally an RD tent was combined with an EPIP, but this was hardly large enough. As the fear of bombing receded, the operating tent was often joined on to the pre-operation or resuscitation tent.

Each FSU had its own operating theatre acting independently of the theatre of the mother unit, so that if two FSUs were attached to an MDS there would be normally three theatre units, one being provided for the operating teams of the MDS.



PLAN OF OPERATING THEATRE, 5 NZ FIELD AMBULANCE, ITALY

For the operating theatre in Italy in a modified form either two IPP tents or two rooms were used. The staff consisted of:

1 Sergeant alternated as assistant to surgeon and in supervising the sterilisation and preparation of trays.

1 Corporal alternated as assistant to surgeon and in supervising the sterilisation

and preparation of trays.

2 Orderlies who alternated as theatre assistant and steriliser orderly.

The CCS frequently had two theatres for its own personnel apart from those set up by the attached FS units. This independent working of the theatres made the spelling of personnel easily carried out. There were many other types of operating theatre utilised in the desert campaigns. There were elaborately equipped mobile van theatres presented by the Americans, and other less elaborate van theatres built by the Army in Egypt. Though mobile, most of these were somewhat cramped and proved unpopular. Tarpaulin penthouses attached to trucks were constructed, but they proved hot and more difficult to protect from sand. The ordinary hospital marquee was found to be less suitable. The hospital extending tent was excellent for large theatres, but was heavy and difficult to erect. For desert conditions, and generally when buildings were not available, the double EPIP tent proved the most satisfactory. The Germans provided a very satisfactory operating tent. Some were captured by us and at times used by our units. It should be possible for us to provide a special operating tent especially designed for forward operating work.

Autoclaves: A small autoclave was useful for the sterilisation of guards and dressings.

Sphygmomanometer: This was an essential apparatus for the estimation of shock.

Anaesthetics: Macintosh's apparatus proved excellent in forward surgery. Specialist anaesthetists often utilised modifications of Boyle's apparatus.

Extras: Electric lighting was normally provided, and standard lights were sometimes available. Arm boards, as extra attachments for the table, were excellent and simple, both for the giving of pentothal and also for blood transfusion. A kidney pillow was sometimes useful. Drums for sterile guards, and overalls, were much to be preferred to simple bags, though bags would do for sterile dressings and spare guards. An HP steriliser was essential in a busy CCS. There was great wear and tear on surgical instruments, especially Spencer Wells forceps, due to constant boiling.

FORWARD SURGERY: CLINICAL FEATURES — TREATMENT OF WOUNDED IN THE FIELD

FORWARD SURGERY: CLINICAL FEATURES

Treatment of Wounded in the Field

The Unit Stretcher-bearers

These were normally the first to contact the wounded man in the field. Although not members of the Medical Corps, they were trained by the RMO to render first aid before carrying the casualty to the RAP. They applied field shell dressings and attended to bleeding by applying firm pads and tight bandaging. Fractures were rendered more comfortable by bandaging the lower limbs together, or, in the case of the upper arm, by bandaging to the body. Morphia by mouth was sometimes administered generally in doses of ¼ grain. No attempt was made to provide any elaborate treatment, and the casualty was transported to the RMO at the RAP as rapidly as possible. This was carried out by the best available and practicable method. Jeeps and Bren carriers, and at times ambulance cars, were used, but sometimes hand carrying was necessary.

Tributes were paid to the unit stretcher-bearers by all who saw them at work in the care of the wounded. They were subjected to many dangers, but these were disregarded as they saw to the safety and treatment of the casualties. There were many casualties among the stretcher-bearers themselves, and at times their work was arduous in the extreme. Jeep drivers, continually going to forward companies over roads subject to heavy fire, were also unflinching in their duty, and were the direct means of saving many lives.

Regimental Aid Post

The treatment given varied considerably according to the campaign and the conditions. Frequently in the desert little could be done beyond rearranging and applying dressings, splinting fractures, and giving cigarettes and chocolates. At times hot drinks were not available for all the casualties. Rapid evacuation was the main consideration.

In Italy much more could be done and the patients made more comfortable, their wet clothes removed, more elaborate wound treatment given, and splints applied. The type of treatment given for the different conditions was as follows:

(a) Control of Haemorrhage: This was usually controlled by direct pressure by pad and firm bandage, the shell dressings being very suitable for this purpose. The tourniquet was very rarely required and was strongly deprecated except in the case of traumatic and inevitable amputation, when it was applied as close to the wound as possible. One RMO of long experience never used a tourniquet except to place it ready for use in case of emergency during transport. He stated that there was never any need to tighten the tourniquet. Another RMO felt that the tourniquet should only be used if all else failed. Opinions were sometimes strongly expressed that the tourniquet should be discarded as it undoubtedly did much more harm than good. It was also pointed out by experienced RMOs that the most serious bleeding had been from axillary and femoral vessels for the control of which the tourniquet was useless. Artery forceps were rarely required.

It was not uncommon to meet with profuse venous oozing, or frank flow, and sometimes spurting from small arteries—these were the most frequent cause of severe blood loss. Cases presenting haemorrhage from a partially severed large or medium-sized artery were rare. In the infrequent case of complete traumatic amputation of a limb the severed arteries had contracted and sealed the end. In partial traumatic amputations the bleeding was from veins or small arteries in most cases.

When the bleeding was profuse control was obtained by the application of artery forceps to the main bleeding vessels and these incorporated in the pad and bandage pressure dressing, and here the use of crepe bandages was a boon in obtaining better pressure.

In those cases where the bleeding had been profuse the limb was immobilised in splints before evacuation and morphine was given. For internal haemorrhage that was clinically suspected or certain, reliance was placed on morphine and rapid evacuation to the ADS for further disposal.

(b) Splinting of Fractures: This was carried out in the simplest method that would give adequate immobility of the limb. Conditions varied so much that at times little could be done, while at others much more elaborate measures were possible. A great deal depended on the proximity of the ADS, and the ease of transport and speed of evacuation, as to whether much time should be spent in handling and applying very elaborate splinting. If casualties were numerous time could not be devoted to elaborate splinting, and the simple measures of binding the arm to the chest and the legs together were utilised.

Even in battle adequate splinting, without recourse to extempore measures, was, however, always possible. The adequacy depended only on time—whether or not it was wiser to retain the patient in an area of danger while time was spent on splinting, or whether to evacuate him at once if transport was available. Time spent on adequate splintage was indeed well spent, the patient being able to be sent through to the operating centre without further interference to the wound before coming to operation, and travelling more comfortably, with relief of pain and in a much better frame of mind.

In the infantry, with the necessity of planning for the minimum of gear owing to the frequency of establishing the RAP on foot without transport being immediately available, it was usual to use the Thomas splint for the lower limb, and Kramer wire for the upper limb with bandage fixation of the limb to the body.

These splints proved very satisfactory in every respect, quick and easy to apply, giving complete immobility, and the comfort in handling and in transport, sometimes over very rough country, was marked, and the patients arrived in good shape.

It was felt, however, that the success of the splinting depended to a large extent on the fact that RMOs were able to use POP [1] bandages around the splints rather than the ordinary bandages. It was easier to apply these—the finished result was better for the preservation of immobility and relief of pain, the splints were no more difficult to remove than those using soft bandages, and the patients benefited from this method. Except for very occasional periods it was always possible to do any splinting necessary, and the type of splint seldom varied, the Thomas splint being equal to any lower limb indication, and the Kramer wire, reinforced with POP bandages, for the upper limb; and on those occasions when the supply of Thomas splints was exhausted it was possible to use the wire, with POP, for the lower limb as well, with good results.

It was a routine to splint all large soft-tissue wounds in the limbs as well as those involving bone; much benefit came from this decision and practice.

In those cases where plaster was used round the splint it was very important to have marked in large letters on the exposed part of the splint that it was a temporary travelling splint only and had to be removed as soon as the patient reached the operating centre, even though there was no constriction.

Pentothal was sometimes used for the application of splints in difficult cases.

(c) Relief of Pain: Morphine was the routine treatment. It was first administered by hypodermic injection, apart from the oral doses given by stretcher-bearers. The dosage varied, the ordinary dose being ¼ grain, and sometimes ½ gr. doses were given. There was a tendency at times to repeat morphia dosage too frequently, and this led to dangerous complications, as in shocked cases with sluggish circulation morphia was slowly absorbed and action was much delayed. When resuscitation was carried out there was a sudden increase in absorption and strong morphia action resulted. Warnings were given concerning over-dosage, and the dosage given was recorded clearly on the Field Medical Card, and also often on the patient's forehead in grease pencil, the exact dose and time of administration being given. Intravenous administration was found to be much more efficient, and smaller doses were given, ⅛ gr. generally, and repeated if necessary. The danger of accumulated dosage was much less than when given subcutaneously.

Syrettes were available for personnel in tanks and armoured vehicles, but not for the infantry. The dosage was ½ gr., which was considered too large, and one RMO instructed his stretcher-bearers to give only half the dose. He made a strong plea for the supply of syrettes to all ranks and for ¼ gr. dosage. Bottles of morphia solution were very useful to the RMO, especially if away from his RAP.

Morphia was only required for the more serious casualties associated with severe pain and restlessness, and for bleeding that was profuse or suspected internally. It was contra-indicated in head cases so as not to mask the signs of cerebral injury.

(d) Relief of dehydration: There was always lack of fluid, and dehydration was sometimes very marked, especially in those cases associated with considerable loss of blood. This was met by the regular provision of hot drinks, generally sweetened tea, which was liberally provided for all cases fit to take it, with the exception of the abdominals. In the desert campaigns scarcity of drinking water at times prevented the giving of adequate quantities of fluid.

(e) Resuscitation: In both Italy and in the Western Desert evacuation was generally so well arranged and the distances to cover, both in miles and in time, were so short that there was no great necessity for routine urgent resuscitation in the RAP. The patient was better served by rapid dressing of wounds and control of blood loss and rapid evacuation to the ADS, where facilities for resuscitation were so much better and the patient freed from the atmosphere of being still in the line. Rapid evacuation to the ADS, with the patient warmly wrapped in blankets, of which there was always an abundance, and hot-water bottles, was generally greatly to be preferred to resuscitation in the RAP.

However, in those cases where it was not wise or expedient to evacuate at once, as when the patient had been a long time wounded before it had been possible to bring him back to the RAP, and was in poor condition—or when the line of evacuation was too dangerous at the time—resuscitation could always be carried out, much the more easily in Italy than in the desert, as in Italy the RAP was generally established in a building of sorts, so that warmed blankets and hot-water bottles and hot drinks were available and ready for any casualty.

Plasma or blood could readily be given, at the risk of inadequate asepsis at the site of transfusion, but one was never informed of any sepsis having occurred at the site of needling. A good supply of plasma, both wet and dry (this latter more commonly in the later stages of the war), was always carried, and blood was sometimes available through the excellent offices of the Transfusion Service, and was given on rare occasions. In the main the standby at the RAP was plasma, and for ease of transport and convenience, as well as for the prevention of waste, the dry plasma was preferred. The distilled water was changed frequently if not used.

The issue transfusion apparatus was admirable, being simple to work and very efficient in action, and the RAP sergeant was trained in the setting up of the apparatus, so that all was ready for the insertion of the needle in the minimum time.

Sites of 1 NZ CCS and NZ General Hospitals during Campaign in Italy

Sites of 1 NZ CCS and NZ General Hospitals during Campaign in Italy

Resuscitation was far better carried out at the ADS, but in those cases where evacuation was for some reason or other delayed, then the RMO could do a great deal. If decision was taken to resuscitate at the RAP, then it was important not to evacuate the patient too soon after the resuscitation had been begun, but to wait until he had recovered as far as seemed possible before evacuation was undertaken, even if the circumstances that had delayed evacuation had passed.

(f) Primary Dressings: The routine consisted in wide exposure of the area, cleansing by soap and water of the surrounding areas of skin, and the application of an antiseptic such as iodine. Rough toilet by removal of gross contaminants and foreign bodies from the exposed wound was carried out and then a powder insufflation of sulphanilamide powder by means of an insufflator made in the Engineers' workshops. An average of 5 grammes of sulphanilamide powder was used in a large wound and lesser amounts in smaller wounds. Then a vaseline gauze, or tulle gras dressing, and pad and bandage was applied.

For small wounds the field dressing on issue to all ranks proved ideal, and for larger wounds one or more shell dressings as were required. These supplied pads, but much more bandage was necessary in cases of bleeding in order to obtain sufficient pressure, and crepe bandages were very useful for this purpose.

(g) Injection of Anti-tetanus Serum: This was given in doses of 3000 units to all wounded men. All members of the force had been originally given doses of tetanus toxoid.

(h) Records: The AF 3118 (the Field Medical Card) was carefully filled in with all essential details of the wound and the treatment, and the envelope containing the card was tied to the patient's clothing. Details of morphia dosage given were especially noted and warnings given of any threatened complications such as haemorrhage.

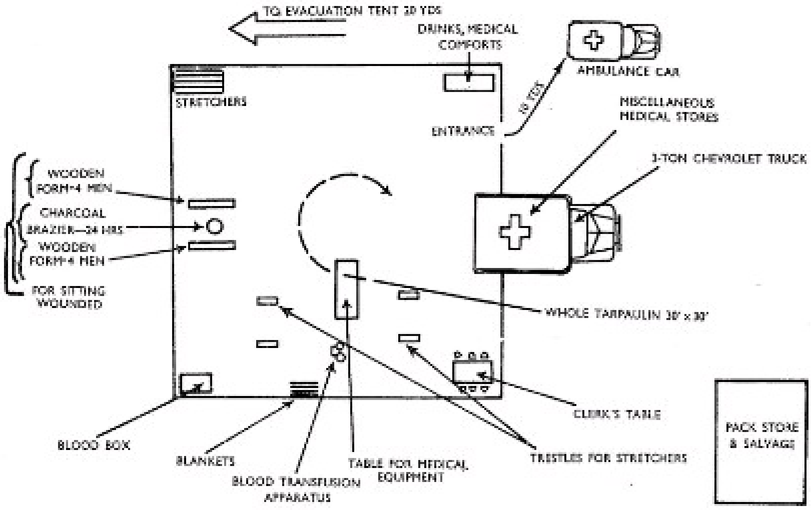
The Advanced Dressing Station

This was still essentially a first-aid treatment centre and evacuation post. No operative treatment was carried out except as an absolute emergency.

(a) Dressing of Wounds: If this had been adequately carried out at the RAP nothing more was required unless there had been some fresh bleeding or the dressings needed adjusting. The same dressing routine was used as in the RAP.

(b) Haemorrhage: Control by pad and bandage was again relied on as the routine. The remarks concerning the tourniquet still applied and operative exposure and ligature was undertaken only in very exceptional circumstances.

(c) Splintage: This was normally applied to all fractures and also often to severely wounded limbs without fracture. For the arm Kramer splinting or plaster was generally used. For the lower limb the Thomas splint was applied for fractures of the thigh and knee, elastoplast extension to the leg being often used if time permitted, and was much to be preferred. Otherwise the boot was used for fixation, either utilising bandage or preferably special heel clamps. As long as extension was not aimed at little disturbance to the foot was caused, provided skin traction was substituted at the MDS or CCS. If extension was attempted, however, sores were caused on the dorsum of the foot and at the ankle. For the leg Kramer splints and plaster were used.



PLAN OF ADS RECEPTION TENT, 6 NZ FIELD AMBULANCE, CASSINO

PLAN OF ADS RECEPTION TENT, 6 NZ FIELD AMBULANCE, CASSINO

(d) Amputation: Traumatic amputation was at times completed at the ADS, but operative treatment was left till the patient reached the forward operating unit.

(e) Resuscitation: Measures used were similar to, but more elaborate than, those described under treatment at the RAP. Warmth was provided by means of blankets, and warm fluids were given by the mouth. Wet and soiled clothing was changed. Plasma and serum were generally available and were given to serious cases. Blood was at times available in small quantities and was given to cases with marked bleeding. An in-ambulance drip transfusion was utilised during evacuation to the MDS, special supports being made to clamp on to the stretchers. Plaster bandages were used to keep the needle in place and the arm steady. Morphia was given as required.

(f) Records: There was usually time to write full details on the Field Medical Card, and special types of cases were sorted out. It was generally possible to do a primary sorting of cases—a great help to the next units on the line of evacuation. Cases were sorted into:

A. Abdomens, bleeders, and sucking chests.

B. Amputations, fractures with swelling and bleeding, joint injuries, large flesh wounds, especially with swollen limbs and situated in the buttock, thigh, or calf.

C. Heads, eyes, jaws, and spines.

D. Lightly wounded.

An indication was generally given that further inspection and dressing was unnecessary, or that complications were feared and inspection required.

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[1] Plaster-of-paris.

THE WORKING OF A FORWARD SURGICAL UNIT SITED AT AN MDS OR CCS

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The Pre-operative Ward

Trestles for a total of thirty stretchers were required for a CCS in the pre-operation ward, with overflow capacity of about the same number for exceptional rushes. The original number was practically always sufficient if two tables were working continuously and if cases were kept on the move and shifted to the wards, either when operation was not deemed advisable or to await operation after all resuscitatory and other preliminary treatment had been carried out. One special ward handy to the theatre was selected, where cases awaiting operation could be housed, the names remaining on the pre-operation list and the cases sent for from the theatre as required.

It was here that the major cases were sorted and thoroughly examined, under conditions of adequate lighting and facilities for the dressing of wounds and thorough cleansing of the patients. Wounds were inspected, and those details necessary for the guidance of the operating surgeon were noted. If no surgery was to be performed, an adequate description of the wounds was given for the information of subsequent units. Abdomens and chests were examined carefully, and head and spinal wounds investigated.

Transfusion and X-ray

A transfusion team was absolutely essential for resuscitatory measures and for advice concerning the suitability of the patient for operation. An X-ray plant, when available, was set up, usually in, or alongside, the pre-operation tent or hut, so as to be readily available for investigating the doubtful cases. The types normally requiring X-rays were:

(1) Abdominal injuries, especially those of a doubtful nature.
(2) Head and spinal cases.
(3) Injuries in relation to joints, especially the knee joint.
(4) Doubtful fracture cases.

Some difference of opinion arose during the war as to the value of X-ray examination, but experienced surgeons found it invaluable in doubtful cases, especially in injuries about the diaphragm and loin. Many abdominal operations were saved because of the information obtained.

Orderlies: These were trained in the careful handling, in the removal of clothing from, and the washing of the wounded. They became adept in the rapid and gentle handling of serious cases and in the application of splints and the preparation of cases for operation.

Lists of Cases for Operation: This was kept in order of urgency. It needed constant readjustment as more serious cases were admitted or as cases recovered, following transfusion, sufficiently to withstand operation.

Resuscitatory Measures: These have already been discussed elsewhere, but consisted essentially in rest, moderate warmth, warm drinks, and the essential measure of blood and plasma tranfusion.

Types of Cases for Early Operation: The priority of operation did not remain stable during the war. At first the order of priority was:

(1) Bleeders.
(2) Sucking chests.
(3) Abdominals.
(4) Large flesh wounds.
(5) Heads.

The abdominals did badly in the early campaigns owing to the mobile warfare and the difficulty of getting them back to the relatively immobile CCS. This led to the employment of the MDS as an operating centre for these cases, and it was proved that cases could be saved in this way, but early evacuation proved disastrous.

At first head cases were dealt with early, but then they were sent back to the base unit in Cairo as non-priority cases.

The sucking chest was always a first priority case, whether it was dealt with by pad and strapping or by operation. Large flesh wounds were at first dealt with after the abdomens, and were often sent back to the CCS while the abdomens were dealt with at the MDS. Then it was realised that severe muscle wounds, and especially the traumatic amputation cases, steadily deteriorated and could not be resuscitated, in spite of transfusion, till operative removal of the traumatised tissue had been undertaken. These cases then became first priority. The abdominal cases, on the other hand, were found to do better if a longer period was given for them to recover from their original shock, and a short period of rest quite apart from the transfusion was of great benefit to them. It was also realised that the abdominal cases did not die of infection but of shock, and that most of the mortality occurred in the first twenty-four to forty-eight hours.

There was a difference of opinion as regards the amount of bleeding in these cases, and many held the view that as a rule little bleeding took place. However, our experience was definite that in about half the cases there was a considerable quantity of blood in the peritoneal cavity, and that in a few cases bleeding from mesenteric vessels was severe. However, the majority of the abdomens could be left several hours to recover before operation, provided a close watch was kept and no suspicion of continued bleeding was present. The change of priority made it desirable for the abdominals to be dealt with at the CCS level, and the serious tissue wounds and the traumatic amputations took their place at the MDS level.

All wounds except small perforating wounds unassociated with any swelling, or small spattered wounds, needed surgical treatment for the removal of the traumatised tissue. The wounds of the different areas and structures are dealt with under other articles.

Technique in the Operating Theatre

This was generally of the simplest kind. The patient was lifted on his stretcher on to the operation table or on to trestles and the operation performed without shifting him from the stretcher. Generally another table or trestle was used for preliminary treatment before operation, or more commonly for the preparation of another patient who could be got ready for the surgeon pending completion of operation at the first table.

It was usual for the surgeon to don a mackintosh overall, a cap, and a face mask—the mask being considered the most important part of the technique. Plain soap and water was used for skin cleansing, and shaving was freely utilised, both as a preparation for adhesive strapping extension and for cleanliness. Iodine was the usual antiseptic skin application.

Gloves were worn by some surgeons as a routine, sometimes being changed for every operation, and sometimes the gloved hand was cleansed between operations. Other surgeons used gloves only in septic cases. For abdominal operations the full surgical technique, with donning of sterile gowns and gloves, was carried out.

As regards guards, the custom varied. Some surgeons used the ordinary sterile linen guards sparingly. Others used mackintosh and rubber guards, boiled or otherwise sterilised between operations. The washing of guards and gowns was, of course, a difficult procedure in forward units, and at times the supply of water rendered washing impossible.

Note Recording at Operation

At the conclusion of the operation the surgeon himself immediately filled in the details in the operation book and also on the Field Medical Card AF 3118, and, if he so desired, also filled in a follow-up card by means of which he could ascertain the later progress of the case at the Base. Clear directions had to be given so that nothing was overlooked later during evacuation. If any dangerous complication might arise, such as bleeding, warning had to be given. The time of wounding and of the operation had to be noted.

Morphia, ATS, and sulphonamide and penicillin dosage were also noted. Specialist cases to be referred to special centres were clearly marked with special tabs. Dangerously and seriously ill cases were marked DI or SI. Illegible and incomplete notes were liable to add serious risks to the patient's life or satisfactory progress. A sketch of the wound and fracture, if any, was made with indelible pencil on the plaster splint, and other details were also added. This recording was rightly considered of the greatest importance, and the essential details were printed in bold letters, as was the name of the surgeon.

Resuscitation in the Forward Areas

Rest was a prime necessity, as was also the maximum comfort that could be given. Warmth was only desirable in as far as it gave comfort. Any excessive heating had been proved deleterious, especially before full replacement of blood volume had been carried out.

The restitution of blood volume by blood, plasma, and serum was the most important factor in resuscitation. Blood had been proved to be essential when blood loss had been severe and the haemoglobin content had been markedly lowered. Plasma and serum were of value as supplements to blood and in cases not associated with actual blood loss, but with loss of serum, as in burns and blast. Fluids by the mouth, especially warm fluids, were of great value in all except abdominal cases. The gentlest method of handling in transportation had to be utilised.

Continuing shock from active bleeding, and absorption from mangled tissues and infected, especially anaerobic, tissues had to be noted, and time had not to be lost in resuscitation when operation alone could relieve the condition. Post-operative resuscitation was often neglected and was often as important as treatment before operation. Plasma or serum could be given in the RAP and ADS with great benefit in serious cases, and the continuance of this transfusion in the ambulance during transportation to the operating centre proved of very great value.

Post-operative Care

The general comfort of the patient was very important, and the provision of hospital beds instead of stretchers made considerable difference to the comfort of patients in front-line units. It was impossible to nurse chests and abdomens well on a stretcher.

Fluid was of first importance, as the wounded were always dehydrated, and copious fluid, if possible by mouth, saved much more elaborate medication. The warmth of drinks was also of value in itself. Chest cases were sat up as soon as possible.

Skin attention was necessary, especially in spinal cases and for those in plasters or splints. Plaster splints had to be constantly watched to prevent constriction of the limb and pressure sores. Gangrene easily ensued, and ischaemic paralysis developed, if tight plasters were not cut up and adjusted.

The ring of Thomas splints had to be watched to see that undue pressure was not being exerted on the crutch or on the tuber ischii. The external aspect of the ring of the splint had frequently to be padded to make it fit the limb more accurately. Pressure on the back of the heel and cutting-in of strapping just above the ankle were common troubles.

Fractured jaw cases and severe facial and neck injuries demanded constant attention.

Heads: Head cases, so frequently semi-delirious, took up much of the time of the harassed sister in the ward. Immediate postoperative treatment generaly consisted of sedatives, such as paraldehyde.

Chests: If respiratory distress was marked, early tapping of the haemothorax or haemo-pneumo-thorax was indicated. At first air replacement was used during the first twenty-four hours as a preventative of fresh bleeding, but this was later given up as unnecessary and undesirable. Later, early tapping became a routine in all cases whether distressed or not, and this was repeated frequently till the chest became clear.

Abdomens: These were at first nursed in the Fowler's position, but towards the latter part of the war this was given up and the cases nursed flat. This gave more comfort and also fewer chest complications. Gastric suction and intravenous fluid remained the routine throughout the war, but fluid by the mouth was introduced, first of all simple fluids, and then definite nourishment was given in the majority of the cases, even when the gastric suction was still being utilised.

General Cases: Further resuscitation with blood or serum was commonly required, and was given more frequently in the latter part of the war.

Essentials of Treatment of Special Types of Cases

1. Ordinary Limb Wounds: Adequate exposure of the wounded surface, especially in the depth of the wound. Removal of all devitalised tissue which does not necessitate damage to vital tissues. Preservation of bone fragments. Removal especially of damaged and avascular muscle. Relief of tension and provision of drainage. Application of bacteriostatics and antibiotics, such as sulphanila-mide and penicillin, to the wound. Dressing to ensure the wound being left open. Provision of rest by splintage, generally plaster, more elaborate if a fracture be present. The plaster splints padded, and split before evacuation.
2. Head Cases: Referred to forward neurosurgical centre for operation. Details given under head surgery.
3. Chest Cases: Wounds, except simple penetrating or perforating wounds, excised with removal of rib fragments. Sucking wounds closed by pad stitched in place, after the muscular layer had been sutured to close the chest. Early tapping of the chest carried out with introduction of intra-pleural penicillin. Details given under chest surgery.
4. Abdomens: Careful resuscitation before operation with urgent operation only in those cases not responding and deemed to have continued bleeding. Routine catheterisation before operation. Suture of small intestine and stomach wounds. Exteri-orisation of large intestine except healthy wounds of the right colon. Drainage for bile and rectal injuries, and when in doubt and always in retro-peritoneal areas. Infrequent operation in liver and kidney injuries. Routine post-operative gastric suction and intravenous salines and glucose, with fluids by the mouth. Nursing flat on back for first forty-eight hours.
5. Spines: Suprapubic drainage for paraplegic cases.
6. Burns: No operative measures. Treatment of shock by plasma and simple dressings. Parenteral penicillin.
7. Traumatic Amputations and Gross Muscle Injuries: Early and radical operation with free excision of damaged muscle and other tissue, not waiting for full resuscitation.
8. Amputations: Should preserve as much limb as possible, except that in the lower limb the amputation should be at least three inches above the ankle to prevent a possible unnecessary re-amputation later. The same applies in lesser degree to thigh and arm amputations. Flaps should be fashioned if at all possible so as to enable delayed primary suture to be done four days later.

Factors Governing Time of Evacuation

Patients from the forward areas were normally evacuated at the earliest possible moment. As soon as a patient had recovered from his anaesthetic he could be transferred by ambulance. There were certain types of cases that had to be retained. There were never enough of these cases to embarrass the forward operation centre. There were:

1. Cases Unfit to Travel, whatever the lesion. Resuscitation by blood and fluids could, within a relatively short time, render most cases fit to travel. Naturally the distance, and the type of transport, influenced the decision as to fitness.
2. Abdominals: Were held at the site of operation for from ten to fourteen days. Experience conclusively proved the life-saving value of this procedure. No abdominal case was evacuated till it was definitely stabilised and free from either wound or peritoneal infection.
3. Chests: Severe chest cases associated with dyspnoea and cyanosis were often quite unfit for travel, and often had to be held for several days. Aspiration, blood transfusions, and rest enabled them to travel later.
4. Burns: Severe burns cases were often too shocked or too toxaemic to travel, and had to be held for some days.
5. Anaerobic Infection: Gas gangrene and severe anaerobic infection of wounds necessitated holding till the condition stabilised, so as to avoid change of surgeon and ensure careful watching.
6. Haemorrhage: Serious danger of haemorrhage necessitated retaining the patient for observation.
7. Gangrene: Impending gangrene, following vascular injury, required the retention of the patient till the position was clarified. 'Half alive on the field is better than dead at the Base' (Donald).

On the other hand:

1. Head Cases travelled very well, the only bar being extreme restlessness, making handling during transit impossible.
2. Chest Cases, if they had no distress in breathing, travelled comfortably.
3. Spine Cases travelled satisfactorily.
4. All Fractures travelled well if splinting was well done.

Evacuation of Cases from the Forward Operating Centres

In the earlier campaigns in the Middle East, with the rapid movement, the evacuation of casualties was very difficult and entailed often long and rough desert and road transportation. The lack of mobility of the CCS also threw the forward operating work on to the Field Ambulances, and this necessitated rapid evacuation so as not to hamstring the field medical units, which perforce had to keep up with the Army. This early and prolonged evacuation of the serious cases had serious effects as regards the survival of abdominal and other casualties.

In Greece train evacuation to Athens was available in the early stages, but during the retreat long ambulance carry was necessary; fortunately the casualties were light. In Crete sea evacuation was available, but only in the early stages of the campaign.

During the second Libyan campaign the difficulties were extreme and the New Zealand casualties were captured during the critical stage. Even when relieved the convoys had to traverse long distances of rough desert before reaching the railhead behind the frontier, where adequate resuscitation was first available. The condition of many of the casualties when they reached 2 NZ General Hospital at Gerawla was that of extreme exhaustion, and often dehydration following the long period of marked restriction of water supply. Few abdominal cases were seen at the Base—a silent commentary on events.

From the railhead area some cases were evacuated by air, and some also by the coastal road with staging posts set up on the way to the Delta. The difficulties of looking after casualties with the many changes of medical units on the long route of evacuation were realised. It was appreciated that constant changing of dressings was undesirable, as was the constant shifting of seriously wounded men.

During the pre- Alamein and Alamein periods the evacuation route was short, and means of transport by road, rail, and air were all available. Air transport was very gradually introduced in the desert. At first use was made of the return journey of supply planes, and ihese were used in the second Libyan campaign. These planes were subject to enemy attack, and several were shot down. Strong efforts were made to obtain ambulance planes, but aircraft-were in short supply and could not be spared for this purpose. The South Africans and the Australians supplied the first ambulance planes in the desert, and these were available at the Alamein period, but the ordinary supply planes still carried the majority of the patients. Air transport was utilised both to take head cases to base hospitals for their primary surgical treatment, and also to evacuate serious cases, including abdominals, shortly after operation. This proved quite unsuitable for the abdominal cases, and many of these patients died shortly after arrival at Cairo. Major-General Monro, Consultant Surgeon

MEF, drew attention to this, and a conference held in our divisional area recommended that in future all abdominals should be held in the forward areas for ten days before evacuation to the Base, and that other seriously ill cases, such as chests, should also be held till deemed fit to travel. The recommendation was immediatefy adopted and beds were supplied for abdominal and other serious cases to the forward units, both the Field Ambulances and also later the FSUs. Head cases were not affected adversely by air transport.

During the advance from Alamein to Tunis at first road and rail transport was utilised, but later, as the distances increased, air was used increasingly, transport planes being employed on their return trip to the advanced bases, such as Tobruk, to which the railhead had been extended. Medical units were commonly sited near the airfields. Fortunately casualties were light, so that the majority of the serious cases were able to be carried quickly back by air.

Air transport was particularly useful during the left hook at Mareth when our own ambulance personnel constructed a landing ground alongside our Field Ambulance centre, thus enabling the evacuation of serious cases when the road access was in the hands of the enemy. Sea transport was utilised from Tobruk, Tripoli, and Sfax.

In Italy motor ambulances were largely used, rail services being seriously dislocated by the German demolitions. The railways were rapidly repaired, however, and gradually came into use, and they carried out the greater part of the long evacuations. Air also came more into the picture, and, with complete dominance in the air, safety was ensured; as the length of evacuation steadily increased, more and more casualties were evacuated by air. Finally, hospital ships were utilised both from Anzio, and later from Ancona on the Adriatic coast.

In general, for short distances ambulance transport remained the routine method. For intermediate distances the ambulance train was used, whilst for long distances air transport was supreme. The hospital ship was again the most useful method of transporting large numbers over long distances, such as from the Middle East to New Zealand. It was also useful for intermediate distances in the Mediterranean, but was at times subjected to danger from bombing and mines, even though the Geneva Convention was adhered to by the enemy.

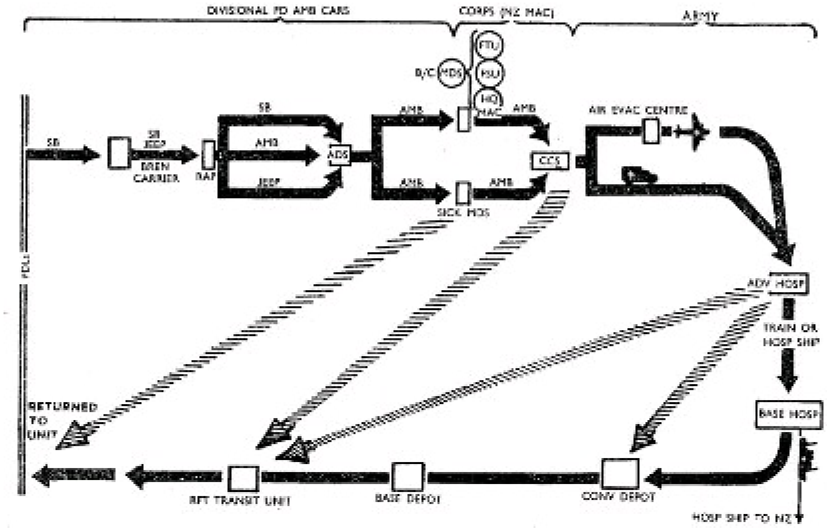

DIAGRAM OF CHAIN AND METHODS OF EVACUATION, ITALY, 1944

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Analysis of Methods of Transportation

The Effect of Transportation by Road: This was never comfortable, and on rough roads could be very uncomfortable and distressing. The movement had a deleterious effect on all wounds, and it was for this reason that wounds could not be sutured in the forward areas, and why splinting was so necessary even when there was no fracture.

Air: The only difficulties with air transport were: (a) the road to the aerodrome was often very rough; (b) some uncertainty as to the exact time of the evacuation; (c) in some planes ordinary stretchers could not be used, and the patients had to be shifted on to the stretchers and back again at the end of the flight; (d) if the plane had to fly high, some extra distress was caused to chest cases.

Apart from these relatively minor difficulties, air transport, especially for long distances, was ideal, and was responsible for great improvement in the comfort of patients, and also must have contributed to a decrease in mortality amongst the very severely wounded cases.

Train: Patients could be transported long distances by train very comfortably, and this was the best practical method for large numbers.

Ship: Travel by sea had the advantage that operative measures could be carried out during transit.

FORWARD SURGERY IN 2 NZEF: BY CAMPAIGNS

FORWARD SURGERY IN 2 NZEF: BY CAMPAIGNS

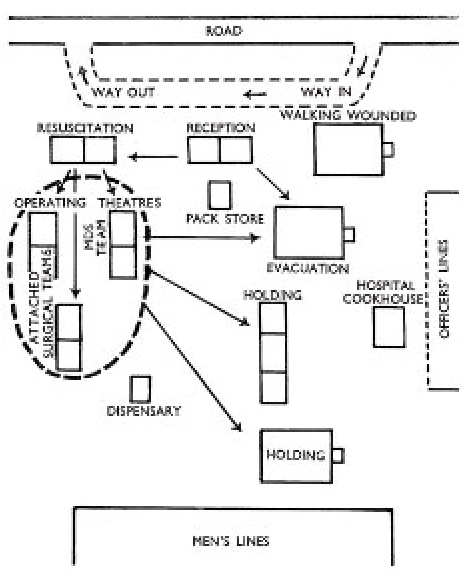
Greece: In Greece comparatively little forward surgery was carried out by our medical units. During the early stages of the fighting our casualties were dealt with by ⅔ Australian CCS and 24 British CCS, and then sent on either to 1 NZ General Hospital at Farsala or to 26 British General Hospital at Athens. At the Thermopylae line 5 MDS did some operating at the Greek Hospital.

Crete: Forward surgery was carried out to some extent by 5 MDS in Crete and also by 7 British General Hospital, and by our surgical team attached to 7 General Hospital and later to 189 British Field Ambulance, cases being referred back from the Field Ambulances.

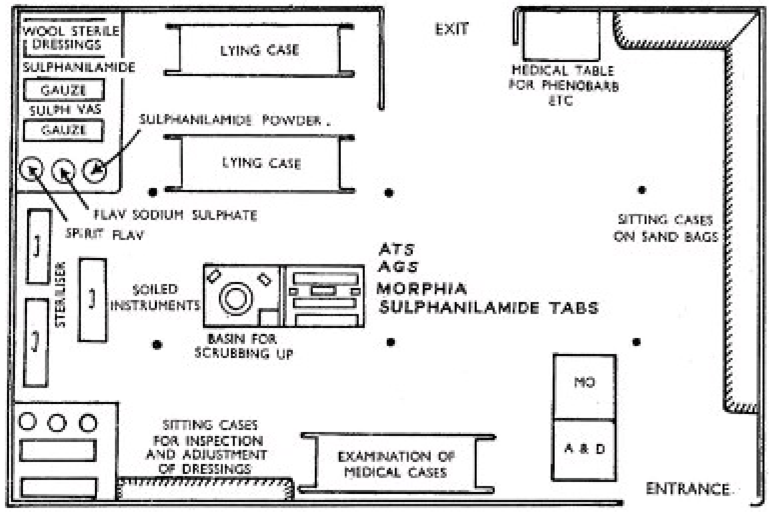
Second Libyan Campaign: The Mobile Surgical Unit did a considerable amount of surgery, including abdomens and heads. A certain amount was also done by the MDS of the Field Ambulances. The L of C [1] units were a considerable distance back and evacuation was always difficult, and was impossible for ten days after the MDS area had been captured by the enemy. The shortage of water created serious difficulties and hardships, as did shortage of plasma and crystalloids. Evacuation of cases after operation over long stretches of rough desert militated against the recovery of serious cases, and few abdominal cases survived the ordeal.

Pre- Alamein: The organisation of forward surgery had been developed and FSUs and FTUs were available for attachment to both Field Ambulances and CCSs. The 2nd NZEF now had a well-equipped CCS, buttressed by the excellent equipment of the MSU. The first New Zealand surgical team was attached to the active MDS, and British FSUs were also attached to our forward medical units. The Blood Transfusion Service was operating well with blood freely available. The FSUs were well equipped, some even with specially constructed mobile operating vans. The lines of evacuation were short and both road and rail, as well as some air, transport were available.

Alamein: For this battle there was a well-planned organisation. A cluster of Field Ambulances was operating around Alamein itself, two being placed underground and others on the sea coast and alongside the rail and road. With these were FSUs and FTUs. Our own active MDS was alongside the railway and had attached to it our own FSU and FTU and received cases from active ADSs. First priority cases were dealt with, including abdominals. Further back at Gharbaniyat were a group of CCSs, including our own CCS as well as a British and Australian and Indian CCS. These were sited on a road inland to the main coastal road, with a British Field Ambulance stationed in front of them to sort out the cases, treat and evacuate to the Base the lighter cases, and distribute the heavier cases and those requiring surgical treatment in an ordered plan to the different CCSs. Our CCS did not restrict its work to our own personnel, but took its turn in the more or less even distribution of the casualties as they came along the medical route of evacuation. With the MDS it was different as our ADSs evacuated our own cases directly to our MDS.



LAYOUT OF MDS OF 5 NZ FIELD AMBULANCE, BATTLE OF ALAMEIN, 24 OCTOBER 1942, when unit admitted 839 casualties in 24 hours



PLAN OF MDS RECEPTION DEPARTMENT, 5 NZ FIELD AMBULANCE

PLAN OF MDS RECEPTION DEPARTMENT, 5 NZ FIELD AMBULANCE

Field Ambulances were protected in some cases by underground dressing stations and the CCSs by the digging in and dispersal of tents. The tents were officially supposed to be 100 yards apart, and the distance was such that ambulances were used at times to carry patients in the hospital area.

From the CCS evacuation was arranged by motor ambulance to Alexandria, where many cases were referred for primary surgery in rush periods; by train to the Delta and Canal for cases not requiring any urgent treatment and those already operated on; and by plane for special cases, such as head cases, to special centres in Cairo. By that time it had been learnt that air transport was unsuitable for all seriously ill cases except heads, and especially unsuitable for abdomens for at least a week following operation.

A list of operations undertaken by a single operating team during the first fortnight of this period was:

Nature of Injury	Total Cases	Percentage
Compound Fractures of Limbs	61	37.5
Amputations	8	5.0
Wounds of joints	12	7.5
Shell wounds of soft parts	19	12.0
Abdominal (including three abdominothoracic and 15 non-penetrating)	40	24.5

Chest	3	1.85
Heads	3	1.85
Burns	4	2.4
Clinical gas gangrene	4	2.4
Sick	8	5.0
	162	100.0

Our own CCS dealt with 2203 battle casualties and 2928 other cases, a total of 5131 cases, with 41 deaths, in the period 1 October to 31 December 1942.

The Advance to Mareth: Casualties were slight during this period, largely consisting of mine wounds from the minefields and the scattered mines placed all along the route by the Germans. The forward operating units leapfrogged each other during the rapid advance, and a team from the NZ CCS was attached to one of these units, 151 British Light Field Ambulance. As our advance continued our Air Force got much the upper hand and wide dispersal of the medical units became unnecessary. Air transport was developed markedly at this period, and forward landing grounds were set up close behind the advancing troops. A section of a field ambulance was detached for duty at each landing strip. Air evacuation became the most efficient and the regular method, though the train was pushed through to Tobruk and was used for evacuation of casualties.

Mareth: Special arrangements were made to cope with the peculiar position of the left-hook force which was built round 2 NZ Division. This force was out of contact with the rest of the force as its line of evacuation was in the hands of the enemy for some time. Special arrangements were therefore made to provide an adequate surgical set-up in the Field Ambulances. The NZ FSU and the light section of the CCS and the NZ FTU were attached to the active MDS. Evacuation by air was arranged, the airstrip being constructed by our ambulance personnel. When the road became available an evacuation ambulance convoy, previously got together by Brigadier Ardagh, was rushed up to bring back the less serious casualties.

The CCSs were grouped at Medenine behind the coastal front, the NZ CCS being one of the two active units there, and one CCS was placed inland behind the outflanking force. From Medenine evacuation was by road to Tripoli with a staging area in between.

Mareth to Tunis: At Wadi Akarit grouping of CCSs was arranged as at Medenine. The grouping of CCSs was not carried out so well during the Eighth Army's later progress to Enfidaville. The CCSs moved separately, and behind Enfidaville the NZ MDS took over the great bulk of the forward surgery for some time as the CCS was too far behind at El Djem. Evacuation still took place by air, but at Sfax sea evacuation became possible. The layout of the medical units was stabilised, protection being effected largely by dispersal, though the gradual decrease of enemy air activity led to more efficient concentration of tentage.

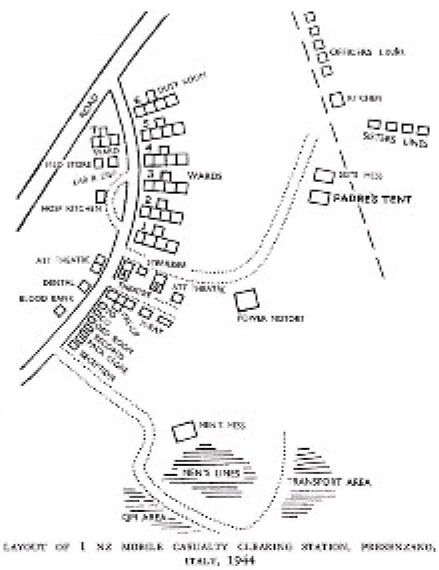
The Sangro: During the early period of this long-drawn-out battle the greater part of the surgery was carried out in the MDS, and at one time nursing sisters were utilised by one of the MDSs which had established their unit in a building in a small village from which evacuation was difficult. Our CCS, with two others, was established in Vasto within reasonable distance of the line, but the bulk of the surgery was still carried out at the MDS. A special neurosurgical unit was available in a British CCS at Vasto. Evacuation from Vasto was by a rather bad road to railhead at Termoli, where two British CCSs were stationed.

Cassino: The NZ CCS was well placed at Presenzano on a good road and near enough to the line to make it the natural forward operating centre, only urgent cases being dealt with by our MDSs? Neurosurgery could be undertaken at an American Evacuation Hospital quite close to our CCS, and we availed ourselves of its excellent service. Road evacuation to our hospital at Caserta and British hospitals at Naples was satisfactory, and an ambulance sorting post was instituted at Capua to distribute the casualties to the different hospitals and special centres.

Florence: Our CCS was stationed at Siena well forward, but nevertheless our active MDS, with our New Zealand surgical unit attached, carried out a considerable amount of forward surgery, and the CCS suffered depletion of its surgical staff.

Evacuation was difficult as there was a long ambulance route to Lake Trasimene where air evacuation was carried out. British CCSs acted as staging posts half-way to Trasimene and also on the northern shore of the lake. Special centres of neurosurgery and facio-maxillary and opthalmology were arranged at one of the British units at Trasimene. An ambulance centre was arranged at the aerodrome to muster and tend the casualties.

Rimini Battles: Here, for the only time in Italy when the Division was in action, our CCS was not functioning, and we supplied a surgical team to a Canadian CCS which was carrying out the forward surgery for our troops. A certain amount of this work was carried out in our MDSs. Evacuation was by road and also by air, as airstrips were constructed steadily as the line moved forward. Sea evacuation was also arranged from Ancona to Bari.



LAYOUT OF 1 NZ MOBILE CASUALTY CLEARING STATION, PRESENZANO, ITALY, 1944

River Battles: Our CCS was now functioning satisfactorily in a large building at Forli, and the greater part of the major surgery was carried out there. The MDS carried out surgery on first-priority cases such as traumatic amputations and severe muscle wounds, and also in minor wounds. The abdominals were dealt with at the CCS. The trinity of neuro, ophthalmic, and facio-maxillary surgeons was functioning very satisfactorily in a small 400-bed British hospital at Riccione, and all special cases were sent there. Evacuation was by road and rail to Senigallia, where our 1 NZ General Hospital was established, British units acting as staging posts on the way. Air and sea evacuation was also available to our 3 NZ General Hospital at Bari. The arrangements were almost ideal.

The Advance to Trieste: Very little surgery was necessary during the rapid advance. A detachment of 2 NZ General Hospital was utilised at this period to reinforce the CCS. The CCS was first moved to north of Bologna, then to Mestre, near Venice, and finally to Udine. Evacuation was carried out by road to the railhead at Forli and later by air to our hospitals at Senigallia and Bari.

[1] Line of Communications.

STATISTICS

The casualties sustained in the different campaigns are shown in the following tables. These show very clearly the severe effect on our Force of the early battles, associated with the loss of many men as prisoners of war. There was a relatively large number of men who died of wounds in these battles, where forward surgery had to be undertaken under difficult conditions. From Alamein onwards there was a steady improvement in the ratio of 'died of wounds' to 'wounded who recovered', until the ratio was 1 to 20 in the final battles in Italy, when forward surgery was carried out under the best conditions.

It is difficult to correlate the improvement with any one cause, but the better facilities for the performance of good surgery must have had a marked effect on the results, quite apart from any improved technique and the use of penicillin. It has to be noted that there is a marked difference in the chances of recovery of the wounded man according to whether the army is advancing victoriously or suffering a heavy defeat.

The table of the regional classification of wounds in 2 NZEF covering the greater part of the war shows clearly the relative numbers of the different types of wounds that required treatment. It provides a guide for administrative planning and the provision of specialist surgical teams and equipment and medical supplies, as well as accommodation for the wounded. It shows clearly that the great bulk of the wounded who survive suffer from limb injuries. If a classification could be made of all the wounded (including those killed in action and dying of wounds) it would be found that the proportion of limb injuries would be appreciably lowered, as a much larger proportion of those wounded in the trunk and head die from their wounds, either on the battlefield or later in medical units.

Examination of detailed reports of the deaths in action of 82 New Zealanders in Tunisia reveals that the main injury in each case affected the following regions of the body: head 26, chest 32, abdomen 12, other areas 5, and multiple injuries 7.

The series is small, but it can be regarded as fairly typical of the injuries that cause almost immediate death on the battlefield.

2 NZ DIVISION

2 NZ Division

Killed and Wounded by Campaigns [1]

Campaign	Killed in Action	Died of Wounds	Wounded	PW Died of Wounds	Wounded	Total
Greece	180	50	371	25	225	851
Crete	507	136	1039	31	496	2209
Libya, 1941	671	208	1699	5	201	2784
Battle for Egypt	587	313	2414	36	247	3597
Alamein-Tripoli	335	123	1527	1	5	1991
Tunisia	316	71	1297	2	9	1695
Sangro	298	101	1116	4	16	1535
Cassino	340	114	1823	2	7	2286
Florence	227	71	896		4	1198
Rimini	180	44	878		8	1110
Faenza	141	52	847	1		1041
Senio-Trieste	183	59	1145			1387
	3965	1342	15,052	107	1218	21,684

Ratios (approximate)

	Killed and Died of Wounds to Wounded (incl PW)	Died of Wounds to Wounded (not incl PW)
Greece	2:5	1:8
Crete	2:5	1:8
Libya, 1941	1:2	1:8
Battle for Egypt	1:3	1:8
Alamein-	1:3	1:12

Tripoli		
Tunisia	1:3	1:12
Sangro	1:3	1:12
Cassino	1:4	1:12
Florence	1:3	1:12
Rimini	1:4	1:20
Faenza	1:4	1:20
Senio-Trieste	1:5	1:20

The second column (died of wounds to wounded) indicates an improved recovery rate for wounded as war medical science progressed and as lines of evacuation became more favourable. (If prisoners of war are included the only changes are that Crete and Libya become 1:9 instead of 1:8.)

Analysis of the first column must take account of other complications, but severity of injury resulting in death (immediate or postponed) seems to have decreased as balance of power in armour, air force, and artillery swung from the enemy to us.

Survey of Causes of Wounds and Types of Wounds in Casualties of 2 NZ Division, 20 June to 31 July 1942

(Deaths not included)

Cause of Wound	
GSW	450
SW	477
Air bomb	277
Mortar	4
Crushing	3
Bomb and shell blast	37
Mines, etc.	64
	1312

Site of Wound

head—	
Concussion	39

Contusions and simple wounds, scalp	37
Fractur cranium	4
Penetrating cranium	9
Penetrating eyeball	8
Contusion, eyeball	2
Enucleation, eye	3
Ear	5
Ear, with rupture tympanic membrane	12
face—	
Simple flesh contusions and wounds	26
Fracture mandible	2
Fracture maxilla	1
neck—	
Simple flesh contusions and wounds	15
chest—	
Simple flesh contusions and wounds	53
Penetrating chest	37
Haemothorax	2
Pneumothorax	3
abdomen—	
Simple flesh contusions and wounds	7
Penetrating and perforating abdomen	8
back and spine	69
genital organs	13
upper extremities—	
Simple flesh contusions and wounds	280
Joint involvement	28
Compound fractures	50
Compound fractures, hand	33
Nerve injury	9
lower extremities—	
Simple flesh contusions and wounds	440
Joint involvement—	
Hip	4
Knee	27
Foot	8
Compound fractures—	

Pelvis	1
Femur	29
Patella	2
Tibia and fibula	35
Os calcis, tarsus	13
Phalanges	8
Nerve injury	7
	1329
burns—	
First degree	5
First and second	5
Second	11
Second and third	1
effects bomb blast (no traumatic injury)	15

Regional Classification of 5111 Wounds

			Percentage of Total Wounds
head—			
Fracture cranium	30	303	5.93
Penetrating cranium	43		
Concussion and contusions	165		
Eye	65		
ear—			
Rupture membrana tympani	152	205	4.01
Other	53		
face—			
Fractures	39	210	4.11
Flesh wounds	171		
neck—			
Flesh wounds	93	93	1.82
chest—			
Perforating	186	344	6.73
Non-perforating	158		
a bdomen—			
Penetrating and perforating	531	106	2.07
Fracture pelvis and lesions abdomen	18		

Flesh wounds	35		
back and spine—			
Fractures with lesions cord	5	250	4.89
Fractures without lesions cord	7		
Ilium	13		
Flesh wounds	225		
upper extremities—			
Simple fractures	26	1477	28.90
Compound fractures	418		
Nerve injuries	75		
Flesh wounds	958		
lower extremities—			
Simple fractures	58	2084	40.78
Compound fractures	483		
Nerve injuries	35		
Flesh wounds	1508		
burns	39	39	0.76
	5111	5111	100.00

Killed in action and deaths in medical units NOT included.

Note: A survey of 4991 wounds in 2 AIF in Middle East in 1941 produced similar figures regarding the parts of the body wounded: head, 5.09 per cent; face, 4.69 per cent; neck, 0.90 per cent; chest, 5.27 per cent; abdomen, 1.84 per cent; back and spine, 4.09 per cent; upper extremities, 26.43 per cent; lower extremities, 40.93 per cent; old wounds, 9.50 per cent; others, 1.26 per cent.

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[1] Compiled from Statement of Strengths and Losses in the Armed Services and Mercantile Marine in the 1939–45 War, Parliamentary paper H-19B, 1948.

2 NZEF MEF and CMF

Battle Casualties, July 1941—May 1945

Regional Classification of Wounds

			Percentage of Total Wounds
head—			
Fracture cranium	192	1628	8.13
Penetrating cranium	513		
Concussion and contusions	923		
eye—			
Enucleation	83	361	1.80
Other	278		
ear—			
Rupture membrana tympani	386	664	3.32
Other	278		
face—			
Fractures	149	913	4.56
Flesh wounds	764		
neck—			
Flesh wounds	407	407	2.03
chest—			
Perforating	839	1523	7.60
Non-perforating	694		
abdomen—			
Penetrating and perforating (of these, 313 had intra-abdominal lesions)	355	529	2.64
Flesh wounds	174		
back and spine—			
Fractures with lesions cord	19	769	3.84
Fractures without lesions cord	34		
Ilium	108		

Flesh wounds	608		
upper extremities—			
Simple fractures	95	5811	28.09
Compound fractures	1172		
Nerve injuries	421		
Joint involvement	637		
Flesh wounds	3486		
lower extremities—			
Simple fractures	125	6843	34.13
Compound fractures	1248		
Nerve injuries	250		
Joint involvement	876		
Flesh wounds	4344		
burns	150	150	0.75
other	442	442	2.21
	19,750	19,750	100.00

Note: The number of wounds exceeds the number of wounded, as a casualty with more than one wound has been classified more than once.

Regional Classification of Wounds causing Deaths in Action

Survey made of New Zealand casualties in Tunisia 21 March–15 May 1943 (Tebaga Gap- Enfidaville). Detailed reports received of 693 casualties (nearly half of total casualties for period), including 82 killed in action.

Classification of wounds of these 82 was:

Head	26
Chest	32
Abdomen	12
Blown to pieces	4
Multiple, including head	1
Multiple, including trunk	2
Femur	2
Amputation both legs	1
Back	1

Blast	1
	82

missiles causing death	
Shell	40
Mortar	11
Machine-gun	13
Gunshot	11
Bomb	3
Mine	2
Miscellaneous	2
	82

2 NZEF(IP) — ANALYSIS OF WOUNDS 3 NZ DIVISION IN SOLOMON ISLANDS

2 NZEF(IP)

Analysis of Wounds 3 NZ Division in Solomon Islands

Abdomen	2
Chest	19
Head	15
Face	8
Neck	2
Eye	1
Ear-Blast	7
Ear-Other	2
Shoulder and upper arm	16
Elbow and forearm	8
Arm (undefined)	7
Wrist	2
Hand	4
Thigh	16
Knee	9
Legs	12
Foot	8
Back	9
Sacral region	3
Buttock	11
General	7
Unknown	21
Unknown (remained with unit)	14
	205
missile causing wound	
GSW (? mostly rifle)	68
Grenade	32

Shrapnel (? mortar)	20
Mortar	22
Shell	12
Bomb blast	8
Bomb	7
Aerial bomb	1
Machine-gun	2
Unknown	10
Unknown (remained with unit)	23
	205

Killed in action not included.

CHAPTER 3 — SHOCK

Contents

FIRST WORLD WAR

THIS condition had been studied extensively prior to the First World War, and much research had been undertaken in an endeavour to find explanations of the cause and nature of the phenomenon and the best methods for its relief.

It was realised that there were many diverse causative factors and that these were both psychic and traumatic. At one time a differentiation was made between shock which was unassociated with loss of blood or fluid and collapse which was held to be due primarily to loss of body fluids. This distinction proved unsatisfactory as there was so much overlap, and the final pathological condition seen in the two states proved to be more or less the same. However, stress was laid on the serious effects produced by loss of blood or body fluids, and in the wounded this was naturally of the greatest importance.

The utilisation of intravenous fluids was common prior to the war, saline and glucose solutions being especially employed. Blood transfusion had also been used in the treatment of blood diseases, as well as for the restoration of blood loss. It had been shown that stimulants of all kinds had but a temporary beneficial action, and later a definitely deleterious one. The main factors helping recovery were rest and the restoration of fluid loss.

It was known that there were fairly constant changes in certain body tissues, especially the brain, the liver, and the adrenals, and also in the acid content of the blood giving rise to a condition of acidosis.

During the war there was ample scope for observation of, and the development of treatment for, shock encountered in the exhausting and prolonged battles in France, and following the severe wounds sustained in such very large numbers. Rapid evacuation to the operating centres in the CCSs, where early operation could be undertaken and comfort and nursing provided, was arranged. Warmth was supplied by stoves, hot-water bottles and, when possible, by electric cradles, and was of special use during the cold and wet weather on the Continent. Fluids were provided by the mouth and in serious cases were given intravenously as isotonic saline, glucose solution, and sodium bicarbonate solution, the latter in order to combat the acidosis-known to be present.

In the latter part of the war some blood transfusions were also given, but the supply was limited, both by the absence of any blood bank and also by the lack of a simple and uniform method of transfusion. Many methods were employed at that time, and even anastomosis, by small cannulae, of the artery of the donor and vein of the recipient was practised. Waxed glass tubes and oiled syringes enabled unaltered blood to be given. The citrate method was also used and gradually ousted the more complicated methods. Volunteer donors were obtained, and rewards, such as extra leave, were granted to them. Naturally under such conditions the amount of blood given was strictly limited, but it was recognised that this treatment was of the utmost value. Seldom was more than a pint given to any wounded man.

The deleterious effects of the ordinary inhalation anaesthetics, especially chloroform, were recognised, and gas and oxygen was often utilised.

The frequency of gas gangrene infections complicated the picture, and intravenous alkalies were frequently used in these cases to combat the associated acidosis, but with little effect. The great benefit of early excision of wounds, and efficient splinting of fractures, was recognised. It was also known that in the serious cases transportation had a deleterious effect, especially in certain types of cases such as chests and abdomens.

Between the wars research continued and further knowledge was gained. Blalock drew attention to the marked loss of serum into the body tissues following burns, with the development of haemoconcentration, a discovery that revolutionised our treatment of this condition.

The citrate method became the universal method of blood transfusion for ordinary conditions, though unaltered blood was still used for the treatment of some blood diseases. Transfusion services had been widely established in many countries, and blood banks had been set up in many large centres. The giving of bloed had become a regular part of medical practice. Blood grouping had been stabilised, as had the techniques used in the determination of the individual group.

SECOND WORLD WAR

SECOND WORLD WAR

Administration of Transfusion Service

Preparations were made six months before the onset of war to set up a Blood Transfusion Service in Britain under the aegis of the Medical Research Committee, and a memorandum on the subject of shock was drawn up by the committee for general circulation both to the services and to the civilian medical authorities. The memorandum stressed the importance of the restitution of the blood volume as the primary need in shock.

The Transfusion Service was based on a main unit in Britain at Bristol, where blood was collected and stored and where experiments were sponsored which resulted in the production of blood plasma, both dry and wet, in large quantities. Here also crystalloid solutions such as glucose saline were prepared, and the unit became a huge factory for supplies of blood, plasma, and crystalloids, as well as apparatus. Simple and very efficient blood taking and giving sets were designed and sent to every theatre of war. Plasma and crystalloids were also sent abroad in large quantities and also made available in Britain for the heavy air-raid casualties. Blood transfusion units were organised and trained and then sent abroad.

Middle East

In the Middle East Force a base unit was set up in Cairo at 15 Scottish Hospital, and here Lieutenant-Colonel G. A. H. Buttle, RAMC, organised the service for the African and Syrian campaigns, and supplied blood and crystalloids and sulphonamide drugs to both the base and the forward areas in the desert. Buttle's organisation developed the highest efficiency and can be said to have been the most successful part of the whole medical service in the MEF. Plasma was not available in any quantity for some time, and blood was relied upon almost entirely. The development of the transfusion service in the MEF was partly due to the difficulty of obtaining supplies of plasma from England, much of which was lost in transit. This forced

Buttle to supply whole blood, and, as this proved eminently suitable, it became the normal transfusion.

The Australians under Lieutenant-Colonel Wood, as Transfusion Officer, had organised blood transfusion during the first Libyan campaign, and they utilised their own Soluvac apparatus, and also wet serum which had been produced in Australia and sent overseas. Some valuable reports of their experiences are available. They had to depend on drawing off the blood from donors on the spot. They pointed out the value of adding glucose to the blood, and demonstrated that this rendered the blood quite fit for use for fourteen days, and also much delayed haemolysis. The necessity for thorough cleansing of the apparatus and rigid aseptic techniques in the preparation of blood was stressed.

2 NZEF Experience

In the early campaigns of Greece and Crete stored blood was not available, and very little was given to the wounded men. In the second Libyan campaign blood was available at the CCS level, but in the divisional area very little blood was given and little plasma was available. Blood, however, was given when the casualties got to the CCS level, and later more was given at hospitals on the L of C and at the Base.

In this very difficult campaign with disrupted communications proper blood service in any case was impossible in the forward areas, and the conditions, which included long rough transport over the desert, militated against the proper treatment of shock. The transfusion service, however, had developed during this period and was fully active at the Base. The great benefit of blood transfusion was recognised, as was the necessity to give large amounts in the serious cases associated with marked haemorrhage. The other methods of resuscitation were being utilised, including adequate dosage of morphia, warmth, and hot drinks such as tea or cocoa.

Provision of NZ Field Transfusion Unit

Up to this stage the 2 NZEF had made no special provision for transfusion officers or units, nor were there any transfusion officers appointed till the Division returned to the desert to help to stem the victorious march of Rommel before Alamein. A transfusion unit was then formed from 1 NZ General Hospital under Major

Stewart, who was pathologist to the hospital. The unit had the standard equipment and staffing of the RAMC unit and was attached to a forward operating unit, generally the active MDS. Our CCS was at that period supplied generally with an RAMC tranfusion unit.

The transfusion unit consisted of one medical officer, two transfusion orderlies, and two drivers, with one refrigerating truck and one stores truck. One of the drivers was a refrigeration mechanic. There was an insulated box, surrounded by a water jacket, capable of holding 110 bottles of blood. The temperature was controlled by a refrigerating pump using methyl chloride as a cooling fluid, and driven by a small petrol motor. This was all placed in the tray of the truck and fitted in any 3-ton truck.

Built-in shelves and drawers were also used to keep the equipment handy and tidy, with specially made boxes to contain sets for typing transfusions and for bleeding. Transfusion stands were found essential. The transfusion unit obtained supplies of whole blood, plasma and saline, and glucose and saline, from the British Base Transfusion Unit, which organised the distribution by means of an executive forward transfusion officer. The personnel of the New Zealand transfusion unit was changed from time to time, but its establishment remained constant. Two New Zealand units were set up at one period in Italy. Units without attached FTUs carried out resuscitatory measures utilising their own personnel.

Treatment at Medical Units

This varied according to the medical unit and the circumstances at the time, the following procedures being normal:

At the RAP: The main factor here was rest, both general and also local at the site of the injury. Morphia and the recumbent position supplied the first want and dressing and splinting the other. Morphia was more efficient and safer if given intravenously. If given subcutaneously to a serious shocked case there was often lack of absorption till the circulation improved following transfusion, when a dangerous dosage from the repeated injection might arise. The adequate foolproof recording of morphia administration proved essential to prevent overdosage. Marks were made on the Field Medical Card and often on the patient's forehead. Plasma or serum was given when available, and at times even whole blood was possible. Fluid by mouth was of great value. This was generally given as large cups of hot sweetened tea, and the medical comforts supplied by the Red Cross enabled cocoa and other warm drinks to be given. The application of a tourniquet as close to the wound as possible in cases of traumatic amputation both stopped bleeding and also the toxic effects produced by the wounds. (The tourniquet otherwise was used sparingly.)

At the ADS: The treatment given at the RAP was again carried out, but more elaborately and with more efficient splintage. Efficient splinting was of particular importance throughout the course of treatment, but especially so during the course of evacuation, which was often carried out over rough desert or bad roads. Blood was often given if available, but plasma and serum were the more usual transfusions. Warmth and copious drinks were routine treatments.

At the AIDS: The treatment at this level depended on whether the MDS was being utilised as a forward operating centre -or not. In 2 NZEF the MDS almost always did act as an operating centre, and our NZ FTU was attached to it and supplied full facilities for resuscitation and transfusions. Adequate blood, plasma, serum, and crystalloids were available, as was a trained staff to administer them. At the Alamein period and afterwards beds were made available for the nursing of abdominals and other serious cases. As it became realised that wound shock in the cases with large flesh wounds and in traumatic amputation persisted till adequate excision of the damaged tissues had taken place, provision was made for these cases to be treated in the MDS as first priority.

At the CCS: Here all facilities were available including an FTU, operating team, nurses, and hospital beds.

The transfusion service of the Eighth Army units provided dry plasma for the RMO, dry and wet plasma or serum for the ADS, and plasma and blood for the MDS. Blood was sent out in ice-packed boxes holding up to twenty bottles each, and it kept well for twenty-four hours. Over 1000 bottles of both blood and plasma were issued each month to the Eighth Army, and over half was used in the Field Ambulances. In spite of transfusions at the Field Ambulances, it was found at the CCS level before Alamein that the case might be severely distressed on reaching the CCS and then was very difficult to resuscitate again. A month later arrangements were made to keep the transfusions going during the journey from the Field Ambulance, and this kept the patients' condition satisfactory. This enabled RMOs and Field Ambulances to transfer bad cases even when otherwise not quite fit for a journey. In abdominal cases it was found particularly that patients stood travel badly for the first six or seven days following operation. After the Mareth battle our CCS was detailed to go forward and very carefully shifted seven abdominal cases to another CCS alongside only half a mile away. Four of the cases died in the next twenty-four hours. Ever afterwards when the CCS shifted, the abdominal cases were left in their own tent with the same personnel to attend to them and to carry on the continuous gastric suction and intravenous glucose saline treatment. On an average, each abdominal case had 18 pints of intravenous fluid after operation.

Cases of burns, penetrating chest wounds, and maxillo-facial injuries travelled badly, and plasma or serum was administered during transport with great benefit.

Desert Campaign, Alamein to Tunis

The organisation of the transfusion service of the MEF during the desert campaign from Alamein to Tunis proved very efficient. Adequate supplies of blood, serum, plasma, and crystalloids were sent up from the base unit in Cairo to blood depots under the charge of special transfusion units, whose officers functioned as distributing agents to all the forward medical units. At the same time they gave advice and valuable information on military matters to the scattered units. The blood depots were generally placed at the headquarters of an MAC or on an aerodrome, so that refrigeration was available at the places where blood arrived from the Base and where it could most easily be distributed. The transfusion officer paid daily visits to all units, not only supplying the blood, but also removing any surplus supplies and used apparatus needing servicing at the Base.

Experience of NZ FTU, Alame'm to Tunis

This has been well summarised by Major D. T. Stewart and Captain C. P. Powles, both of whom were in charge of our FTU at different periods. They gave the results of their experience in the operations from Alamein to Tunis. They utilised the standard transfusion apparatus and were supplied from the Base Transfusion Unit at Cairo, under Lieutenant-Colonel Buttle.

The percentage of casualties transfused varied from 3 to 16 per cent, 6 to 9 per cent being the average figures.

An analysis taken from records of 246 cases shows that:

21 per cent had had prior transfusion in ADS or RAP.

11 per cent had had prior whole blood transfusions in ADS or RAP.

One third had subsequently died.

Stewart and Powles came to the conclusion that blood transfusion was definitely of great value and saved many lives. Nevertheless the mortality in transfused cases was high. The most important lesson was the value of large transfusions both in the forward areas and at the Base. Those at the Base had to be given slowly.

During the Alamein battle from 24 to 31 October 1942, 2 NZ Division had 1428 casualties. Two to six per cent of these were transfused at the MDS with an average of 2·6 pints of blood and 2·1 pints of plasma. On 1 November there were 573 casualties, of which 8·5 per cent were transfused at the MDS. There were sixteen beds available in the resuscitation tent and two each in the three theatres. During the Mareth battle there were 1004 casualties handled by the Field Ambulances, and nearly 8 per cent of these were transfused with 305 bottles of blood and 174 of plasma. Twenty donors were bled locally.

At that time the supplies normally available from the transfusion service were whole blood, dry plasma and distilled water, wet serum or plasma, glucose (5 per cent) and saline (0·3 per cent), sodium citrate (4 per cent), sodium bicarbonate (4 per cent) in 100 c.c. bottles for intensive alkali administration, and sulphonamides.

There were many problems encountered during this campaign. There was a loss of plasma into the damaged tissues produced by movement during evacuation, which could be overcome by setting up travelling transfusions in ambulance cars. The absence of roads in the desert, and the long distances the wounded had to be transported over rough desert, led to great difficulties. The short water supplies also led to dehydration, especially shown after wounding. Mine and booby-trap injuries were very severe, producing much tissue destruction. Wounds in the desert were especially severe, and as a result larger quantities of blood were required than in the fighting near Enfidaville.

Total Amount of Blood Required

It was generally estimated that 10 per cent of casualties required transfusion and that 2 to 3 pints was the average amount given. That would mean 20–30 pints per 100 casualties. The Americans stated in North-West Europe that they needed 1 pint for every two wounded men. In Italy it was finally estimated that 9–12 per cent of wounded required transfusion and that every 100 wounded required 40 bottles of blood, 50 of plasma, and 100 of glucose saline.

Taking of Blood for Transfusion

The need for the provision of blood transfusion for the wounded was recognised at the beginning of the war and all New Zealand servicemen were blood-typed when called up. The particulars of their blood group were stamped on their identity discs. Only members of the O/4 group were used as universal donors, rechecking of the group being carried out for safety. Prospective donors who had had malaria, infective hepatitis, or syphilis were eliminated. Blood from other groups was only very occasionally used to supply fresh blood for patients of the same group. Normally a bottle of blood was taken from each donor. The blood was drawn off by means of a needle from an arm vein. Veins along the radial aspect of the forearm were utilised whenever possible, and the needle was introduced up to the hilt.

Preservation of Blood

Refrigerators were used by the base units where the blood was withdrawn and by all the FTUs. A box holding 110 bottles was fitted into the refrigerator. Kerosene refrigerators were used by the FTUs. Ahead of the FTUs blood was packed in boxes with straw and ice, only small quantities (four bottles) being sent up at a time. Blood was found to keep satisfactorily for up to two weeks in spite of the long transport. It was thought that old blood given did not give good results and in some cases might have caused death, but although a maximum of twelve out of the forty-seven deaths reported by Stewart might have been related to the transfusion, only two showed jaundice or anuria; the others simply did not respond.

After a week a filmy clot sometimes arose at the junction of the plasma and cell layers. A wastage of 20 per cent of blood took place at one period, but later was reduced to 10 per cent. This depended naturally on the number of casualties requiring transfusion at the time.

Little blood was used from donors on the spot. Wet plasma was found to be satisfactory, but occasionally became turbid and had to be discarded.

Technique in Giving Blood

Positive pressure was used and care was taken to prevent air embolism, especially as the bottle was getting empty. Small quantities of air, however, seemed to cause no trouble.

Reactions in the field were very uncommon, well under 1 per cent, and were of minor nature. Orderlies readily acquired the skill to give and look after transfusions.

It was pointed out that the use of whole blood was both more satisfactory and more economical than the use of serum or plasma. A case was recorded of a traumatic amputation just below the hip where operation was carried out with transfusion taking place in both arms, and eight pints were given before the finish of the operation. The patient recovered. Another case was recorded with an abdominal wound associated with vasoconstriction, where marked collapse had taken place after warming the patient. This was relieved by three pints of plasma.

Position at End of North African Campaign

At the close of the North African campaign the treatment of shock had been developed considerably, and blood, plasma, and serum were freely available. The researches of Lieutenant-Colonel Wilson at Alamein had made a valuable contribution to our knowledge, and Lieutenant-Colonel Buttle had developed a highly efficient organisation for the supply and distribution of blood and all other supplies, even up to the RAP, The treatment appropriate to the different types of wounds had been determined, and FT units were available to shoulder the greater part of the work in the field units undertaking forward surgery.

Whole blood had been proved essential when there had been much bleeding, and serum had been of value when blood loss was not so great, and in burns and blast injuries, as well as a supplement to blood. Movement had proved deleterious, especially following operation in abdominal cases. The FTU had become a normal part of the forward field units, and the close co-operation between the Field Transfusion Officer and the Field Surgical Officer had become well established and remained so throughout the war.

Relative Worth of Blood and Plasma

Differences of opinion arose, especially at the beginning of the war, as to the value of blood and plasma in restoring the blood volume. Many held that the restoration of the volume and not the haemoglobin content of the blood was the cardinal factor. This led Brigadier Whitby, head of the British Transfusion Service, to concentrate on the provision of plasma and serum, which had the advantages of simplicity in handling and stability for long periods. Supplies of plasma were not available, however, in the MEF, largely because of enemy action against shipping, and this led to the use of whole blood in this theatre of war. This was carried out so efficiently by Lieutenant-Colonel Buttle and his unit that sufficient blood was available for all purposes, and the plasma available was utilised for the treatment of burns and as a supplement to whole blood. The great value of blood in wound shock was appreciated so much by the forward medical units that it led to modification of the original view in England that it was volume alone which was required. There were at first two schools, one favouring blood and the other plasma, and these met at Tunis when the Eighth and the First Armies joined forces. The First Army had ample supplies of plasma and appreciated its value, whereas the Eighth Army had quite fixed ideas that blood was definitely to be preferred to plasma, and their efficient base transfusion unit at Cairo had always furnished adequate supplies.

When the two armies amalgamated to form the Central Mediterranean Force, the value of both blood and plasma was appreciated, but the pre-eminence of blood was established for all cases with serious bleeding and a low haemoglobin content.

Italy

In Italy a British base transfusion unit was set up at Bari, and this supplied the

British armies during the campaign. It worked under considerable difficulties, but carried out the work efficiently and never failed in the supply of blood. Field transfusion units carried on in the same manner as they had done in North Africa, and more units were available. The personnel kept up the high standard and were helped and stimulated by the constant research work undertaken by British and Canadian research units.

The importance of early surgery in large muscle wounds was clearly recognised. In abdominal injuries more time was given to pre-operative treatment so as to ensure full resuscitation. The danger of overdose of morphia was countered partly by intravenous injection. The evacuation of the serious casualties was postponed till serious danger of increasing shock by movement was past. This especially applied to abdominal, chest, and burns cases. There had been no marked change in the ordinary routine developed in North Africa. Blood was still pre-eminent in the treatment of wound shock.

NZ FTU in Italy

In Italy the function of the NZ FTU, the type of cases treated, and the blood used were as follows:

Functions: (1) To act as a divisional blood and plasma bank. Transfusion stores were drawn from the Corps' blood bank located at a CCS—from there they were distributed to ADSs which, in turn, supplied to RAPs in the usual manner. Small insulated boxes holding four bottles were supplied to ADSs for storing blood and sending it forward to RAPs. (2) To take over at the MDS the resuscitation of those casualties who were not fit to be evacuated further, or not fit to undergo the necessary surgery; also to maintain the general condition during surgery, and to carry out such intravenous therapy as might be indicated in the post-operative period.

The NZ FTU was generally attached to the active MDS, the NZ CCS having a British FTU attached. A considerable amount of work was done during the active periods of the Division at the Sangro, Cassino, Florence, Rimini, and in the Po Battles. Blood and other supplies came from the British base unit at Bari, and, apart from some trouble with infection, mainly of glucose solution, no difficulties arose.

The average dosage of blood remained at about 3 pints, and plasma and serum were freely used. There was some trouble with the vis-caps of the giving sets. The need for the relief of the transfusion officer and the training of the orderlies was recognised.

For the Sangro battle a blood bank was available at Vasto. On only one occasion was it necessary to bleed donors, when 23 pints were taken. The average transfusion given at the MDS varied from 3·3 pints for limb injuries to 2 for abdomens and heads and 1·4 for chests. Some blood was used up to twenty-one days old.

In March 1944 it was observed that 'the casualty, arriving at the MDS, being considered not fit to travel further, was brought in for resuscitation before resuming the journey to the CCS, a distance of 10½ miles over a road with a deteriorating surface. Following up the resuscitated wounded showed that, in spite of a travelling transfusion, the journey reduced or removed the benefit that had accrued from treatment on the standard lines at the MDS, unless the required surgery had been available before evacuation to the CCS, abdominal and head cases excepted. Men with large limb wounds, chest injuries which produced sufficient shock to prevent evacuation without resuscitation, did better if they had the necessary surgery and eight to twelve hours' rest than if they were temporarily resuscitated and speedily evacuated.'

Quantity of Blood Used: Over the period 20 November 1943 to 31 March 1944, being the period from the Division's first campaign on the Sangro River to the relief of the Division in Cassino, 1245 bottles of blood were handled by 2 NZ FTU.

The use of penicillin increased the scope of the FTUs, but the giving of blood and plasma still remained their main function.

There was some difficulty with the apparatus at times, but the base unit at Bari, in spite of difficulties, continued the excellent service we had become accustomed to in North Africa.

Transfusion Service at Base Hospitals

The problems and requirements of the base hospitals differed from those in the forward areas. The base hospitals made their own arrangements for blood transfusion and generally appointed a member of the staff as transfusion officer. In our own hospitals the pathologist was so appointed. Each hospital arranged its own supply of blood, but serum and plasma were supplied from the base transfusion unit. Severe reactions following blood transfusions were not uncommon, especially in patients who had had prior transfusions. This necessitated the use of fresh blood and careful retyping and cross-typing. The previous transfusion had brought about an alteration in the blood characteristics.

The work carried out is shown by the following account of the experience of the New Zealand base hospital at Helwan during the period of the desert campaigns.

Transfusion at a New Zealand Base Hospital

This was organised and carried out by the pathologist, who set up a blood bank and arranged for the collection of blood from donors, mainly from the base camp, and also serviced the apparatus. Although all 2 NZEF personnel had been blood-grouped on enlistment, check grouping was carried out before utilisation of blood from the donors. An error of only 2 per cent was found in 1000 2 NZEF donors.

For planned transfusions in hospital, especially for late cases which had already had previous transfusions, blood of the same group was used as often as possible, and both check-grouping and cross-matching was done. A form was filled in by the donors, giving full particulars for identification as well as the history of malaria, infective hepatitis, and venereal disease. Kahn's test was carried out in any case with a VD history, and syphilis meant exclusion, as did a history of any allergic disease. Bristol-type needles were used, being introduced up to the hilt, and veins along the radial aspect of the forearm utilised, splints being used as required. A record form was used giving full details of the transfusion. Plasma and serum were also always available.

During a period of twelve months the total admissions to the New Zealand hospital at Helwan were 11,500. Five thousand of these were surgical cases and 1350 were battle casualties. A total of 221 transfusions were given to 150 patients, 103 of these being battle casualties. Four hundred and fifty pints of blood and 50 pints of plasma were used. The majority of the battle casualties transfused were septic cases, mainly compound fractures and septic joints. No abdominal wounds were treated. The secondary anaemia present was associated with sepsis and secondary haemorrhage, mostly small and repeated. The clearing up of sepsis and the healing of the wounds were both helped greatly by blood transfusion. In the septic cases care was taken to use fresh blood under twenty-four hours old. Blood was kept in store for the treatment of secondary haemorrhage, for which full restoration by giving up to 3–4 pints of blood was carried out. In septic cases the blood was given slowly, not more quickly than a pint in three hours. In some cases very large quantities of blood were given, the maximum being 27 pints in thirty-one days to a case of repeated serious secondary haemorrhage from the axilla. The case recovered. Reactions were common in the first eight months, but less common later. They were largely of little severity and, unless severe, did not necessitate stopping the transfusion. Cases with septic wounds and prior transfusions were more liable to severe reactions. There was one fatal case and another with anuria recovered. The plasma available was reserved for burn cases. Crystalloid transfusions were given, often in large quantities, the moistness of the tongue being used to determine the amount of fluid required.

In Italy the base hospitals continued the work in the same way, utilising fresh blood for the late cases.

Experience of 2 NZEF (IP)

The blood transfusion service in the Pacific offered a problem in that hot, humid atmosphere, where the keeping properties of stored whole blood and wet plasma were limited. High humidity, more obvious on refrigeration, softened the vis-caps and permitted contamination along the moist thread of the screw-capped bottles. For large-scale operations it was quite feasible to transport supplies by air to the forward areas from non-malarious areas, but when the operations were limited there was a considerable loss by wastage, as it was very difficult to estimate beforehand possible demands in jungle warfare. It was agreed that stored blood should be used within a week. Reliance was placed mainly on dried blood plasma, and when whole blood was indicated donors on the spot were used, due precautions being taken to exclude possible malaria. Apart from the malaria risk it was, of course, not good practice to take blood from forward troops, and more so in the islands because there was a tendency for nutritional anaemia to occur amongst the troops.

Recommendations for the Future

1. An organisation similar to the British one in the Second World War.
   (a) Large mother unit to train personnel, to collect blood, to manufacture plasma and serum, etc., to furnish equipment of all kinds.
   (b) Base units in every theatre of war to draw and furnish blood, service equipment, and act as mother unit for field units.
   (c) Field Transfusion Units. Some to organise and carry out distribution, the others to act as resuscitation teams to forward units, such as CCSs and MDSs.
   (d) Transfusion units to be formed in each base hospital.
2. Increase of field transfusion units, and especially of personnel. Two officers to be attached to each unit for relief purposes.
3. Research units to be formed in each theatre of war to investigate specific problems and stimulate scientific thought throughout the Corps. Pathologists, biochemists, as well as research personnel, to be available for these units.
4. Investigation to be carried out in first twenty-four to forty-eight hours after wounding, when the majority of the deaths occur.
5. Provision of larger bottles to hold two pints of blood or plasma. Provision of standard bottle holders for ambulances.
6. Large transfusions of blood and serum to be given to injuries associated with severe bleeding, and given quickly.
7. Post-operative transfusion to be given much more frequently and transfusion personnel to be set aside especially for that purpose.
8. Glucose salines to be given early in all severely wounded cases, especially abdominals, to prevent anuria.
9. In wounds involving much muscle and in traumatic amputations early operation is imperative in spite of, and largely because of, lack of response to resuscitation. The same sometimes applies to abdomens.
10. In heads, chests, and blast injuries only tranfuse to replace blood definitely lost, and replace slowly.

PROBLEMS OF SHOCK FROM THE CLINICAL ASPECT

Causation of Shock

Formerly shock was classified as (a) primary shock, and (b) secondary shock.

(a) Primary shock was held to be due to several factors, including psychogenic and neurogenic.

(b) Secondary shock was due to more prolonged actions, including blood loss, fatigue, dehydration, cold, and wet.

The differentiation was unsatisfactory, and shock began to be qualified by the circumstances under which it had arisen, and wound shock was the term applied to shock arising as the result of wound trauma. The causation of wound shock was then held to be largely due to loss of blood volume, by loss of blood from the wound. (A survey had shown that 80 per cent of deaths on the battlefield were due to bleeding from a main vessel.) Later, attention was drawn to the marked loss of blood serum into the damaged tissues and also the loss of serum from the surface of extensive burns as a cause of loss of blood volume. All agreed that loss of blood volume constituted the most important cause of wound shock.

Lieutenant-Colonel W. C. Wilson, RAMC, Medical Research Section, MEF, in his investigation at Alamein could find no evidence that injuries of any special nature or part caused any extra degree of shock. The effect of histamine in the production of shock had been known for a long time and it was thought that some such substance might be responsible for the occurrence of severe shock in wounds complicated by gross injury to muscle. Research, however, had shown no histamine in these cases, but something of that nature probably accounted for the failure of resuscitation noted.

Chloroform and spinal anaesthesia were both deleterious.

Signs of Shock

Lieutenant-Colonel Wilson described the typical case as' a talkative, even garrulous, man with ashen grey face, beads of sweat on the brow, and tiny pupils narrowed by morphia, making restless fidgety movements, keeping an apprehensive eye on the bearers lest his wound be jarred, asking constantly for drinks, and vomiting without warning a few minutes after each drink.' There was a serious loss of vitality, with weakness, pallor, low body temperature, sweating, low blood pressure, rapid thready pulse, vomiting and intense thirst.

1. Colour: Paleness denoted a moderate degree of shock. Cyanosis of lips, lobes of ears, and finger tips might be present in the severely wounded. In the worst cases the skin might be a blotchy purple.
2. Temperature: The extremities and nose were cold in severe cases. The forehead was cold in the gravest cases.
3. Constriction of peripheral veins was present in the moderately severe cases, and was marked in the severest cases.
4. Respiratory Rate: Air hunger was seen in severely exsanguinated cases and in chest cases.
5. Dehydration: Dryness of the tongue was common, as was thirst.
6. Pulse: The pulse was rapid and of low tension: (a) the volume was of much greater importance than the rate; (b) rates over 140 were serious.
7. Blood Pressure: This was normally lowered to a degree corresponding to the blood loss. Reactionary vasoconstriction was able to compensate for moderate loss of blood and occasionally even brought about temporary hypertension which disappeared after transfusion. The pressure might vary with respiration.
8. Urine: Little or no urine was passed for many hours after wounding.

Lieutenant-Colonel Grant, in charge of the Research Shock Unit of the Medical Research Council, described different syndromes recognisable as: (a) vasovagal collapse, with bradycardia, hypotension, and vasoconstriction; (b) post-traumatic hypotension with normal or slow pulse, hypotension, and vasoconstriction; and (c) oligaemic hypotension with tachycardia, hypotension, and either vasoconstriction or vasodilatation.

He explained that superficial vasoconstriction was shown by a thin pulse, small veins, cold extremities, pale face. These signs were present in cold hypotension, and the patient looked ill. Cold hypotension was common before operation, and presented the ordinary picture of shock and low blood pressure. There was an associated low blood volume, for which plasma was indicated. After operation the condition probably indicated low blood volume, and if recovery did not take place in three or four hours transfusion was indicated. Blood loss was often greater than was realised, and even if adequate fluid had been given before operation a good deal soon left the circulation. Also, before operation the circulation might be restored, but not the blood volume.

Warm hypotension was common before operation and very common afterwards. In warm hypotension there was a wide pulse and warm extremities. The face might even be flushed and the patient look well, and the condition was often not recognised. It was associated with warm surroundings and after-effects of ether anaesthesia, but these after-effects generally cleared up quickly. It was frequently associated with large muscle injuries. Treatment of this condition was not stabilised. Transfusion gave some relief.

In both conditions there was a reduction of urine which was rectified by raising the blood pressure.

Grant also observed that:

(a) Pallor, cold extremities, low blood pressure, and a rapid pulse, associated with a large wound, indicated haemorrhage.
(b) The same signs associated with small wounds, from which loss of blood was unlikely, usually indicated blast.

Reactions to Blood Loss

Vasoconstriction was the normal reaction to blood loss and was effective for moderate bleeding in which it could often sustain the blood pressure. When the bleeding was more marked and the blood pressure fell, diminished tissue circulation with anoxaemia occurred, leading to irreversible changes including increased capillary permeability. This caused plasma loss in the tissues and pulmonary oedema.

Estimation of Severity

Although some observers relied more on one particular sign than another, it was generally agreed that no one sign was sufficient in itself and that a general evaluation was essential, taking into account the extent of the damage and the general vitality of the patient. The pulse and blood pressure were relied on to supply most of the information. A rapid pulse of poor tension was a serious sign, the volume being of more importance than the rate. A rate over 140 was serious.

Lieutenant-Colonel Wilson stated that the pulse rate was found to show enormous variation. A rapid weak pulse was invariable in a desperately ill man. A rapid pulse, and especially a rapid pulse of low volume, was a more constant indication of danger than a fall in blood pressure, but examination of the pulse alone was not sufficient for a proper assessment of the general condition.

The blood pressure could be readily assessed and changes noted, and thus its observance was particularly valuable. Any pressure under 100 was generally a cardinal sign of wound shock with blood loss, and a blood pressure of 80 was held by Wilson to be the crucial level, anything under that being extremely serious and demanding urgent treatment by replacement of blood loss. Cyanosis was a very serious sign. A rapid pulse and cold, pale extremities were sometimes seen when the blood pressure was satisfactory, indicating vasoconstriction. Low blood pressure, pallor, and a rapid pulse were the usual signs that demanded blood transfusion.

Warmth

In the First World War the warming of the patient was considered to be of considerable importance in combating shock. In the Second World War, however, it was soon realised that it was dangerous to warm the patient unduly, especially in the early period before full resuscitation. The body's first reaction to the loss of body fluid brought about by the blood loss from wounds was vasoconstriction of the superficial blood vessels. This enabled the lowered quantity of blood to suffice temporarily for the preservation of the vital centres. If warmth were applied to the body vasodilatation of the superficial vessels would ensue, with corresponding loss to the vital centres and increase of shock. This was clearly pointed out by Lieutenant-Colonels Wilson and Grant. The latter carried out experiments in the chilling of patients to prevent and combat shock, but this was never adopted in the treatment of casualties. Care was taken, however, only to use simple measures such as covering with blankets till adequate restoration of blood volume by blood transfusion had been brought about. The use of oil stoves and primuses under the stretcher had been responsible for overheating with increase in shock. It had also led at times to serious burns. Major Staveley, NZMC, in 1944 stated that he had seen no deterioration of the circulation which he could attribute to warming, but at that time care was taken to transfuse early and the danger of warming had been brought home to all. The use of stoves under the stretcher was discontinued in the latter period of the war.

Variations according to Wound Conditions

1. Loss of Blood: Shock in general corresponded directly to the degree of blood loss.
2. In serious muscle injuries, and especially in traumatic amputations, in addition to the serious blood loss generally experienced there was another factor associated with the damaged tissues themselves which accentuated the shock and which persisted till the surgical removal of the tissue. Resuscitation by blood proved unsatisfactory and impossible without operation. Cases were seen that had been in quite good condition at the ADS and even at the MDS, but on arrival some hours later at the CCS the condition was one of profound shock and many of these cases died. The opinion in favour of early operation in cases of massive limb wounds was forcibly stated by Major Staveley, OC NZ FTU in Italy, when he said that time and again it had been found that, where haemorrhage had not produced an acute exsanguination, transfusion of blood resulted in a negligible improvement. On the other hand déAbridement or amputation, if necessary, produced a very satisfying improved circulatory position which was then satisfactorily stabilised by blood transfusion—slowly. The unit had been forced to the conclusion that in the treatment of massive limb wounds, regardless of the presence of fracture or not, the pre-operative exhibition of blood to restore the general condition was disappointing. The transfusion of blood, concurrently with surgery designed to procure a rapid removal of damaged tissue and fixation of a fracture if present, had given the most satisfactory results. This early surgery, made available to men in an almost moribund condition, had resulted on occasions in dramatic recovery. Transfusion had clinched the complete recovery and the casualty was evacuated to face the risks of convalescence. The evidence that haemorrhage had proceeded to the point of exsanguination required to be strong to centra-indicate surgery in favour of blood transfusion.
3. Burns: In these cases loss of serum either into the wound or, more importantly, into the damaged tissues was the cardinal feature.
4. Blast: Here again loss of serum, especially in the abdomen, was of great importance.

Variation according to the Site of the Wound

1. Heads: Here blood loss was generally slight and shock was not marked.
2. Chests: In the absence of bleeding from the intercostal arteries blood loss was not severe, shock being more dependent on interference with respiration and severe internal injuries. Open chest wounds accentuated shock.
3. Abdomens: Bleeding varied considerably, in some cases being very severe and associated with marked degree of shock. In other cases very little blood was lost.
4. Limbs: Blood loss was often very severe and was always considerable in any large wound. Lieutenant-Colonel Grant estimated that a loss of half the blood volume was common in these injuries. These wounds formed the bulk of the casualties arriving at the MDS in a shocked condition: 56 per cent of all cases admitted to the resuscitation ward on the Sangro and Orsogna fronts, and 50 per cent on the Cassino front were in this group. The shock was related to the amount of the blood loss and the extent of the tissue damage.

Quantity of Blood to be Given

There was much difference of opinion over this. Lieutenant-Colonel Wilson, as a result of his researches at Alamein, considered that early rapid adequate blood transfusion was the prime necessity in the treatment of wound shock, and that a volume at least equal to the loss should be given and any extra loss at operation made good.

Major Stewart, NZMC, and Captain Powles, NZMC, gave as much as seven to eight pints in a couple of hours when bleeding had been very severe. They gave blood till the colour appeared normal, and found that three to four pints of blood were generally required.

Lieutenant-Colonel Grant considered the average transfusion should be about three pints, but that in severe bleeding much larger quantities should be given. The Canadian research unit stressed the need for rapid transfusion in severe cases and also the necessity for blood post-operatively. Captain Milne, an FTU officer in the North-West European front, strongly urged the giving of much larger quantities of blood and considered that insufficient blood had been given during the war. He normally gave 5 pints before operation and in severe cases up to double that amount.

Great variation was needed according to the type of injury.

1. In Large Flesh Wounds: There was general agreement that large quantities were necessary as there was normally serious blood loss. Up to five pints was frequently given in these cases, and at times, following severe and repeated haemorrhage, double that quantity had been given. (The normal blood volume is about 9 pints.)

2. Head Cases: Transfusion was only required to replace any actual bleeding which had occurred. Normally very little was needed.
3. Chest Cases: The quantity needed again depended on the blood loss, which was as a rule not great unless there was bleeding from the intercostals. Blood given when there had not been much loss could be harmful and was apt to cause pulmonary congestion.
4. Abdomens: Our experience had been that in half the abdominal cases there was considerable peritoneal bleeding and that in some there was very extensive bleeding from mesenteric vessels. In these cases fairly large quantities of blood were given, up to 6–8 pints. In cases without much bleeding little pre-operative blood was required, though plasma and blood were generally given. Captain Milne considered that most abdominal deaths were due to haemorrhage. He gave up to 6 pints before and more during operation and had only six deaths in over forty cases. Lieutenant-Colonel Grant considered that there was normally little bleeding in abdominal injuries and that little blood was required. He thought that plasma before operation was sufficient.
5. Blast Injuries: Blood was not required and was held to be harmful.

Results of Treatment by Blood

These, in the presence of real blood loss, were generally excellent. There was not a discordant voice throughout the war on this point.

Temperature of Blood when Given

Some difference of opinion was expressed on this point. It was asserted that cold blood was deleterious. A War Office memorandum of July 1941 recommended warming to 40 degrees C, and not allowing it to go below 4 degrees C., and the Canadian research unit recommended heating to room temperature. Milne, on the other hand, thought warming of the blood unnecessary. It would seem there was no definite data to support either point of view.

Rate of Administration

At the beginning of the war it was held advisable to give blood slowly because of the danger of incompatability. This soon proved to be wrong because of the consequent inability to relieve the shock in cases of severe bleeding. It was then considered that the first blood should be given as rapidly as possible and positive pressure utilised; up to 3 pints could be given rapidly without trouble (2 pints in half an hour), and some field transfusion officers gave more. After the first 4 pints blood was given more slowly unless serious bleeding was still taking place. In secondary anaemia blood was always given slowly and in much smaller quantities at a time.

Conditions causing Failure of Resuscitation by Blood Transfusion

If the giving of 3–4 pints of blood failed to restore the circulation and so combat shock, other factors were present such as excessive haemorrhage requiring a larger transfusion; continued haemorrhage; transfusion given too slowly; massive muscle injury; cerebral shock; blast injuries; fat embolism; unsuspected abdominal or chest injury; toxaemia from sepsis, abdominal injury, or gas gangrene.

Estimation of Condition of Patients Fit for Operation

The patient was considered ready for operation when his general condition and also his pulse and blood pressure were considered satisfactory. The estimation of the general condition depended on the knowledge and judgment of the transfusion officer and the surgeon. It depended on many things, the colour and warmth of the patient and his alertness. The estimation of the pulse depended on both the volume and the rate, the volume being especially important. A blood pressure of 110–120 systolic was generally aimed at before operation, but a level of 100 systolic was considered quite satisfactory, and patients were operated on frequently with still lower blood pressures when operation was essential to their chance of recovery. Wilson gave 80 mm. as the danger level below which operation was extremely hazardous. Accurate and repeated observations of the blood pressure, pulse rate and volume, skin circulation and colour were necessary. Once the patient's condition was deemed satisfactory and the optimum level had been reached, operation was undertaken at once. Any delay led to a deterioration of the patient's condition and further resuscitation to the same level was generally impossible.

Post-operative Resuscitation

It was realised more and more as the war progressed that severe cases, especially abdominals, needed the same attention after operation as before operation and generally needed further blood replacement as well as glucose salines. Experienced workers urged the provision of a field transfusion officer especially for post-operative resuscitation. Grant drew attention at the Rome conference to the importance of post-operation care and urged careful supervision and further transfusion.

Transportation

The effect of shifting the patient was found to be of marked influence on shock. This referred to all cases, but particularly to those with abdominal wounds after operation when any movement in the first week was fraught with danger. It also affected the more serious chest cases and patients with burns. The excellent splinting of fractures as a rule prevented serious disturbance in these cases.

Resuscitation during Travel

The giving of transfusions of serum or blood during evacuation by ambulance was developed in the Western Desert and was continued in Italy. Special clamps were invented to fix on to the stretchers, and the needles were held more securely in the arm by means of plaster bandages. The results of this treatment were considered very valuable.

Particular Values of Blood and Plasma

Blood was considered preferable for:

(a) Any severe bleeding.

(b) Secondary anaemia whether due to blood loss or infection. Whitby stated that blood was essential to raise the haemoglobin to at least 55 per cent so as to render the man fit for operation and survival afterwards.

Plasma was considered preferable for (a) burns, (b) blast, (c) sometimes in abdomens in the absence of any serious blood loss, and (d) protein deficiencies during convalescence.

It was considered advisable to combine blood and plasma so as to minimise any dangers from large dosage of whole blood. Plasma was also of great value in the forward areas where refrigeration was impracticable.

Blood that otherwise would have been wasted could be converted into serum or plasma and stocks could also be laid down in the intervals between the active periods of warfare.

Value of Crystalloids

In the 1914–18 War intravenous salines and gum arabic were used as a preventive of shock. It was appreciated, however, that salines did not have any lasting effect on blood volume, and in the latter part of the war some blood was given. Crystalloids, however, were valuable in combating dehydration and in stimulating renal action, as well as in supplying any deficiency in chlorides. They were especially valuable in the post-operative treatment of abdominal cases when fluid could not be given by the mouth, particularly when gastric suction was still further depleting the body fluids. Isotonic saline was the ideal fluid when chlorides were required, and isotonic glucose solutions made an ideal non-toxic and useful metabolic base.

The use of glucose salines as a preventive of anuria was stressed in the latter part of the Second World War. It was held by most observers that anuria was associated with profound and prolonged shock, especially in abdominal cases. Many considered that anoxaemia of the kidney resulted because of diminished renal circulation during the profound shock, possibly increased by the shunting of the renal circulation to buttress up the general circulation. Whitby considered renal ischaemia associated with exsanguination was one important factor in causation and therefore counselled early and adequate restoration of the circulation. Air Commodore Keynes stated that the RAF considered renal ischaemia was the most important factor in anuria. It seemed rational to try and increase the fluid content of the blood by salines as soon as possible, as well as to give the requisite blood and plasma, so that kidney functions might early be stimulated. Certain it was that when anuria developed, treatment was unavailing, so any possible preventive measure was called for. In the treatment of anuria fluid had to be restricted as the kidneys were unable to excrete, and the fluid administered merely embarrassed the circulation and led to oedema.

The quantity of crystalloid required in abdominal cases having gastric suction was evaluated, and special attention was given to the amount of chloride that was required in these cases. Lieutenant-Colonel Grant advised a routine of 2 pints of plasma or normal saline daily, plus 1 pint for every pint of gastric contents withdrawn by suction. More saline (up to 4 pints) might be needed in tropical climates or if the urine did not contain chlorides. The remainder of the fluids given should be 5 per cent glucose or other non-saline fluids. A total of 8 pints of glucose and saline fluids was generally given daily to these cases.

The urine output was a valuable indication of dehydration and an output of between 2 and 3 pints was aimed at. Normal fluid loss from the body from the lungs, skin, and urine was about 3 pints. With lack of fluid the urine output became insufficient for adequate excretion, and uraemia resulted. A normal man deprived of all water would die within nine days. Dehydration was a major factor in rendering a casualty seriously ill, giving a clinical picture similar to that of secondary shock. Dry mouth and scanty urine, low blood pressure, feeble pulse, and cyanosis occurred. The chloride content of the urine was also an indication of value.

Oxygen was of value in cyanosed cases, especially in chest injuries. The BLB mask was utilised.

Reactions after Blood Transfusion

1. Mismatched Transfusion: This was extremely uncommon. Whitby stated at the end of the war that disasters from incompata-bility had been almost unknown. Symptoms usually occurred after only a few cubic centimetres had been transfused. These were: respiratory distress, rigors, pain in the back and vomiting which might be followed by unconsciousness, sudden collapse, and death if transfusion was continued. In lesser cases not immediately fatal there arose later signs of haemolysis such as jaundice, haemoglobi-nuria, embolic phenomena, and urticaria. Death might occur later from cerebral embolus, or anuria and uraemia from blocking of the urinary tubules. Treatment consisted in immediate cessation of the transfusion on the first sign of trouble, and then alkalinisation of the urine and the giving of copious fluids. Sodium citrate in 3 per cent solution was given

intravenously. The most serious disturbances arose at base hospitals where transfusions were given, some time after wounding, for anaemia and infection, and when previous transfusion which had altered the patient's blood grouping had been given in the forward areas. This necessitated fresh blood grouping and cross-matching.

2. Pvrogenic Reactions: Minor reactions were not uncommon and varied with different consignments of blood. These might occur within a few hours. Symptoms included fever, rigors, jaundice, urticaria, haemoglobinuria. Treatment was similar to that for the more severe reactions. The lack of adequate cleansing of the apparatus was held to be largely responsible for these reactions, and the better arrangements for cleansing minimised the attacks. Particles of blood clot were often retained in the apparatus and gave rise to trouble.
3. Use of Haemolysed Blood: The reaction was characterised by chills, fever, brief haemoglobinuria, slight increase of serum bilirubin, and usually rapid disappearance of the injected cells. No serious results ensued. It was thought that the stroma and not the haemoglobin was the noxious factor.
4. Use of Blood with a High Titre of Agglutmms against the recipient's Red Cells: Great destruction of red cells, in some cases of practically all of them, took place. This occurred only when using group O blood for other groups.
5. Anaphylactic Allergic Reactions: Altogether in the forward areas these reactions, were not of any great moment. The transfusion was slowed up, and if the reaction was severe the transfusion was stopped and the blood was changed.

At the Base severe reactions did arise and called for careful matching and the use of fresh blood. Renal changes from incompatability proved to be rare, as was also the finding of haemoglobin in the tubules.

Changes in Stored Blood

The necessity to draw off blood before an offensive rendered it inevitable that some blood waste should take place. With refrigeration and careful handling it was proved that blood would normally last for fourteen days. Haemolysis gradually took place, but was little marked before that time. The changes could be seen in the blood. They consisted in the loss of the clear-cut margin between the corpuscles and the plasma layer, with the gradual discoloration of the plasma and the change of colour from orange to purple red. Infection was very uncommon in stored blood. It did, however, sometimes occur with marked alteration in the blood colour. Blood not showing any marked changes was often used when occasion demanded at a later period than fourteen days, but, despite no serious reaction, the blood had much less effect in relieving the shock.

Plasma and Serum

1. Preparation: The main basic British unit at Bristol sponsored research into the preparation of the plasma and serum components of blood. The result was the preparation of dried serum and plasma and wet serum and plasma. Fluid Plasma: This was obtained by removing the plasma from citrated blood (440 cons, blood plus 100 ccms. 3 per cent sodium citrate). Over-age blood was utilised for this purpose; 200 ccms. of plasma was obtained from the 540 ccms. bottle of citrated blood. The blood of all groups was pooled for two hours to render it agglutinin-free and so avoid haemolytic reactions. The plasma was clarified of fat and passed through a bacterial filter and then bottled. The plasma was a clear golden or slightly orange fluid. When infected and so unfit for use it became diffusely turbid. Fluid Serum: Was used similarly to plasma. It contained no citrate and no fibrinogen so did not clot. The serum was pooled to prevent reactions and could be stored if desired in a refrigerator, but was normally kept in a cool dark place. Dried Serum and Plasma: The serum was easier to prepare and more concentrated than plasma. Pyrogen-free distilled water was used to prepare serum for use.
2. Preservation: Plasma was stored at room temperatures in the dark, as cold storage encouraged clotting and sunshine denatured the protein. Properly stored it kept for at least twelve months. Fluid serum was normally kept in a cool dark place. Dried serum and plasma kept indefinitely and needed no refrigeration.
3. Method of Administration:Wet serum and plasma were given from the containers and dry plasma was dissolved in pyrogen-free distilled water before transfusion.
4. Quantities Given: It was in burns cases that serum or plasma was specially indicated and where large quantities had to be administered, 6 pints being frequently given early to bad cases. In ordinary wound shock cases 1 pint of serum was generally given to every 2 pints of blood, and 2 pints of serum was given often in the forward areas. In chronic infection serum was also given in combination with whole blood if anaemia was marked.

In serious abdominal cases 1 pint of serum was given daily along with glucose salines.

Salines and Glucose Salines

These solutions had long been of common use in surgical and medical conditions and were freely availed of during the First World War. They were prepared at the Base Transfusion Units and transported to the forward areas. They were used mostly for abdominal cases during the first week whilst gastric suction was being employed. They acted by relieving dehydration and supplying chlorides. Eight pints a day was normally required when no fluid was being taken by the mouth.

The Problem of Shock as seen at the End of the War

Even at the end of the war the problem of shock and its treatment remained to a large extent unsolved. The most important factor was the early death of the badly shocked patients, the large majority dying in the first twenty-four to forty-eight hours. The transfusion of blood had proved our most effective treatment. When much blood had been lost large transfusions had been essential to success.

In some of our cases very large amounts were given. If many more of the cases dying in the first twenty-four hours were to be saved, then Milne might be right and more blood should have been given, but one cannot but feel that the severity of the injury alone, quite apart from blood loss, would still make the majority of these deaths inevitable under war conditions. There was need for more research and for controlled survey of clinical treatment, and especially for correlation between the two. Concentration of study must be made on the first twenty-four hours following injury.

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CHAPTER 4
Anaesthetics

ANAESTHESIA has transformed war surgery from the primitive operations formerly performed by military surgeons to the ordered and deliberate techniques of today. Anaesthesia had developed considerably before the First World War, and ether had become established as a much safer and more satisfactory anaesthetic than chloroform. Special apparatus had been evolved to render its administration more satisfactory. Clover's apparatus had given way to the open administration on a mask, which was safer but wasteful and difficult to administer in warm countries. Chloroform was still used, especially in Edinburgh, and chloroform and ether mixtures were commonly utilised.

Shipway had introduced a simple apparatus to enable warm ether vapour to be given by passing air or oxygen through the ether bottle which stood in a warm water container. Gas (nitrous oxide) and oxygen had also been introduced and Boyle had invented an apparatus for its administration, ether being also given in conjunction if required. Spinal anaesthesia was commonly used in some hospitals.

First World War

At the commencement of the 1914–18 War provision was first made only for chloroform, in ampoule form, in the field units; but the other anaesthetics used in civil practice were soon available, and ether became the anaesthetic of choice, either alone or in conjunction with chloroform. Shipway's apparatus was popular and diminished the number of chest complications. Gas and oxygen became very much used for seriously shocked cases, but its administration was difficult. Spinal anaesthesia proved to be dangerous when administered to shocked cases, and in consequence was not utilised to any extent. Intratracheal anaesthesia was well established and was utilised in special cases. Local anaesthesia was utilised extensively in head injuries and very occasionally for other injuries. Pre-medication of morphia and atropine was a routine.

Between the Wars

Between the wars anaesthesia developed markedly and became more and more recognised as a specialty. Elaborate machines were developed for the administration of a variety of anaesthetics, though ether still remained the most common type. Cyclopropane was introduced and proved very safe and satisfactory. Intravenous administration of new drugs proved satisfactory for the induction of anaesthesia and for short operations. Rectal administration was also utilised. Pentothal sodium was used before the beginning of the 1939–45 War and rapidly came into favour.

SECOND WORLD WAR

Types of Anaesthetic

It was well recognised before the war that chloroform was a dangerous drug, especially in shocked and septic cases, and was quite unsuited to war conditions. Spinal anaesthesia was also banned in similar cases and was restricted to cases of civilian surgery.

Ether remained the basic general anaesthetic for ordinary purposes, but its grave disadvantage was rapid evaporation in tropical countries. (Lieutenant-Colonel Anson, senior anaesthetist, however, stated that there was no real difficulty found in its use in conditions of extreme heat.) It also produced vasodilatation which was deleterious in shock, though this condition could be counteracted by efficient treatment by transfusion.

The regular administration of intravenous fluids (blood, plasma, glucose-salines) rendered intravenous anaesthesia a very simple procedure.

Pentothal began to be used early in the war, and became the routine method of induction and the only anaesthetic for the majority of the cases. Care was necessary to prevent overdosage, and caution required in cases with any possible liver damage such as extensive burns. The average wounded man reacted well to pentothal, and there were few complications. The drug was usually given by intravenous dosage of fixed amounts, repeated as required up to a predetermined maximum. It was also administered by continuous intravenous injection, the total dose being controlled. In shocked cases care was necessary, and small doses sufficient. Pentothal was without question the most satisfactory anaesthetic used during the war for all ordinary wounded or civilian cases.

Ether was given in addition to the more severe cases, such as the abdominals. The introduction of the Macintosh ether apparatus, the Oxford inhaler, proved a very valuable method of administering ether, especially for the ordinary anaesthetist as distinct from the specialist. It was especially useful in the tropical areas.

Gas and oxygen was not often available in North Africa, but was utilised more in Italy. The supply of cylinders proved a difficulty. Cyclopropane was used wherever available and was the common anaesthetic in the chest centres, and was also utilised in the neurosurgical and faciomaxillary units. Trilene was also used in the latter part of the war.

Boyle's apparatus was part of the ordinary army equipment for hospitals and was freely utilised, but our New Zealand hospitals acquired the more elaborate and efficient American models such as the Heidbrinck, which no doubt should be a regular army supply.

Endotracheal administration was very commonly used by specialist anaesthetists in the chest, head, and facio-maxillary units.

The war conclusively proved the great value of trained anaesthetists in every surgical centre, and especially in the forward areas. Unfortunately the New Zealand force contained few specialists of this type, but it was fortunate in having British specialist anaesthetists attached to its forward medical units for long periods. The choice of anaesthetic varied according to the type of case and the medical unit.

Anaesthesia in Forward Areas in 2 NZEF

In the Field Ambulance: Pentothal was used for almost all the cases, supplemented at times with ether at first by open method and, after its introduction, by Macintosh's apparatus. On a few occasions induction was brought about by C_1E_2 mixture and the anaesthetic continued by open or closed ether. Local anaesthetic proved unsatisfactory. No special apparatus except that later introduced by Macintosh was available in the Field Ambulances except as part of the equipment of an attached FSU.

In the CCS: Boyle's apparatus was available, and gas and oxygen also in the latter part of the war, as was Macintosh's apparatus.

Types of Anaesthesia in CCS

Pentothal: This was the most frequently used anaesthetic and was given intravenously in small divided doses or added to the drip as required. It was well tolerated by the wounded and a relatively small dosage was required.

Gas and Oxygen: Given by Boyle's apparatus, was used in addition in prolonged cases, the oxygen percentage being kept high.

Ether: Was not usually given in an open mask because of quick evaporation, but was given by means of Boyle's or Macintosh's apparatus.

Anaesthesia in Relation to Type of Case

1. For Light Cases:
   - (a) Pentothal was the common and most useful anaesthetic.
   - (b) Ethyl chloride or GE2 induction, followed by ether either by open method or by Macintosh's apparatus.
2. Prolonged Cases:
   - (a) Pentothal supplemented by gas and oxygen.
   - (b) Pentothal supplemented by gas and oxygen and ether.
   - (c) Pentothal supplemented by gas, oxygen, and trilene.
   - (d) Ether by Oxford vaporiser.
3. Severely Shocked Cases: Pentothal was given in minimal dosage supplemented by gas and oxygen and, if relaxation was required, minimal dosage of ether.
4. Severe Burns: Intravenous morphia. Any anaesthetic was poorly borne, and if any was required minimal doses of pentothal with oxygen or gas and oxygen were given.

Regional Types of Cases

1. Heads: A combination of local anaesthesia and pentothal was used by our forward surgeons. In special centres local anaesthesia was superseded by general anaesthesia, generally pentothal in small dosage, supplemented by gas and oxygen. Cyclopropane was also used when available in special units. Endotracheal

anaesthesia was used when necessary in cases involving the sinuses and when operation had to be performed in the prone position. Pentothal was used for induction and then followed by gas and oxygen, supplemented if necessary by minimal dosage of trilene or chloroform.

2. Facio-maxillary: In minor cases pentothal was used when there was no interference with the airway. In severe cases an endotracheal tube was passed, the throat packed-off with gauze soaked in saline or paraffin, and the anaesthetic continued with gas and oxygen and minimal quantity of ether. An efficient airway was necessary at all times, both during the operation and afterwards, and a naso-pharyngeal tube was generally used in severe cases following operation. In cases with serious bleeding or when intubation was impossible, tracheotomy was performed.

3. Chests: In minor cases, such as for closing the wound or arresting haemorrhage, pentothal was used. In more serious cases after pentothal induction gas and oxygen with trilene was given using Boyle's apparatus. Cyclopropane was utilised in special units for these cases. Diathermy and naked lights were centra-indications to its use.

4. Abdomens: Pentothal was used for induction followed by gas and oxygen and ether, or by ether alone using Macintosh's apparatus. Relaxation necessitated the use of ether in these cases. Local anaesthesia was used by some surgeons either in the area of the incision or as an intercostal block below the ribs. Splanchnic block was also sometimes utilised. Intratracheal anaesthesia was employed at times.

Anaesthesia in the Ease Hospitals in 2 NZEF

Operations on patients were generally performed under pentothal, supplemented by ether or gas and oxygen, utilising anaesthetic machines, either the army Boyle's apparatus or more commonly the more elaborate American types. Macintosh's Oxford vaporiser was very efficient for the administration of ether, though specialist anaesthetists preferred the more elaborate machines. Continuous pentothal was used considerably at one period in our base hospitals. Cyclopropane became available in the latter part of the war and was used for special cases. For the routine civilian type of operation pentothal was also generally used.

Spinal anaesthesia was used by some surgeons for operations such as those for inguinal hernia and haemorrhoids. A heavy stovaine solution, the most readily available, was used in Egypt, but limited use was made of light nupercaine, chiefly for lower abdominal and kidney operations. Defective ampoules were detected when they were placed in coloured antiseptic. Severe post-operative headaches resulted from solutions prepared at the hospital. Pentothal, however, remained the routine anaesthetic not only for induction, but for the completion of the operation, and proved a reliable and safe drug.

An interesting step was taken at 2 General Hospital in the resurrection of the use of intravenous ether. This was found most useful for operations requiring comparatively light anaesthesia without profound relaxation—for instance, in operations on the limbs. The solution used was at first made up accurately as 6 per cent in normal saline or glucose saline. As the solubility of ether in these solutions is round about this mark, it was found unnecessary to do more than make a saturated solution by shaking up the ether with the saline and assuming a saturated solution if a small quantity of undissolved ether could be seen floating on the surface of the fluid. A simple infusion set was used and was mounted on a board attached to the anaesthetic table. The tube from the set terminated in a male fitting to connect with a record needle. This tube rested in a sterile dish when not in use. A 19 or 20 gauge needle was used for venipuncture, and when blood flowed the fitting on the end of the infusion set was pushed into the hub. A fast drip rate was immediately started, and it was found that even a continuous flow was often required. To expedite unconsciousness and minimise any undesirable manifestations of the second stage of anaesthesia a small dose up to 0–5 grammes of thiopentone was injected through the infusion tube. As the anaesthesia proceeded the rate of infusion of the ether solution could be greatly reduced and stabilisation in a light plane of anaesthesia was easily accomplished. At least eight hundred of these administrations were performed without any untoward reactions. In one hundred or more 5 per cent alcohol was used with the ether with some benefit in depth of anaesthesia, but a few cases of post-operative thrombosis of veins ensued. It was realised that very large quantities of fluid were being infused into each patient if the operation was in any way protracted, but it was found that no apparent harm resulted. Of course, this work was done in conditions of great heat and minimum humidity, and the patients were losing large quantities of water by evaporation from the skin, and it may well be that there would be some risk of 'water-logging' if the method was used in cool and humid climates.

Post-anaesthetic Complications

Chest complications were common, often being associated with collapse of the lung and sometimes with infection. Collapse of the lung was considered by all to be due to bronchial obstruction from mucous plugs. Infection was most commonly associated with pre-operation infection such as common colds and bronchitis. Preventive measures were adopted, firstly, by the institution of regular breathing exercises before operation, and, secondly, by the exclusion of patients with infection from operation. Treatment in the cases with collapse of the lung consisted in continuing breathing exercises and encouraging movement and coughing. In cases with infection, sulphonamides and penicillin were given when the type of infection was suitable to their use.

Organisation of Anaesthetic Services in 2 NZEF

There was provision for an anaesthetist on the staff of our general hospitals, and Captain Slater was appointed to 1 NZ GH, Major Anson to 2 NZ GH, and Captain Taylor to 3 NZ GH. Captain Slater was captured in Greece and remained a prisoner of war for the greater part of the war. Major Anson, after service for some time at the Helwan hospital, was transferred to administrative work.

The anaesthetic work was of necessity carried out by medical officers largely without much previous experience in anaesthesia, though many later proved very capable anaesthetists. There was no special anaesthetic organisation, medical officers being delegated to anaesthetic duty by the OCs of the units or attached to a surgical team or FSU as anaesthetist. The unit anaesthetist was generally utilised in quiet periods for other medical work such as the control of the blood bank.

New Zealand had very few whole-time anaesthetists in civil practice available as anaesthetic specialists. The 2nd NZEF was thus at a great disadvantage compared with the British and American forces, where specialist anaesthetists were readily available, many of them very highly qualified for the work. The 2nd NZ Division was fortunate in having attached to its forward units British FSUs containing very capable specialist anaesthetists, who not only provided excellent service in our units, but helped in training many of our young medical officers. The British anaesthetists were given definite status as specialist anaesthetists or graded specialists, but this did not apply to 2 NZEF.

Recommendations for the Future

It is beyond our scope to go into the question of the value of newer methods of anaesthesia, such as the use of curare, in a future war. Perhaps newer methods will supersede those used in the Second World War. We can only give an impression of what seemed most practicable at the end of the war. Elaborate machines were utilised freely at the end of the war, and if these and supplies of gas and oxygen were readily available it would seem that they should be utilised at the CCSs and the General Hospitals.

In the field units intravenous anaesthesia by pentothal or similar drug, and ether by Macintosh's apparatus, would appear to be the most satisfactory methods to adopt.

If circumstances rendered elaborate methods impossible, then pentothal and ether by Macintosh's apparatus for the wounded man, and spinal and local with whatever other methods of anaesthesia were available for the civilian surgery type of cases, would provide efficient anaesthesia.

Staffing: With the utilisation of more elaborate methods of anaesthesia it will be necessary to have specialist anaesthetists. Specialist or graded anaesthetists should be appointed to the base hospitals, to the CCS, and to the FSUs. They would not only give the anaesthetics, but would be available for training MOs for work both in the forward and base units, and, if required, to train nursing sisters or orderlies to give simple anaesthetics under supervision.

There should be a senior anaesthetist available in an advisory capacity as regards the appointment of specialist and graded anaesthetists and the anaesthetic service in general.

If highly trained anaesthetists are available and are suitably employed, and their advice sought and taken, then a satisfactory service would be ensured, as the provision of apparatus and supplies is, in comparison, a secondary consideration.

Lieutenant-Colonel Anson has stressed the necessity for having trained anaesthetists in the New Zealand Medical Corps. He has also urged the standardisation of relatively simple, foolproof, ruggedly-constructed anaesthetic apparatus, easily serviced and maintained; an agreement on such apparatus within the British Commonwealth, or even farther afield, would be of great benefit not only in war but in civilian practice also.

WAR SURGERY AND MEDICINE

[SECTION]

ANAESTHESIA has transformed war surgery from the primitive operations formerly performed by military surgeons to the ordered and deliberate techniques of today. Anaesthesia had developed considerably before the First World War, and ether had become established as a much safer and more satisfactory anaesthetic than chloroform. Special apparatus had been evolved to render its administration more satisfactory. Clover's apparatus had given way to the open administration on a mask, which was safer but wasteful and difficult to administer in warm countries. Chloroform was still used, especially in Edinburgh, and chloroform and ether mixtures were commonly utilised.

Shipway had introduced a simple apparatus to enable warm ether vapour to be given by passing air or oxygen through the ether bottle which stood in a warm water container. Gas (nitrous oxide) and oxygen had also been introduced and Boyle had invented an apparatus for its administration, ether being also given in conjunction if required. Spinal anaesthesia was commonly used in some hospitals.

FIRST WORLD WAR

First World War

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BETWEEN THE WARS

Between the Wars

Between the wars anaesthesia developed markedly and became more and more recognised as a specialty. Elaborate machines were developed for the administration of a variety of anaesthetics, though ether still remained the most common type. Cyclopropane was introduced and proved very safe and satisfactory. Intravenous administration of new drugs proved satisfactory for the induction of anaesthesia and for short operations. Rectal administration was also utilised. Pentothal sodium was used before the beginning of the 1939–45 War and rapidly came into favour.

SECOND WORLD WAR

Types of Anaesthetic

It was well recognised before the war that chloroform was a dangerous drug, especially in shocked and septic cases, and was quite unsuited to war conditions. Spinal anaesthesia was also banned in similar cases and was restricted to cases of civilian surgery.

Ether remained the basic general anaesthetic for ordinary purposes, but its grave disadvantage was rapid evaporation in tropical countries. (Lieutenant-Colonel Anson, senior anaesthetist, however, stated that there was no real difficulty found in its use in conditions of extreme heat.) It also produced vasodilatation which was deleterious in shock, though this condition could be counteracted by efficient treatment by transfusion.

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Pentothal began to be used early in the war, and became the routine method of induction and the only anaesthetic for the majority of the cases. Care was necessary to prevent overdosage, and caution required in cases with any possible liver damage such as extensive burns. The average wounded man reacted well to pentothal, and there were few complications. The drug was usually given by intravenous dosage of fixed amounts, repeated as required up to a predetermined maximum. It was also administered by continuous intravenous injection, the total dose being controlled. In shocked cases care was necessary, and small doses sufficient. Pentothal was without question the most satisfactory anaesthetic used during the war for all ordinary wounded or civilian cases.

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Regional Types of Cases

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minimal dosage of trilene or chloroform.

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Recommendations for the Future

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CHAPTER 5
Gas Gangrene

T he anaerobic infection of war wounds presented problems in both World Wars.

First World War

In the 1914–18 War, during the fighting in Europe, anaerobic infection was very common and was responsible for many amputations and deaths. The technique of the primary excision of the wound was developed largely to combat this infection. The radical removal of damaged and avascular muscle was determined because of the ready growth of the anaerobic organisms in this tissue. The priority as regards operation was commonly arranged not by the extent of the wound, but by the presence of anaerobic infection, which was generally rapidly detected by the characteristic smell and often by the discoloration of the skin. General signs of toxaemia with rapid, thready pulse and anaemia were present, and locally the limb was swollen and gas was present in the tissues, giving a feeling of crepitation on examination and showing up in X-ray examination.

The anaerobic infection was accentuated by the wet and dirty condition of the clothing brought about by the nature of trench warfare at that time in Flanders and Northern France. Treatment consisted in the radical excision of all traumatised tissue, especially avascular muscle, and the removal of any retained pieces of clothing or foreign bodies. The wound was freely enlarged and left wide open and treated by antiseptics. The continuous irrigation with the hypochlorites by the Carrel-Dakin method was of great value. Intravenous injection of sodium bicarbonate solution was utilised as well as saline and glucose. Some blood transfusion was also given. X-ray was used as treatment, and some success claimed.

The results of treatment were good as regards prevention and in localised infection. Removal of whole muscle and muscle groups often proved entirely successful in preventing the spread of the infection and amputation of the limb often saved life.

In the fulminating cases associated with generalised infection death normally occurred. Gas infection can be said to have been the main anxiety of the forward surgeon in France in the First World War.

Second World War

During the 1939–45 War the problem was much less serious and the cases much less numerous, and forward surgeons only rarely came across marked cases. There was no question of sorting out cases for operation because of the presence of signs of anaerobic infection. It has been stated that anaerobic infection was just as common during the last war as it was in 1914–18. No surgeon with experience of the conditions in the forward areas in both wars could possibly hold such an opinion. Our observation showed that anaerobic infection was uncommon during the desert campaigns, and that gangrene seldom developed apart from the destruction of the main blood supply of the limb. In Italy, in spite of the conditions being more suited to the development of the infection, there was no marked increase noted. This was probably due to the satisfactory wound treatment and partly to the action of penicillin in the prevention of infection. The treatment of anaerobic infection during the war was, as in the First World War, largely preventative.

The surgical cleansing of the wound and, as has been pointed out, the removal of devitalised muscle remained the essential part of the treatment. When infection was actually present surgery again was all important, and consisted in the free exposure of the wound and the removal of all infected muscle. When serious infection of a single muscle or muscle group was present, radical removal of the muscle or group was undertaken.

Amputation was only carried out when these measures were insufficient and when the main blood supply of the limb was interfered with. When complete removal of infected tissues was impossible because of the widespread nature of the infection or the condition of the patient, very free incisions were made into the infected tissues. All other forms of treatment were of secondary importance.

Serum was given in large doses throughout the war and was at one time thought to be of benefit, but finally was considered to have no definite effect on the progress of the infection. It was given also as a prophylactic in cases of serious muscle injury and in buttock wounds, and may have been of some benefit in that way. At first it was thought that the serum was ineffective because there was insufficient of the malignant oedema component, and the proportion of this was increased. It was estimated that malignant oedema organisms were present in 9 per cent of the cases, as against Welchii organisms in 66 per cent and Vibrio Septique in 14 per cent. The malignant oedema cases, however, were much more serious and carried a high mortality.

The dose of serum administered as a minimum was 49,500 units (in three ampoules), and this was repeated six-hourly if necessary. When there was no reaction much larger doses were given, especially if B. Oedematiens infection was suspected. There were only 15,000 B. Oedematiens serum in 82,500 units of the composite serum.

The sulphonamides were given regularly during the greater part of the war, both as a preventative and as a curative agent, but were considered finally to be of little use. Penicillin superseded the sulphonamides and proved of definite value in all cases surviving for more than twenty-four hours after infection had been observed.

In the fulminating cases little effect was seen. Large doses were given parenterally in all cases of established infection, and there was general agreement that this was of definite value. Blood transfusion was given both as a means of raising the resistance of the patient to infection and also of combating the anaemia always associated with it. It was also of value in the prevention of secondary infection to which very anaemic patients were specially liable.

In October 1944 it was noted that gas gangrene had been a little more common and that one death had occurred. All the other cases had cleared up rapidly after the excision of the affected muscles, and early secondary suture of the wounds had been successfully carried out. With adequate and prompt surgery, except for the occasional fulminating case, the cases had presented no great difficulty.

At the end of the war anaerobic infection was combated by the preventative measures of surgery, the administration of blood, parenteral penicillin, and serum. Treatment of established infection consisted of the radical surgical removal of muscle, at times of amputation (amputation was unnecessary if the limb was viable), and the administration of large doses of penicillin and moderate quantities of blood.

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(b) The presence of gas in the tissues.
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Infection by B. Oedematiens showed very severe toxaemia, marked swelling, diffuse gelatinous oedema, profuse discharge and a feeling of weight. There was no gas formation. The symptoms developed later than those due to B. Welchii. The majority of the cases recovered or died within twelve hours of the onset of the symptoms.

There were two distinct types of anaerobic infection, gas gangrene proper and claustridial myositis. The latter was associated with the presence of gas in the muscles and also in the subcutaneous tissues, but gangrene did not occur nor was there the profound toxaemia associated with the gangrene cases. Whereas there was a mortality of about 50 per cent in gas gangrene, myositis in itself did not cause death.

Anaerobic streptococcal myositis gave rise to a swollen limb with bright-red muscles which were not gangrenous. The muscle smear showed small chained streptococci. Deep incisions were made into the muscles, and large doses of sulphathiazole, 60 grammes in forty-eight hours, were given till penicillin became available and was administered in full parenteral doses.

In Italy there were 72,000 battle casualties in the Allied armies between

September 1943 and October 1944, and among them 236 cases of gas gangrene were reported with a mortality of 46 per cent. Of a total of 312 cases (including accidental injuries), there were 17 New Zealanders. About half the total cases had damage to the main vessels. A few were caused by tight plasters. Some of the deaths were due to other causes, including severe sepsis and anuria. Just over half died in the General Hospitals, and most of the others at the CCSs. The heaviest rate of mortality was seen in wounds of the abdomen, head, and neck (100 per cent), and in buttock and thigh wounds it was about 60 per cent.

[SECTION]

The anaerobic infection of war wounds presented problems in both World Wars.

FIRST WORLD WAR

First World War

In the 1914–18 War, during the fighting in Europe, anaerobic infection was very common and was responsible for many amputations and deaths. The technique of the primary excision of the wound was developed largely to combat this infection. The radical removal of damaged and avascular muscle was determined because of the ready growth of the anaerobic organisms in this tissue. The priority as regards operation was commonly arranged not by the extent of the wound, but by the presence of anaerobic infection, which was generally rapidly detected by the characteristic smell and often by the discoloration of the skin. General signs of toxaemia with rapid, thready pulse and anaemia were present, and locally the limb was swollen and gas was present in the tissues, giving a feeling of crepitation on examination and showing up in X-ray examination.

The anaerobic infection was accentuated by the wet and dirty condition of the clothing brought about by the nature of trench warfare at that time in Flanders and Northern France. Treatment consisted in the radical excision of all traumatised tissue, especially avascular muscle, and the removal of any retained pieces of clothing or foreign bodies. The wound was freely enlarged and left wide open and treated by antiseptics. The continuous irrigation with the hypochlorites by the Carrel-Dakin method was of great value. Intravenous injection of sodium bicarbonate solution was utilised as well as saline and glucose. Some blood transfusion was also given. X-ray was used as treatment, and some success claimed.

The results of treatment were good as regards prevention and in localised infection. Removal of whole muscle and muscle groups often proved entirely successful in preventing the spread of the infection and amputation of the limb often saved life.

In the fulminating cases associated with generalised infection death normally occurred. Gas infection can be said to have been the main anxiety of the forward surgeon in France in the First World War.

SECOND WORLD WAR

Second World War

During the 1939–45 War the problem was much less serious and the cases much less numerous, and forward surgeons only rarely came across marked cases. There was no question of sorting out cases for operation because of the presence of signs of anaerobic infection. It has been stated that anaerobic infection was just as common during the last war as it was in 1914–18. No surgeon with experience of the conditions in the forward areas in both wars could possibly hold such an opinion. Our observation showed that anaerobic infection was uncommon during the desert campaigns, and that gangrene seldom developed apart from the destruction of the main blood supply of the limb. In Italy, in spite of the conditions being more suited to the development of the infection, there was no marked increase noted. This was probably due to the satisfactory wound treatment and partly to the action of penicillin in the prevention of infection. The treatment of anaerobic infection during the war was, as in the First World War, largely preventative.

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CHAPTER 6 — TETANUS

CHAPTER 6
Tetanus

FIRST WORLD WAR

THE distribution of tetanus spores in the soil varies to a marked degree over the world. In the First World War most cases were infected in France and Belgium. Few cases were reported in British armies in other areas—seven in Mesopotamia, six from Gallipoli (all in cases of trench foot), four in Salonika, and three in Italy. Lack of recorded cases suggested there were few cases in Egypt. In 1 NZEF the number of cases is not known, but there were three deaths. Among the British troops in France the rate of infection at the beginning of the war was over eight per 1000 wounded, but this was reduced by the giving of injections of anti-tetanic serum after wounding from the end of 1914, so that the over-all rate for the period of the war was 1·47 per 1000 wounded. The total number of British cases was 2529. Mortality was 50 per cent in these cases, but death was not necessarily due to tetanus alone.

SECOND WORLD WAR

In the Second World War active immunisation of all troops sent overseas was practised, and the results proved the value of inoculation. There were few cases of tetanus recorded among New Zealanders, although it is not known that any of the soil over which they fought was highly infected.

The procedure for prophylaxis was for each man, shortly after mobilisation, to be inoculated with two doses of 1 ccm. of tetanus toxoid at an interval of six weeks. After a further interval of at least six months a third dose of 1 ccm. was given, with further doses at intervals of a year or less.

As soon as possible after an injury was inflicted each wounded man was given a dose of 3000 international units of anti-tetanus serum (ATS). This was intended to cover any gaps in the protection offered by active immunisation.

There are three reports of cases in 2 NZEF during the war. Captain Borrie recorded two deaths from tetanus at Kokkinia prisoner-of-war hospital in Athens. One was a Maori, but the force to which the other belonged was not stated. [1] Both had severe wounds, no adequate surgery, and had had no ATS after wounding. Both had had tetanus toxoid a year previously. Boyd and Maclennan, RAMC pathologists, in 1942 recorded two cases, both Maoris, one of whom died. The Consultant Surgeon CMF recorded two New Zealand cases in a total of 42 Allied cases in Italy. Both survived. There are no other reports of cases in the 2 NZEF.

This gives a total of a certain five (and possibly six), with two (or three) deaths during the whole period of the war. Two, or possibly three, were wounded in Crete and had no ATS and inadequate surgery. Three were Maoris, two of whom were wounded in Crete, and two died. The report of 2 General Hospital on the Maori who developed tetanus in the hospital eight days after being wounded in Crete stated that a complete recovery followed massive injections of ATS intramuscularly and intravenously.

It would appear that the lack of prophylactic ATS, associated with lack of adequate surgical treatment, together produced a dosage of toxin in the body sufficient to overwhelm the protective barrier produced by the tetanus toxoid injections.

There may also be a relative lack of immunity in the Maori race, but as there appear to have been no further cases after July 1942 this can hardly be a matter of much importance.

Boyd and Maclennan emphasized that early diagnosis must be based on clinical signs and symptoms as bacteriological examination gives no timely positive assistance. They consider that immunisation by tetanus toxoid in three doses has proved eminently satisfactory, but that prophylaxis by ATS and particularly adequate surgical treatment are both still necessary and that massive production of tetanus toxin in the body can still be fatal in spite of immunisation and prophylaxis.

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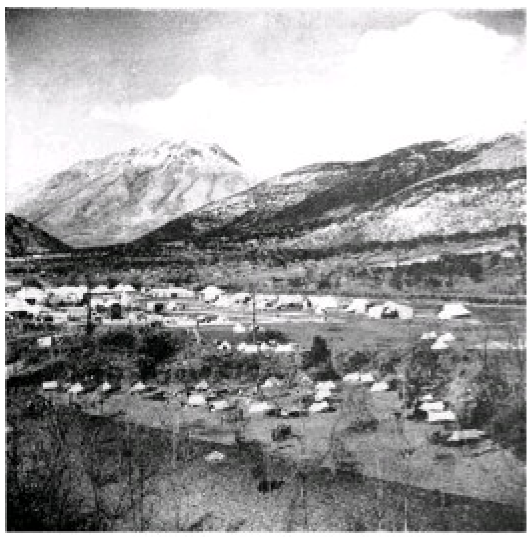

5 MDS near Cassino, March 1944

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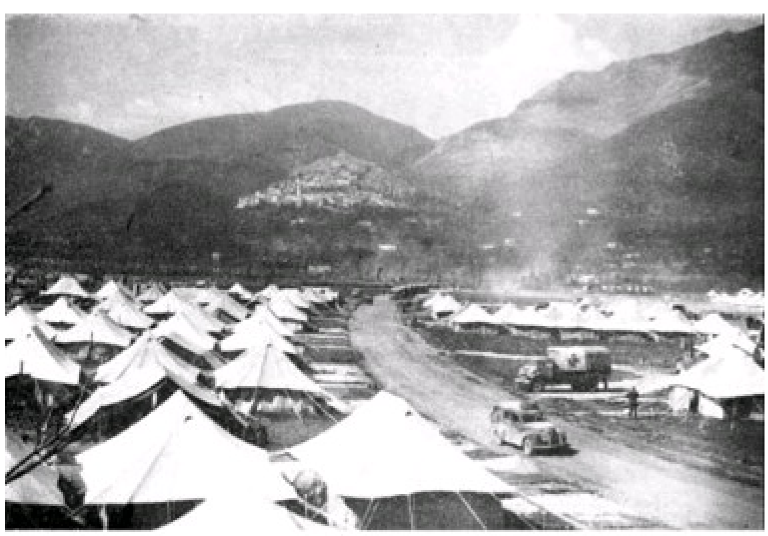

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Patients on stretcher-jeep near Cassino, April 1944

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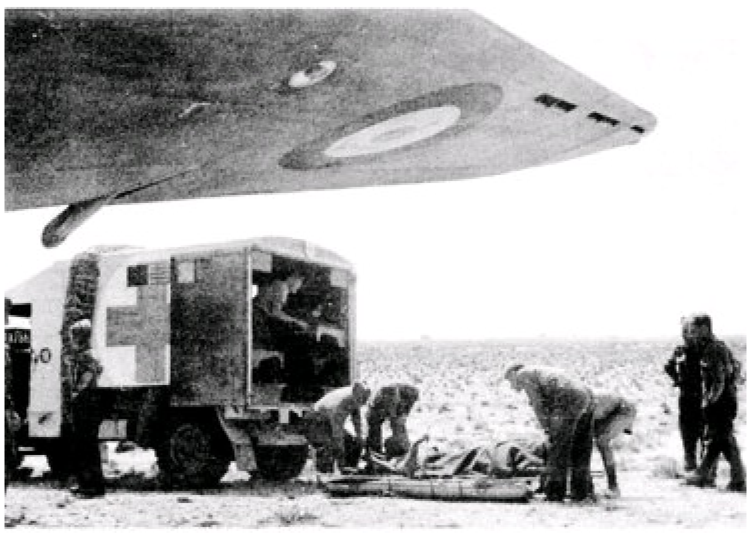

Air evacuation, Tunisia, April 1943

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Mobile Surgical Unit equipment van, Maadi

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A surgeon of the British Field Surgical Unit operating at 1 NZ CCS, Gabes

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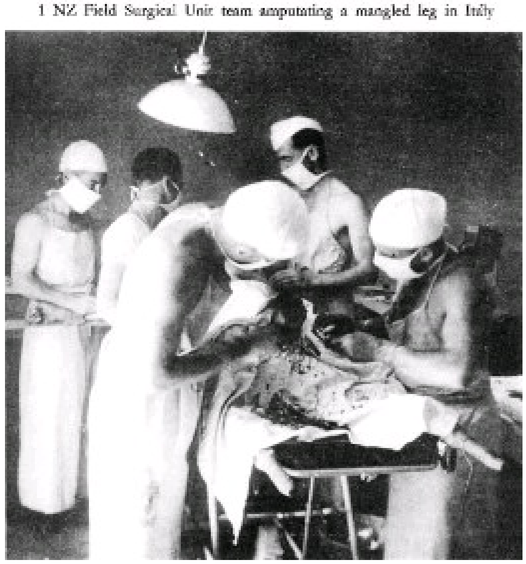
1 NZ Field Surgical Unit team amputating a mangled leg in Italy



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2 NZ Field Transfusion Unit collecting blood from donors at Tobruk, November 1942

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Resuscitation room at 4 MDS, Faenza, January 1945

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1 NZ CCS Operating Theatre at MDS, Alamein Line, August 1942

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4 MDS Operating Theatre, Alamein Line, August 1942

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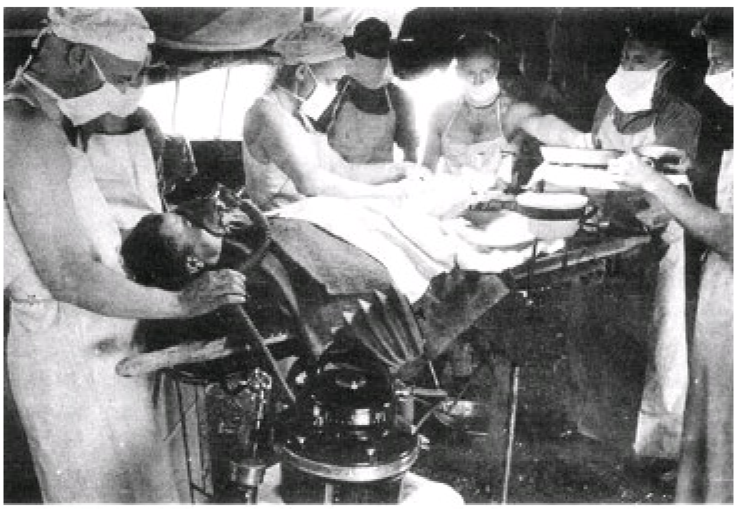

Application of a Thomas splint and use of Macintosh anaesthetic apparatus, 6 MDS, Cassino, April 1944

Application of a Thomas splint and use of Macintosh anaesthetic apparatus, 6 MDS, Cassino, April 1944

Bomb casualty, Alamein, showing traumatic amputation

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Abdominal operation, Alamein, 24 October 1942 showing suction apparatus

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Operation on severe leg injury, 1 NZ CCS

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Post-operative intravenous saline and gastric suction for abdominal injury, 1 NZ CCS, Forli, 1944

Post-operative intravenous saline and gastric suction for abdominal injury, 1 NZ CCS, Forli, 1944

Ward of abdominal cases, 1 NZ CCS, Gabes, 1943, showing gastric suction and intravenous saline apparatus.

Ward of abodominal cases, 1 NZ CCS, Gabes, 1943, showing gastric suction and intravenous saline apparatus

Nursing sister in tented ward in 1 NZ CCS at Tarnet in January 1943

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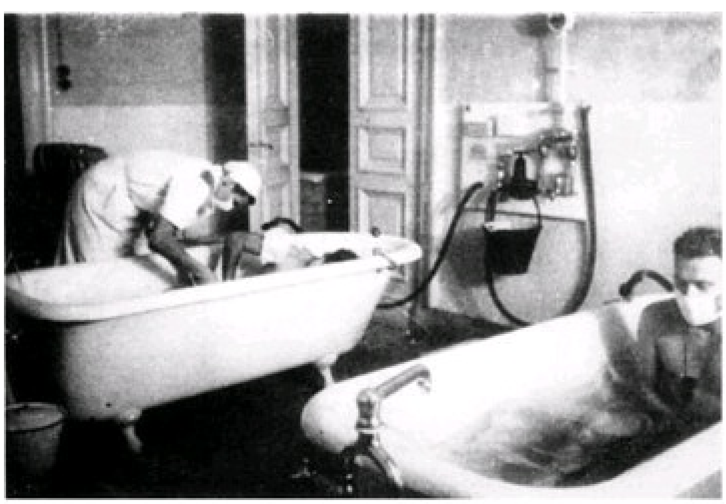
Tobruk splint applied for fracture of femur, 6 MDS, April 1944
Note the drawing on the plaster

Tobruk splint applied for fracture of femur, 6 MDS, April 1944



Saline bath unit, 1 NZ General Hospital, Helwan. Note precautions against secondary infection

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X-ray Department, 3 NZ General Hospital, Beirut

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Kramer wire abduction frame, prisoner-of-war hospital, Kokkinia, Athens, 1941

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Examples of calipers and splints made by prisoners of war at Lamsdorf, Germany, 1944

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Fighting the fly menace, Alamein Line, September 1942

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28 NZ Battalion taking showers, Cassino, March 1944

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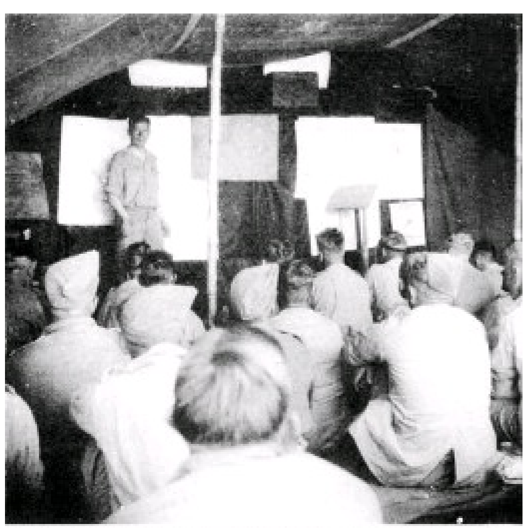

Lecture to anti-malaria squads from New Zealand units in Italy, May 1944

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Malaria Control Unit spraying pools, Guadalcanal, 1944

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Treatment: ATS on 24 July at 4.30 p.m., 60,000 units partly intravenously partly intramuscularly; at 6 p.m. 90,000 units intramuscularly.

Autopsy: Left forearm and arm greatly swollen; two large wounds on posterolateral aspect of left arm with superficial healing; spiral fracture of middle third of humerus, and all deep muscles showed extensive necrosis, almost colliquative; no actual pus or gas present; liver and kidneys showed toxic changes. Portions of muscle from the upper and lower thirds of triceps, and the deep surface of the trapezius, and a portion of bone-marrow from the humerus all yielded a growth of Cl. tetani, type III. Other anaerobes were present, but have not yet been identified.

Reference

J. S. K. Boyd and J. D. M acL ennan Lancet, 26 December 1942.

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[1] Believed to have been an Australian.

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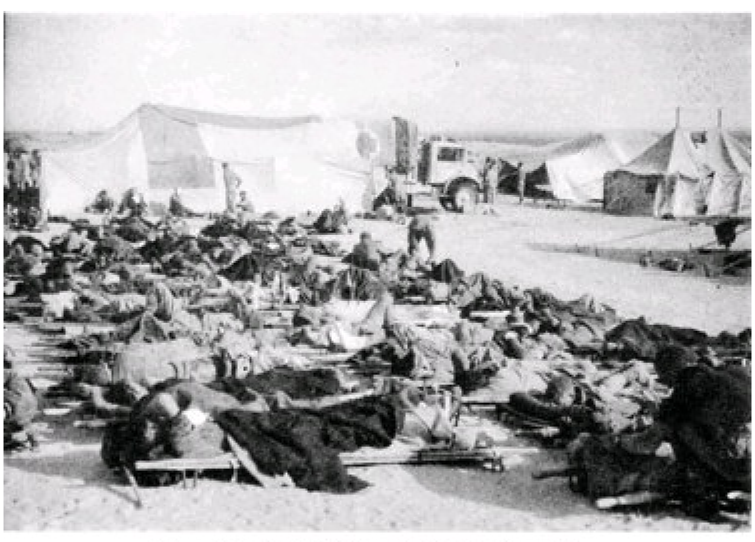

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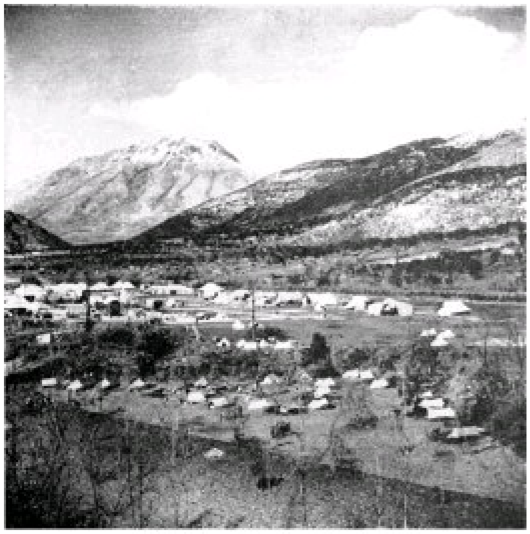

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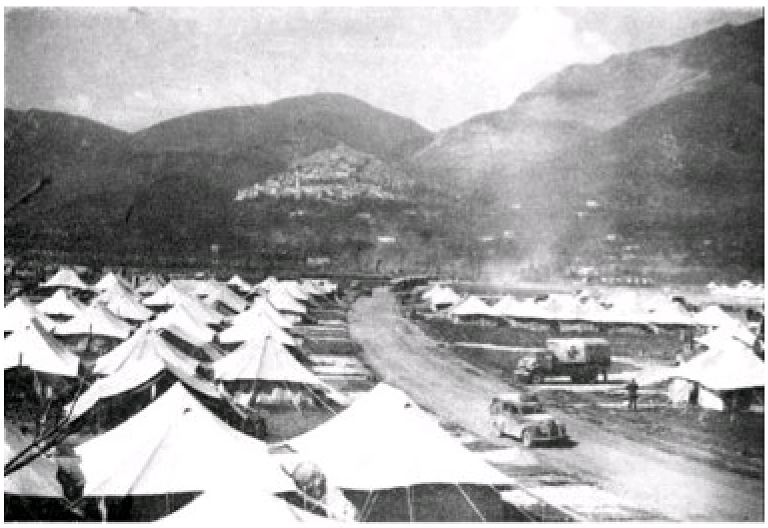

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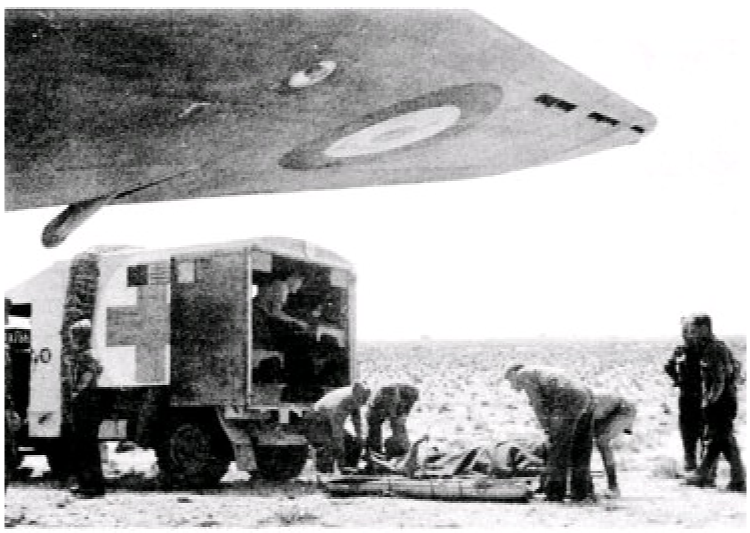
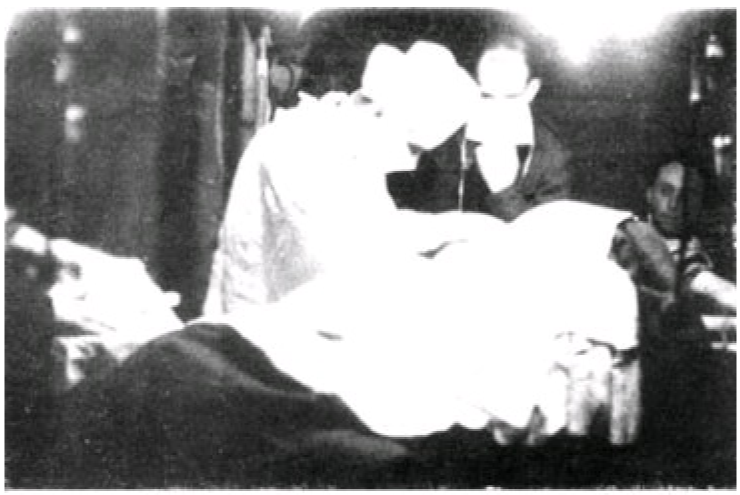


Air evacuation, Tunisia, April 1943

Air evacuation, Tunisia, April 1943

Mobile Surgical Unit equipment van, Maadi

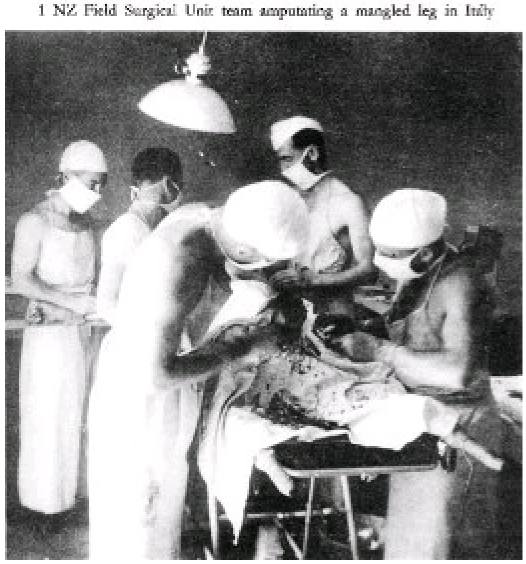
Mobile Surgical Unit equipment van, Maadi



A surgeon of the British Field Surgical Unit operating at 1 NZ CCS, Gabes

A surgeon of the British Field Surgical Unit operating at 1 NZ CCS, Gabes

1 NZ Field Surgical Unit team amputating a mangled leg in Italy



1 NZ Field Surgical Unit team amputating a mangled leg in Italy

2 NZ Field Transfusion Unit collecting blood from donors at Tobruk, November 1942

2 NZ Field Transfusion Unit collecting blood from donors at Tobruk, November 1942

Resuscitation room at 4 MDS, Faenza, January 1945

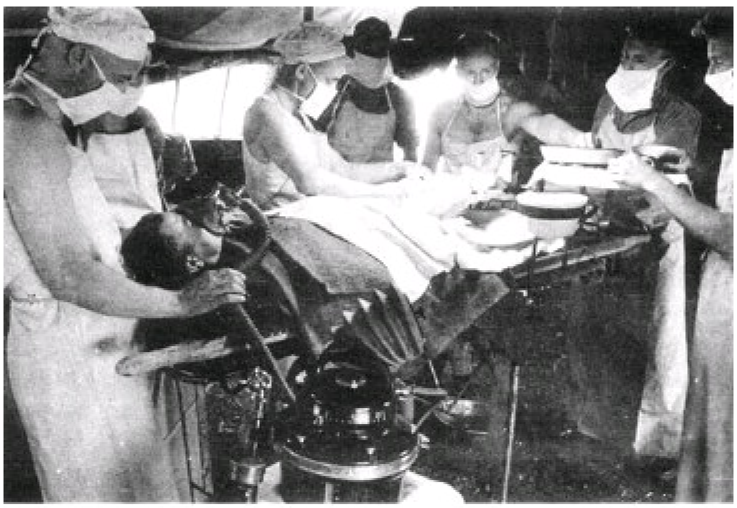
Resuscitation room at 4 MDS, Faenza, January 1945

1 NZ CCS Operating Theatre at MDS, Alamein Line, August 1942

1 NZ CCS Operating Theatre at MDS, Alamein Line, August 1942


4 MDS Operating Theatre, Alamein Line, August 1942

4 MDS Operating Theatre, Alamein Line, August 1942


Application of a Thomas splint and use of Macintosh anaesthetic apparatus, 6 MDS, Cassino, April 1944

Application of a Thomas splint and use of Macintosh anaesthetic apparatus, 6 MDS, Cassino, April 1944

Bomb casualty, Alamein, showing traumatic amputation

Bomb casualty, Alamein, showing traumatic amputation

Abdominal operation, Alamein, 24 October 1942 showing suction apparatus

Abdominal operation, Alamein, 24 October 1942 showing suction apparatus

Operation on severe leg injury, 1 NZ CCS

Operation on severe leg injury, 1 NZ CCS

Post-operative intravenous saline and gastric suction for abdominal injury, 1 NZ CCS, Forli, 1944

Post-operative intravenous saline and gastric suction for abdominal injury, 1 NZ CCS, Forli, 1944

Ward of abdominal cases, 1 NZ CCS, Gabes, 1943, showing gastric suction and intravenous saline apparatus.

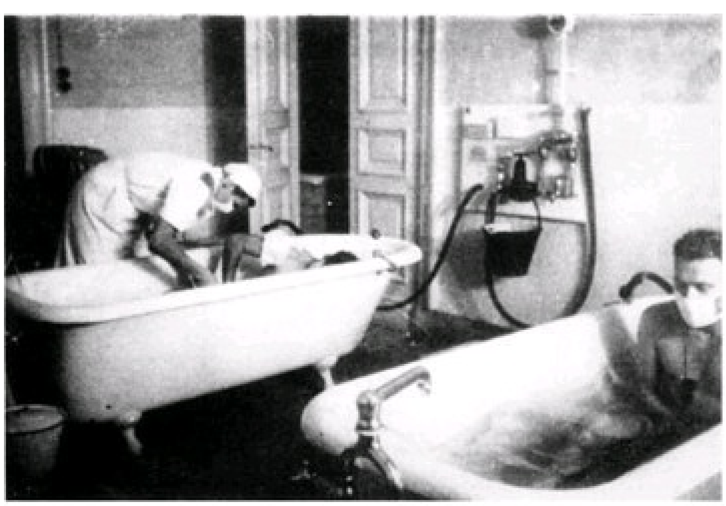
Ward of abodominal cases, 1 NZ CCS, Gabes, 1943, showing gastric suction and intravenous saline apparatus

Nursing sister in tented ward in 1 NZ CCS at Tarnet in January 1943

Nursing sister in tented ward in 1 NZ CCS at Tarnet in January 1943

Tobruk splint applied for fracture of femur, 6 MDS, April 1944
Note the drawing on the plaster

Tobruk splint applied for fracture of femur, 6 MDS, April 1944



Saline bath unit, 1 NZ General Hospital, Helwan. Note precautions against secondary infection

Saline bath unit, 1 NZ General hospital, Helwan, Note precautions against secondary infection

X-ray Department, 3 NZ General Hospital, Beirut

X-ray Department, 3 NZ General Hospital, Beirut

Kramer wire abduction frame, prisoner-of-war hospital, Kokkinia, Athens, 1941

Kramer wire abduction frame, prisoner-of-war hospital, Kokkinia, Athens, 1941

Examples of calipers and splints made by prisoners of war at Lamsdorf, Germany, 1944

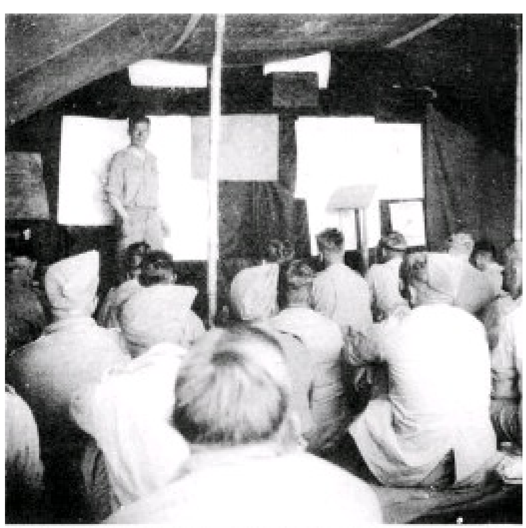
Examples of calipers and splints made by prisoners of war at Lamsdorf

Fighting the fly menace, Alamein Line, September 1942

Fighting the fly menace, Alamein Line, September 1942

28 NZ Battalion taking showers, Cassino, March 1944

28 NZ Battalion taking showers, Cassino, March 1944



Lecture to anti-malaria squads from New Zealand units in Italy, May 1944

Lecture to anti-malaria squads from New Zealand units in Italy, May 1944

Malaria Control Unit spraying pools, Guadalcanal, 1944

Malaria Control Unit spraying pools, Guadalcanal, 1944

Treatment: ATS on 24 July at 4.30 p.m., 60,000 units partly intravenously partly intramuscularly; at 6 p.m. 90,000 units intramuscularly.

Autopsy: Left forearm and arm greatly swollen; two large wounds on posterolateral aspect of left arm with superficial healing; spiral fracture of middle third of humerus, and all deep muscles showed extensive necrosis, almost colliquative; no actual pus or gas present; liver and kidneys showed toxic changes. Portions of muscle from the upper and lower thirds of triceps, and the deep surface of the trapezius, and a portion of bone-marrow from the humerus all yielded a growth of Cl. tetani, type III. Other anaerobes were present, but have not yet been identified.

REFERENCE

Reference

J. S. K. Boyd and J. D. M acL ennan Lancet, 26 December 1942.

CHAPTER 7 — HEAD INJURIES

Contents

FIRST WORLD WAR

HERE was little recorded experience of the treatment of head wounds in war available to the surgeons called on to treat these injuries in the First World War. As the treatment of other war wounds developed, so did that of the head wounds.

When the New Zealand Division reached France the New Zealand surgical teams attached to British Casualty Clearing Stations learnt how to treat the head wounds, which were being dealt with by the general surgeons responsible for all types of forward surgery. At that time the scalp wound was fully excised and enlarged so as to expose the damaged skull adequately. Bleeding was controlled, sometimes by means of a rubber band round the head just above the ears. During operation use was made of the galea to control bleeding by picking it up on forceps and drawing it back over the cut wound. The skull fragments were removed and the edges of the bony defect smoothed and cleansed by means of nibblers. The wound was irrigated with warm saline, which also tended to wash away the mushed extruded brain tissue. Pieces of bone were picked out of the brain track by forceps and, in large tracks, gentle palpation was sometimes used to find the fragments. Suction bulbs were used to syringe out the tracks. No extensive explorations were made of the brain tracks.

The scalp wound was then sutured, generally in one layer with interrupted stitches, as a rule no drain being utilised. To enable the wound to be brought together without tension much ingenuity was shown in the fashioning of flaps, and to relieve tension small lateral incisions were often made on either side of the wound. It was realised that it was essential to get healing in the main wound. The clean lateral incisions would heal up satisfactorily, and, in any case, mild infection of these would not be of such importance.

The suturing of the wound had been decided on at that time as the best means of preventing infection and herniation of the brain. Though the picture is similar to that of the Second World War there is one main difference—there were no special neurosurgical teams and no specialised equipment.

Later our only New Zealand hospital in France, 1 NZ Stationary Hospital, shifted from Amiens to Hazebrouck, and in doing so took over two British units, one of which had been constituted the Special Head Centre for the Second Army. This unit had had the responsibility of attending to all the head cases in that army. It had no X-ray machine and no specialised surgeon or staff, nor had it special equipment, except a few bone instruments. Our Stationary Hospital set up an X-ray unit in charge of one technician in a building, and had it working just in time to deal with the rush of casualties from the battle of Messines. Our hospital took all the head cases from this battle, and there were well over a hundred of them. We had one young general surgeon who had had some experience whilst attached to a British CCS, and an eye, ear, nose, and throat surgeon with no experience of these cases, but who was called upon to deal with serious cases at a table alongside, both tables being serviced by one sister. Gushing and Crile visited the hospital at the beginning of the rush of casualties. They had just arrived in France. Gushing was shown over the two theatres and he asked to see the instruments. He was shown a very poor and small selection of bone instruments, the only special equipment left by the British hospital, and all they had been supplied with as' the special head centre. His comment was, as might be expected,' But where are the head instruments, you cannot do any work with those.' The answer was to the effect that we had to operate with what was available, and he was then asked to take a table himself. He consented to do so and was at first assisted by a surgeon and a sister. Later he was rather startled when he was left with the sister as the only assistant. But whatever he thought of our surgery, Gushing had the highest admiration for our sisters, who had to cope with a very large number of very serious head cases at that period.

Later in the war more marked specialisation took place, and also some changes in the technique. BIPP (Bismuth lodoform Paraffin Paste) was rubbed into the wound by many surgeons and BIPPed silk used as a suture material. In Gushing's technique the scalp was excised down to the bone and radiating incisions were made so as to adequately expose the fracture. Burr openings were made round the injured bone and the whole area removed en bloc by cutting forceps. The dura was exposed. Local anaesthetic (procaine hydro-chloride) was employed. Coughing and straining were utilised to extricate the debris from the brain track. A soft rubber catheter was then attached to a rubber bulb and suction made in the track, bone fragments and foreign bodies being picked out of the track by means of fine forceps, or by a magnet. Primary closure of the wound was then carried out if operation was performed less than eighteen hours after wounding. If later, the wound was not closed, as the results of closure were not satisfactory. Brain fungi were covered with guttapercha and gradually receded. Dichloramine was used as an antiseptic in the treatment of infected wounds. It can be seen that the main characteristics of the technique were the block removal of bone and the use of suction through a catheter.

The results of the treatment in the First World War were better than were expected at the time, especially in the prevention of wound infection. The immediate mortality was heavy. There are German figures available showing that half of the deaths on the battlefield were due to wounds of the head and neck. The Germans stated that 15 per cent of all wounds at the RAP level were head injuries. There are French records available showing an immediate mortality of 48 per cent and later the loss of 33 per cent of the remainder. Gushing stated that there was a mortality of 32.4 per cent in head wounds at the CCS level, and that in penetrating wounds involving the brain mortality was 45 per cent, infection accounting for 88 per cent of the total.

Late Results

There were certain late complications, although many of the serious cases with gross brain injury made remarkable recoveries. They came under three main categories: infection, epilepsy, and cranial defects.

Infection: This generally was shown as a brain abscess associated frequently with retention of debris, often a piece of in-driven bone. It was found that metallic fragments, especially if of small size, seldom gave rise either to any subsequent disturbance or to infection. On the other hand, bone fragments frequently caused brain abscess, and on this experience was founded the operative procedures of the Second World War.

Epilepsy: This proved a common and very serious sequel of head injuries during the First World War. The epilepsy was, as a rule, generalised in form and not Jacksonian. It was most commonly associated with wounds penetrating the brain, especially when infection had been present. Cairns noted a close correlation between delayed wound healing, a manifestation of sepsis, and the development of epilepsy, with the highest incidence following brain fungus. The incidence of epilepsy in wounds penetrating the dura was given by Wagstaffe as 18.7 per cent; by Rawling as 33 per cent to 54 per cent; and by Ascroft as 45 per cent.

Ascroft stated that 11 out of 34 traced cases operated on by Gushing in the First World War developed epilepsy. When there had been no penetration of the dura the incidence was much less, and Ascroft gives a percentage of 23 in a group of pensions cases investigated by him.

Ascroft's figures were taken from a random sample of pension files about twenty years after the war. He showed that if epilepsy came on shortly after wounding it had a tendency to disappear, whereas if it came on two or three years afterwards it then became permanently established. The figures are, in our opinion, unduly pessimistic and this view is confirmed by the New Zealand War Pensions survey at the end of this article.

When large numbers of gunshot wounds of the head are surveyed there is still, however, an important incidence of epilepsy. Sargent quoted 4.5 per cent in a series of 18,000 cases.

Cairns made the interesting observation that the incidence in cases with a retained foreign body was much less than in those cases which had had a foreign body removed, namely, 38 per cent as against 53 per cent. He ascribed this to possible brain trauma.

Our New Zealand experience in regard to the incidence of epilepsy since the First World War, in the opinion of those associated with War Pensions for long periods, is that there has not been a high incidence of epilepsy in these cases. Head injuries in general give rise to much less disability than one would expect, and a few years after a war large numbers cease to draw pensions. In some cases the epileptic fits tend to cease.

It was clearly established, however, that there was a marked incidence of epilepsy following gunshot wounds of the head, especially those penetrating the brain and those associated with sepsis. The routine administration of sedatives for long periods was therefore advised in all serious head injuries. Relief was sometimes obtained by excision of the scarred area of the brain.

Cranial Defects: When large defects are present certain organic symptoms arise, such as giddiness on stooping. More commonly the symptoms are psychopathic in type, associated with the thought of possible injury to the unprotected brain. Following the First World War many large defects were closed by a number of different techniques. Metal plates were first used, composed of ordinary steel, and later of rustless steel and vanadium. Repair by cartilage and bone was also instituted. First grafts were cut to shape from the cartilaginous end of the lower ribs alongside the lower end of the sternum. These were fitted in beneath the rim of the defect. Then shaped arcs of the outer table of the skull were slipped over the defect from a contiguous part of the skull. Again, pieces of bone were taken from the ribs, tibia, and also later from the region of the crest of the ilium, the edge of the defect being freshened so as to allow of bony union. Increasing success was achieved by the different methods.

SECOND WORLD WAR

The lessons learnt in the First World War had not been entirely forgotten between wars. There were available in 1939 well-trained neurologists and neurosurgeons in Great Britain, with their highly efficient equipment developed for the carrying out of the elaborate technique used in brain operations in civil life.

Mobile head and chest units were developed in England at the beginning of the war with special vehicles fitted up with magnificent equipment, included in which was a diathermy set and a powerful suction apparatus. These units were sent over to France with the British Expeditionary Force in 1940 and, with all the elaborate equipment, were captured by the Germans. During hostilities they did a great deal of excellent work, but found that it was impossible to restrict their activities to head injury, and that they were called upon to operate on all types of wounded as they arrived. After Dunkirk fresh efforts were made to equip other units. At that time the Second Echelon of the 2 NZEF arrived in England. The Sims Mobile Surgical Unit was organised and equipped in England just after the Dunkirk period to deal with head and chest cases as well as other war wounds in 2 NZEF, and was equipped on the same pattern, every assistance being given by Professor Cairns and Mr. Tudor Edwards.

In Egypt, meanwhile, arrangements were made for the institution of neurological units. Major Ascroft, in charge of the first unit, carried out work in the forward areas as a special Forward Surgical Unit and gained valuable experience of war surgery. He found, however, that it was impossible to limit his work to neurological surgery as few head cases were seen, and there were many other urgent wounded cases to be dealt with. Most of the head cases were being operated on elsewhere, both in the forward areas and at the Base. Ascroft therefore advised the setting up of a special centre in Cairo where all head and spine wounds could be congregated and dealt with by the Neurological Unit. As a result the unit was attached to 15 Scottish General Hospital in Cairo, and forward units were advised to send head cases there, so that the definitive surgery could be undertaken by the unit and not in the forward areas, except in the case of emergency such as for haemorrhage, increasing compression, and when injuries of other parts demanded immediate treatment.

In cases that could not reach the unit under seventy-two hours a limited operation in the forward areas was advised, consisting of excision of all devitalised tissues and foreign matter, and minimal removal of bony fragments and non-suture of the wound, which was treated with sulphanilamide powder. The head cases did not suffer severely from shock and travelled well, especially by air. The cases which were operated on at the Base within seventy-two hours, Ascroft considered, did much better than those dealt with in the forward areas.

All our New Zealand head and spine cases were transferred to 15 Scottish Hospital both from the forward areas and from the Base, and came under the charge of the unit. This arrangement, which worked admirably without friction, made it possible to provide excellent treatment for our own troops.

The treatment given at that time was outlined by Major Ascroft at a surgical conference in Cairo in February 1942. At that time the attitude adopted was very conservative, but embodied the technique of the First World War.

In first-aid treatment the steps were:

(1) Note degree of shock, depth of coma, the nature of the head wound, and other wounds present.
(2) Cut away the hair around the wound, dust liberally with sulphanilamide powder, apply a first-aid dressing and secure firmly with adhesive tape, and apply pressure by bandaging to control any bleeding.
(3) Lay the patient half prone, to prevent suffocation.
(4) Give sulphadiazine by mouth or intravenously.

On the lines of communication attention was directed to:

(1) The recording at regular intervals of the state of consciousness.
(2) The need to note the presence of any fresh signs.
(3) The necessity of blood transfusion in moderate amount.
(4) The urgency of evacuation to the Base, if possible by air.
(5) The necessity to take measures to combat dehydration, if necessary by saline drips.

At the Base the same advice as given to units on the L of C still held good, but more complete examinations were possible and X-rays had to be taken. Also,

(1) Any eye condition had to be evaluated in conjunction with an eye specialist and any nasal condition, such as cerebro-spinal rhinorrhoea, with a nose and throat specialist.
(2) Any other wound, and these were common, had not to be overlooked.

Blood Transfusion: Though shock was not severe, blood loss was common and transfusion was required, and up to 2 to 4 pints could be safely given, operation itself causing much additional blood loss.

Lumbar Puncture: Major Ascroft held that the value of this was limited before operation, but that after operation it was of the highest diagnostic, therapeutic, and prognostic value. In the early stages, if cerebral compression was suspected, a pressure of more than 250mm. usually meant that immediate operation was required.

Operation: As regards the actual technique of the operation certain points were stressed:

(1) Bone should be conserved wherever possible, and large fragments of bone not completely separated should be levered into satisfactory position and left in situ. Bone should be removed only sufficiently to expose the dural arid brain wounds to allow of cleansing of the brain tracks.
(2) All metallic fragments embedded in bone should be removed if accessible.
(3) The dura should not be opened, if intact, unless there was definite danger to life from subdural clot.
(4) All missile wounds should be drained, the drains to be left in for four to seven days.
(5) All dural wounds should be left open, as 12 per cent developed brain abscess later.

In late cases:

(1) Loose pieces of bone should be lifted out, all debris washed away, and the wound then stitched up and drained by a stab drain. Sulphanilamide powder was dusted and sprayed on the open wound after cleansing.
(2) For septic wounds sulphanilamide and glycerine was often used.
(3) Generally the treatment of late cases consisted in the treatment of infection by:

(a) Drainage of abscesses sometimes through separate dural holes.

(b) The occasional removal of retained pieces of bone or metal.

(4) The danger of spreading infection by removing large pieces of bone and opening the dura was stressed and delay advised in operating on cerebral abscess.

(5) In suitable cases the removal of the abscess as a whole was recommended.

As regards post-operative treatment, particular points were:

(1) An efficient and adequate staff, consisting of at least six trained nurses, twelve medical orderlies, and eight fit patients for a ward of 50 beds. These were all needed to give the constant attention necessary to prevent bedsores and to deal with such conditions as incontinence.

(2) The necessity of plenty of fluids owing to the frequency of dehydration. Fluids had to be forced and given intravenously if necessary. Feeding was often necessary by means of the nasal tube.

(3) Sedatives: Intravenous paraldehyde in doses of 3 ccms. was advised, the injection being given very slowly. Sleep could then be maintained by adding to the intravenous drip small doses of paraldehyde.

(4) Patients were to be got up and interested as soon as possible, and occupational therapy utilised to the full.

There was no doubt that the work done by Major Ascroft and at other units in the Middle East laid the groundwork on which was built the excellent neurosurgical work performed in the British Army during the war. The results achieved by Ascroft's unit at that time were much better than those obtained in the First World War. There were 15 per cent of deaths in 292 penetrating wounds, and only two deaths in 224 non-penetrating cases. There was an overall death rate of 10.8 per cent from infection, as against 36.5 per cent in Cushing's cases.

2 NZEF Experience, Libya, November - December 1941

As far as the 2 NZEF was concerned, there was little in the way of head surgery till the second Libyan campaign. In this campaign the New Zealand Mobile Surgical Unit, staffed with competent surgeons and very liberally equipped, was available and was sited alongside the open Field Ambulance. From the gift of Sir Arthur Sims there had been developed a completely mobile and self-contained surgical unit and a special establishment had been authorised by Middle East command. In particular, a special van had been built to carry the equipment, lighting outfit, steriliser, suction apparatus, and special water tanks. It had equipment and staff to hold and nurse patients. Originally it was intended to restrict the work of this unit to special types of cases including head wounds, but, as had been found in France and also by Ascroft earlier in the MEF, when a rush of serious casualties took place it was impossible to restrict such a unit to special cases. The unit was, however, enabled to operate on all the serious head cases, and this was of special value as evacuation of the cases was rendered impossible by the capture of the unit by the enemy. Our head cases from the Libyan campaign were admitted to Ascroft's unit in Cairo when they reached Egypt and transferred to 1 NZ General Hospital at Helwan for disposal.

Battle of Alamein

The technique by this time had become standardised as recommended by Ascroft. Head cases were not treated as cases of first emergency, and the great majority were evacuated, mostly by air, to the head centre in Cairo, without any operation having been performed in the forward areas. The cases travelled well. From the point of view of the prevention of infection, the Consultant Surgeon 2 NZEF considered that operation on the larger lacerated wounds would be better carried out at the CCS and that X-rays and suction should be provided there.

Advance to Tunis

After the period at Alamein New Zealand surgeons did not carry out the surgical treatment of head wounds except in cases of emergency or in association with wounds of other parts. However, attached to 1 NZ Mobile CCS during a great part of the desert campaign from Alamein to Tunis was a Mobile Neurological Unit under Major Eden, RAMC. This unit was formed to carry out neurosurgery in the forward areas based on a forward CCS, and it was our privilege and pleasure to have the unit associated with our CCS, which was often the foremost CCS in the advance. Our CCS mothered the unit, sorted out and resuscitated the patients, and nursed them following operation. Our own casualties were thus ensured early and skilled treatment as regards head and spine wounds and our CCS personnel learnt how to deal adequately with these difficult cases. First-class work was done by Major Eden and his team, and we felt his death in Italy very acutely.

The equipment of Eden's unit consisted of a captured Italian bus, solid, well-made and roomy, which had been converted into an operating theatre. There were sinks and cupboards, and, although somewhat cramped, it proved quite satisfactory for the special type of work. It was clean and sand-proof, and, of course, could shift off at a moment's notice. Extra space was provided by erecting a small tent alongside to hold patients awaiting operation, to shelter cases waiting return to the wards, to hold extra supplies, and to shelter the staff in between operations. Eden had a good anaesthetist, a capable sister, and orderlies.

After Tripoli had been passed the unit was split up into two sections, the forward section remaining with the NZ CCS whilst the rear section was attached to a British base hospital in Tripoli. This arrangement functioned perfectly. The cases dealt with by Major Eden were staged at Tripoli and afterwards sent by air to Cairo. If Eden was swamped with cases he sent some on to Tripoli to be operated on, and air evacuation was available from there, if necessary, to take the cases to Cairo in another twelve hours.

Major Eden had all the special equipment required to deal with any case, including diathermy, good suction, and blood transfusion. His results showed a very definite improvement on the results obtained in Cairo, where there was a greater time-lag. Infection especially was largely prevented, and his figures compared more than favourably with Base figures as they necessarily included the serious cases which would not ordinarily have survived to reach a base area. (If the Base were back far enough the death rate could be reduced to zero, as no patients but those destined to survive in any case would reach there.)

In 102 brain wounds only 13 became infected, 5 developed meningitis and 1 an abscess. (In Major Ascroft's cases 25 per cent developed abscess.) Primary healing occurred in 85 per cent of all cases, and in 71 per cent of the penetrating wounds of the brain. There was no mortality in scalp wounds; 1.45 per cent in fracture cases, and 23.6 per cent in brain wounds.

Major Eden pointed out the importance of the association of other injuries, especially associated injuries of the eye. In 325 cases 90 had other wounds, and 19 of these had eye wounds. Our observations at that time were that' the early segregation of these cases under a neurosurgical unit in the forward operating centres has led to most excellent results during the last Tunisian campaign.'

Eden's results proved conclusively that, provided skilled staff, efficient equipment, and adequate nursing and other attention were available, operation in the forward areas produced better results than similar treatment at the Base, and this established the set-up for the rest of the war in the British Army.

Eden's cases were selected by his team from those cases set aside by the CCS surgeon in the pre-operation tent. As complete a neurological examination as possible was carried out. Eden considered that lumbar puncture had very little value in the early stages of treatment. All cases in deep coma, especially if breathing was stertorous, were set aside and their condition watched in the pre-operation tent. Very seldom did any of these revive sufficiently to warrant operation.

Eden's table shows the mortality related to state of consciousness:

	Coma	Semi-coma	Confusion	Alert
Cases dying	12	7	4	1
Cases surviving	3	6	23	115

All other cases were put on the operation list and dealt with in order of priority, the penetrating cases being dealt with first. In the meantime resuscitation was being carried out by means of fluid and blood transfusion. Shaving of the head was performed by competent orderlies whenever possible, but generally this had to be left till the patient was anaesthetised on the table. X-ray films were taken from two angles and developed ready for inspection before operation. Local anaesthesia was generally administered after omnopon and scopolamine had been given, but pentothal and some general anaesthetic was given on occasion. The wound was excised with great care down to the bone. Loose bone fragments were removed and the bone edges nibbled sufficiently to expose the dura and brain wound. The brain track was cleansed of debris, including in-driven bone fragments and accessible metallic fragments, by a combination of syringing and suction. Sulpha-diazine powder was dusted on the wound, which was sutured in two layers with thread. The skin was undercut and fresh incisions made if necessary to bring the wound together without tension. A rubber stab drain was inserted for twenty-four to forty-eight hours. A plaster cap was applied to hold the dressings in place. Sulpha-diazine was then given in doses of 3 grammes four-hourly for forty-eight hours and then three times a day. When intravenous administration was required a dose of 5 grammes was given twice daily. Paraldehyde and luminal were given as sedatives, and in comatose patients the stomach tube was utilised for feeding purposes. Normal evacuation to rear units was carried out in two or three days.

Base Hospital, Cairo

Meanwhile the rear portion of Major Eden's unit was working in Tripoli dealing with all the cases that he had operated on and evacuated, as well as cases which had in rush periods been sent back for definitive operation at Tripoli. The same technique was adopted. The cases were held till deemed fit to evacuate by air to Cairo, where they were admitted to the base unit at 15 Scottish Hospital.

For seven months from the end of February to September 1943 there were attached to this hospital two of our New Zealand medical officers, Major McKenzie, a surgeon experienced in neuro-surgery, and Major Caughey, experienced in neurology. This arrangement enabled the neurological unit to be considerably strengthened and at the same time enabled our officers to gain very valuable experience of this special work.

The NZMC seldom contributed medical personnel to British units during the war, so that it is pleasing to record that the work of these two officers was very much appreciated by the RAMC. Major McKenzie, who for many months was in charge of the unit, did a considerable amount of brain surgery, including several successful cases of repair of the dura in cases of rhinorrhoea. His return to New Zealand before the Italian campaign determined our policy of referring all our neurological cases to the special RAMC units.

McKenzie noted the remarkable power of recovery in cases not dying rapidly from severe trauma. He pointed out the difficulty in diagnosis and the danger of overlooking brain injury. For this reason he advised, as did others, against giving morphia but counselled the careful recording of simple neurological observations. At the Base he carried out neurological and X-ray examinations. Spinal puncture was recommended only for later cases at the Base. Blood examination was done as soon as the case arrived at the Base, so as to have a check on the necessity of blood transfusion. Encephalograms and ventriculograms were done without hesitation to localise an abscess or the track of a missile.

In Major McKenzie's operative technique intravenous drip pentoihal was the anaesthetic used and the head was shaved under anaesthesia. A diathermy unit and sucker were regarded as essential. Excision of the wound was carried out. Wounds were closed in three layers by using a triradiate extension or a reversed S-incision. All infected wounds were left open. Minimal removal of bone was carried out and no bone flap was ever used. The dura was not sutured. As regards the brain, suction was used to clear the track and then a narrow band retractor was inserted and the bone chips picked out. The track was gently irrigated and then powdered with sulphathiazole. Bone chips were searched for, even, at the end, in the ventricle, because of the frequency of associated infection. Drainage was provided through a separate stab wound only for a special reason, such as an open ventricle, infection arid fear of haemorrhage. Special points noted were the closing of the subarachnoid space by suture, graft, or vaseline plug, removing only the adjacent mucosa of the frontal sinus. He also removed half an inch of the optic nerve in cases of eye enucleation to avoid sympathetic ophthalmia. Bleeding was feared in wounds near the sagittal or lateral sinuses or the Sylvian fissure.

Chemotherapy was utilised. First, sulphadiazine was given, 6 grammes daily, for prophylaxis, and 12 grammes for the treatment of meningitis, which cleared up unless pus was loculated or undrained. Oral administration was preferred, as intravenously it was efficient only in concentrated solution, and this rapidly led to clotting in the veins. No urinary complications were noted. In McKenzie's opinion penicillin gave no better results. A warning was sounded against sulphonamides being given intrathecally.

Post-operative nursing was heavy, the patient needing constant attention, change of position and often nasal feeding. Intravenous paraldehyde proved the best sedative, and sodium luminal was very useful. Early rehabilitation was essential. All patients had a final spinal puncture and encephalographic examination to exclude latent infection.

As regards results, Major McKenzie noted that regimental medical officers had stated that only one out of three patients with head injury reached a Field Ambulance alive, and on one occasion only one in seven. Out of 116 penetrating and 10 perforating injuries, 126 in all, 14 developed meningitis, 5 abscesses, and there were 6 deaths. Of 55 patients operated on in forward areas by general surgeons, 29 required further operation. Of 113 patients operated on by the forward neurosurgical team only 15 required further operation. Only 28 cases were finally category A.

(Note: It is probable that many of the 55 patients had a deliberately planned partial operation as recommended by the neurosurgical unit, so the figures are not fully comparable.)

Italy

The scene now shifts to Italy, and the part our New Zealand Medical Corps played in the treatment of wounds of the head and spine becomes less important.

Our neurosurgeon returned to New Zealand and the neurologist became re-attached to our own Corps as a divisional medical officer of a base hospital. We relied on the Medical Corps of other forces for the treatment of our head and spine cases. Urgent cases were dealt with at our CCS, but otherwise all cases were referred to the highly efficient British neurosurgical units, the organisation of which followed on the lines developed in the desert campaigns.

From the Sangro, cases were transferred from our CCS at Vasto to the mobile neurosurgical unit attached to 5 British CCS at Vasto and from there to the 98 British General Hospital at Bari, which was sited alongside our 3 NZ General Hospital. When convalescent the cases were transferred to 3 NZ General Hospital for disposal.

During the Cassino battles our CCS at Presenzano arranged for all our head and spine cases to be admitted to an American evacuation hospital nearby, under the charge of a highly competent neurosurgeon, Major Weinberger. This arrangement worked very satisfactorily. The cases were most competently handled, and the association between our own and the American medical officers was of the happiest, and we were sorry when we were separated. From the American hospital all the cases were referred to the British neurosurgical centre under Lieutenant-Colonel Ascroft's command at Naples, and then were finally admitted to 2 NZ General Hospital at Caserta for disposal.

During the battle for Florence our cases went from our CCS at Siena to an advanced neurosurgical unit under Major Shoreston, RAMC, situated alongside Lake

Trasimene. From Trasimene the cases were flown to Naples to Ascroft's unit, and so to 2 NZ General Hospital at Caserta.

During the battles for the Po valley a small hospital was established at Riccione to house all the special units, and all our cases were referred there. They then went to a base hospital on the lines of communication, where the rear part of the forward neurosurgical unit was sited, and then back to Naples again.

The development of the neurosurgical unit is shown by the efficiency of the treatment and the smoothness of administration during the Po battles.

Major Gillingham, RAMC, in charge of the forward section of the neurosurgical unit at Riccione, has put on record the conditions at that time, the technique used, and the results obtained. Contrary to expectation, no more infection was encountered in Italy, and a much bolder attitude to déAbridement was adopted. By the end of 1944 the unit was enlarged considerably, three operating teams being available, and general surgeons were attached to deal with other than head wounds. The attachment of a Field Transfusion Unit was essential. Air evacuation was so efficient that cases could readily be evacuated either to the base section of the unit or to the base unit at Naples.

Some 20 per cent of the cases had other injuries, and it was the custom for the neurosurgeon and the general surgeon to operate under the same anaesthetic, the case being transferred to the general surgeon in another theatre when the neurosurgeon had completed his operation, or vice versa as the condition demanded. The anaesthesia employed was at first local, following omnopon (gr. $\frac{1}{3}$) and scopolamine (gr. $^{1}/_{150}$), but later general anaesthesia was preferred, with induction by pentothal (gr. $\frac{1}{2}$) followed by endotracheal gas and oxygen and ether.

Operative Technique at End of War

The surgical technique at that time consisted of the usual déAbridement of the wound, but the brain track was radically cleaned, removing all of the devitalised brain tissue. Illuminated retractors were used to ensure the cleaning of the deeper part of the track and to assist in the removal of in-driven bone fragments and foreign bodies, more attention being paid to the latter than previously. Ventricular wounds were also cleaned out gently but thoroughly.

Wounds involving the nasal sinuses and the ear were freely exposed, and if it was not possible to carry out the complete operation by approach through the wound at first only déAbridement was done, and after a few days an osteoplastic flap was turned down and the dural defect repaired, generally by fascia.

Posterior fossa cases were given adequate bony decompression. The skin was completely closed in two layers utilising the methods of plastic repair, especially the swinging flap. The dura was repaired as a rule, but the opinion was expressed that with the primary healing being obtained this was unnecessary. When the dura was intact, skull defects were often repaired by utilising the outer table along with the pericranium adjacent to the defect.

In Major Gillingham's series in northern Italy there was a mortality of 22 per cent pre-operative and 11 per cent post-operative. There was only 1 death from infection in 81 cases. Occasional headache and giddiness occurred in 19, severe headache in 9 and fits in 8 cases. Most of the cases were graded down.

Major Gillingham's conclusions were that primary healing depended on the age of the wound, complete déAbridement, especially of the brain track, closure of the scalp wound without tension, and local and general penicillin. He considered operation should be carried out within twenty-four hours and that to ensure this no staging in the forward areas should be allowed.

Changes in Treatment: Penicillin

The main change in treatment during the latter part of the war was the use of penicillin for the control of infection. Though sulphadiazine had been of great value in head cases in particular, the new agent proved still more potent against the ordinary organisms. At first it was employed locally in a sulphanilamide base, but as more penicillin became available full parenteral dosage was administered. There followed a reduction of infection of all kinds in brain wounds from 45 per cent under sulphadiazine to 11.6 per cent under penicillin. There was a corresponding improvement in the progress of the individual case and in the healing of the wound. The necessity for drainage disappeared and a large proportion of the wounds were completely closed without drainage. Penicillin given intrathecally cured meningitis if the organism was susceptible to it. It was also of great value when given systemically in the treatment of grossly infected wounds, cellulitis, osteomyelitis, and brain fungus. Locally it was of use in the treatment of brain abscess.

Morphia

The danger of the early administration of morphia became more apparent as the war progressed, and the neurosurgical units advised that minimal dosage only should be given with the sole object of the relief of pain. Forward units were advised to withhold morphia altogether in brain cases. This was done so that the signs and symptoms should not be masked and that accurate observations should be possible at intervals during the evacuation of the patient. The degree of unconsciousness and the presence of focal signs could not be ascertained if morphia in ordinary dosage had been given.

Neurological Examination

This became more and more efficient and was meticulously carried out as the units became experienced and personnel was increased. Ventriculography on the other hand was gradually discarded and only finally made use of in special circumstances.

Developments in Treatment in Final Stages of the War

1. The major development consisted in the much more thorough cleansing of the brain track, as Cairns notes, a certain boldness and ruthless thoroughness being required. This was rendered easier by the employment of illuminated retractors or lead lights. The track was cleansed down to firm bleeding brain tissue, an exact counterpart to the treatment for an ordinary flesh wound. Even the ventricles were dealt with in the same manner, blood clots being gently removed and the ventricles left clean.
2. The wound of the scalp was completely and accurately closed without drainage except in old-standing infected wounds. Sliding flaps were adopted as advised by Gillies and other plastic surgeons.
3. Wounds of the dura were also closed, grafts being pedicled from neighbouring tissues. Basal dural wounds were closed either at the original operation or later when exposure was obtained by turning down a bone flap.

4. Metallic foreign bodies were found to cause infection and bleeding, and as a result their removal was more frequently undertaken.
5. Fibrin foam was utilised with great success to deal with bleeding from the brain and also from the sinuses.

Bone Grafting

At the latter part of the war three different methods were utilised for the repair of bony defects of the skull.

1. Bone Grafts: In Italy use was made of chip grafts taken from the cancellous bone of the ilium. These were introduced into the bony defect and moulded into place after the edges had been freshened. Often bone was utilised from one patient to fill defects of two patients. Bone was also obtained from the outer table of adjoining skull, which was then slid over the defect. Ribs were split and both halves used for the skull repair.
2. Tantalum Plates: The Americans utilised these on a large scale and reported satisfactory results, though sometimes infection occurred and the plates had to be removed.
3. Acrylic Plates: These were used by Major Shoreston at Trasimene on suitable cases when infection was thought to be improbable. The acrylic graft was 1–1½ mm. thick. It was boiled for ten minutes, wrapped in gauze, and then pressed on to the bone while hot and cooled by saline. It was made to overlap the edges of the defect and was sutured, through holes in the graft, to the pericranium, being tucked between it and the bone. The dura was stitched to the plate to stop bleeding.

The cases selected were those with holes of moderate size and no skin loss, with the brain intact and no, or only transitory, neurological disability. The immediate results were good, but Murray Falconer reported that the only two cases he encountered which were repaired with acrylic plates had to have the plates removed subsequently because of infection.

It would appear that autogenous bone which can become incorporated in the normal tissue is the logical method of closing bony defects, and that a foreign body of whatever kind can never be so suitable and will always be prone to produce tissue reaction and infection. Falconer reported that the bone chips introduced largely became absorbed and that compact bone seemed to be essential to a good repair in the skull. He utilised split rib grafts with success. (Professor Cairns at first thought the defects gave very little disability and only closed large defects below the hair line for psychological reasons. He operated early for that reason. Later he modified his views and repaired any defect sufficiently large to warrant the procedure.)

After-effects of Gunshot Wounds of the Head

The final evaluation of the patient from the point of view of any residue complication, and as to prognosis, was of great importance. For this a thorough neurological examination was required.

Pneumo-encephalography, as has been pointed out, was at first used in every case, but finally was seldom employed. Electro-encephalography was developed in Britain and the USA to take the place of the more dangerous and disturbing investigation.

The development of mental changes fortunately proved to be uncommon. Post-traumatic syndrome, a manifestation of psycho-neurosis, however, was very prone to occur, and the prevention of neurosis became the most important problem in the rehabilitation of the patient. This was stressed by Ascroft in Cairo in his first report and by many neurosurgeons since that time. Ascroft got his patients out of bed as soon as possible and kept them moving and regularly occupied all the time till they were discharged. By this means he was able to return a large proportion to duty. He stressed the necessity for occupational therapy even for those confined to bed, and endeavoured to get the patients to assist in the ordinary work of the wards. There can be no doubt but that this was the only possible method of preventing the onset of serious psychological sequelae in these patients.

Late Ejects

Falconer, in discussing the surgical problem in the later stages of penetrating head injuries, pointed out that many of the serious cases improved considerably and were left with little or no permanent neurological disability, and others, with special training, were able to lead useful lives. Indications for later stage operation were the need for removal of retained foreign bodies, repair of skull defects, treatment of cerebral abscess, and the excision of brain scars. Few retained foreign bodies were likely to cause epilepsy unless they were actually lodged in the cortex, or abscess unless they were already infected. Deep-seated metallic bodies were best left alone, unless they were implicated in a brain abscess, as the operative trauma tended to aggravate rather than improve the condition. When symptoms of epilepsy or abscess were present, however, and the foreign body was infected, then removal should be undertaken.

Operative repair was advised when there was a dural deficiency allowing bulging of the brain, as this was a potent epileptogenic stimulus. Split rib grafts were fixed with silk or fine wire on to a chiselled step at the rim of the defect. The necessity for careful observation of all cases following treatment of brain abscess was stressed because of the liability to recurrence at any time. Falconer advised the complete excision of the abscess whenever practicable, guarding against danger to important areas of the brain.

Epilepsy occurring in the first two years frequently cleared up, but when it arose later it generally persisted. An adequate trial of sedative treatment was essential before operation was considered. Wide excision of the scar was necessary. The results were variable, but in Penfield's series of civilian cases 25 per cent were cured and another 50 per cent improved.

Summary of Experience in Second World War

The war led to the development of efficient, well-equipped neurosurgical units operating both in the forward areas and at the Base. The general principles of wound treatment were adopted for head wounds, surgical treatment gradually became more radical, and foreign bodies were removed more frequently. Wound closure without drainage became the routine except in the presence of sepsis. At first the sulphonamides, and later penicillin, proved most valuable in the prevention and relief of sepsis.

In 1944–45 on the North-West European front the incidence of brain abscess was 3 per cent, whereas in 1941–42 in Ascroft's series it was 27 per cent, and infection in general was only 5 per cent, as against 31 per cent in Cushing's cases in the First World War. By 1945 primary healing took place in 86 per cent of the cases. There can be no doubt, however, that the improvement in surgical technique was the cardinal factor in the decrease of infection.

Recommendations for the Future

Head and spine surgery should be carried out by special neurosurgical units with personnel trained in neurology, neuro-surgery, and anaesthesia. (Two surgical teams.) These units should be equipped with the essential equipment, including suction and diathermy and lighting plant. The primary surgical treatment should be undertaken by mobile neurosurgical units sited at the CCS level, at the convergence of the forward evacuation lines, in a small forward hospital to which are also attached ophthalmic, facio-maxillary, dental and general surgical teams, as well as field transfusion and X-ray units. This primary treatment should be complete, and definitive, surgery, associated with full measures of resuscitation, skilled nursing, and bed accommodation.

There should be set up base neurosurgical units to which the patients can be evacuated, preferably by air, from the forward units. These units should be sited in hospitals associated with ophthalmic, facio-maxillary, dental, and general surgical teams. There is a grave danger of neglect of associated wounds in special units.

Rehabilitation is of the utmost importance, and patients should be got up early, have occupational therapy, be encouraged to do light hospital duties, have every incentive to be fully occupied as soon as possible, and be surrounded by optimistic personnel.

It is possible that there may be a shortage of trained neurosurgeons in a future war if casualties are heavy, and provision should be made for the training of a number of general surgeons in traumatic neurosurgery. This naturally will be of special importance as far as New Zealand is concerned, as there are only two civil neurosurgical centres at present and no reserve personnel who would be available for service overseas in any emergency.

LATE RESULTS: PENSIONS SURVEY

A survey of 953 cases of head injury was made by Dr. D. Macdonald Wilson in 1950. It covered men who were discharged from the services on account of symptoms relating to head injury, and also those who have applied for pensions. They comprised: (a) simple concussion, 600 cases; (b) fracture of skull not due to penetrating missiles, 157 cases; and (c) fractures of skull due to penetrating missiles, 196 cases.

In the simple cerebral concussion group 268 applied for pension, but they were mostly found to have no physical sequelae and nearly all were cases of pure neurosis. Their few physical disabilities were:

Vision: 8 cases of diplopia (3 transient).

Hearing: 8 cases of blast or concussion deafness.

Speech: 2 cases of motor aphasia (1 transient).

Facial paralysis: 4 cases.

Hemiplegia: 2 cases.

Subdural haematoma: 1 case.

Trigeminal neuralgia: 1 case.

Epilepsy: 16 cases.

Of 868 admissions to hospital in the Middle East in 1942–45 for cerebral concussion, only 117 applied for pensions.

Amongst the Maoris there were very few cases of neurosis, and of the 10 cerebral concussion cases only 2 were on pension. One of these had hemiplegia and the other subarachnoid haemorrhage. Of the Maori cases on pension, 57 per cent complained of sequelae due to penetrating missiles, although these battle casualties constitute only 20.6 per cent of the total cases under review.

Attention was drawn to four cases of concussion associated with symptoms due to local injury of the motor cortex. These cases occurred when the head was struck tangentially by a fast-moving missile, causing a gutter wound in the scalp without injury to bone. In addition to general concussion there was evidently a local contusion to the brain immediately beneath the point of impact of the missile with the head, resulting in symptoms due to injury of motor cells in the cortex. Two such cases suffered from hemiplegia, one temporarily and one partially recovered, while the other two still have symptoms of motor aphasia and one has developed Jacksonian epilepsy.

High-velocity missiles striking the head tangentially can produce these symptoms without injury to the skull, but in other cases with similar symptoms there may be fracture of merely the outer table without any depressed bone. Two such cases occurred, and one case has developed Jacksonian epilepsy.

Fractures of Skull, other than those due to Penetrating Missiles

Of the 153 cases, 23 were due to pre-service injuries, 104 were fractures of the vault, 40 of the base, and 10 of both. The following sequelae have occurred:

	Vault	Base	Vault and Base
Deafness	5	2	3
Tinnitus	1	1	1
Ptosis (temp)	1	0	0
Ptosis	3	0	0
Diplopia (temp)	1	0	0
Diplopia	5	0	1
Homonymous Hemianopsia	1	0	0
Anosmia	2	0	0
Motor Aphasia (temp)	1	0	0
Motor Aphasia	1	0	0
Epilepsy	7	2	1
Paralysis 5th nerve	0	1	0
Changed Mentality	1	0	0

Arterio-Venous Aneurysm	0	1	0

Of these 153 fractures, 68.5 per cent remained on pension in 1950—50 per cent of base and 73.5 per cent of vault fractures.

Fifty per cent of those on pensions were assessed at not more than 20 per cent. Four cases received a total disability pension, 1 for hemiplegia, 1 for epilepsy, and 1 for psychosis.

Fractures of Skull due to Penetrating Missiles

Of the 196 cases, 147 had penetration of the dura and brain.

The types of missile causing injury were recorded as being:

Shell, shrapnel	96 cases
Shell, high explosive	30 cases
Shell, mortar	27 cases
Rifle	8 cases
Machine-gun	15 cases
Bomb	12 cases
Land mine	6 cases
Grenade	2 cases

In addition to the subjective symptoms complained of, physical sequelae occurred as follows:

Vision: Homonymous Hemianopsia (18 cases, two temporarily).

Defective Vision due to concussion of eyeballs (16 cases).

Diplopia (6 cases, one temporarily).

Evisceration of eyeball due to direct destruction by missile (12 cases).

Hearing: Concussion Deafness (12 cases).

Rupture of Tympanic Membranes (6 cases).

Tinnitus: 8 cases.

Speech: Motor Aphasia varying from hesitant or slurring speech to marked aphasia (25 cases, four temporarily).

Visual Aphasia: 1 case. Motor Agraphia: 1 case.

Anosmia: 2 cases.

Asteriognosis: 2 cases.

Trismus: 1 case.

Mental changes, varying from dulling of intellect to emotional changes, were noted in 12 cases.

Hemiplegia occurred in 56 cases, resulting in:

(a) Temporary paralysis or paresis with complete recovery: 11 cases.

(b) Slight residual weakness and paresis: 12 cases.

(c) Marked hemiplegia with spastic arm and leg, 33 cases, two showing paraplegia of both legs.

Facial paralysis without limb involvement: 4 cases.

Ptosis: 3 cases.

Arterio-venous Aneurysm on brow: 1 case.

Chronic latent Cerebral Abscess occurred in 5 cases.

Epilepsy had occurred in a number of cases, and is discussed below.

Associated injuries received simultaneously with the head injury were fractures (12 cases), GSW Abdomen (3), GSW Chest, penetrating lung (2), GSW with peripheral nerve injury (1), and below-knee amputations (2).

Four deaths had occurred in civil life directly attributable to the head wounds, two following epileptic seizures, and two from cerebral abscess. One case died of cerebral abscess developing after rupture of the tympanic membrane and middle ear disease. The other case is quoted as it illustrates certain aspects in treatment of these head wounds.

Case 832:

26.11.41: Admitted with shell wound to left of occipital protuberance. X-ray revealed a puncture fracture with depressed fragments of bone lying within the cranium. The wound was cleansed, but no excision of wound, debridement, or craniotomy was carried out. The scalp became infected, and patient developed a temperature with disturbance of vision. Papilloedema was noted. Lumbar puncture produced a blood-stained cerebro-spinal fluid free of pus cells. Expectant treatment with "sulpha" drugs resulted in a good recovery. He was returned to New Zealand and discharged on 31.5.42. Subsequently from time to time he complained of poor vision, depending upon the severity of headaches, but fundi were always normal. As there had been a discharging sinus off and on in the occipital region since 1941, he was on 20.2.45 admitted to hospital for exploration of the wound. Finding a couple of sequestra in the skull gap, the surgeon evidently considered them sufficient to account for the sinus, which was excised. However, the patient was not relieved, and was re-admitted to hospital later, where, on 15.9.45, he died of a ruptured cerebral abscess.

The danger of the silent chronic cerebral abscess following these compound fractures is well illustrated by the following cases:

(1) Case 89:

On 29.5.41 suffered a gunshot wound with penetration of skull and dura mater in the parieto-frontal area. Treated routinely, his wounds soon healed, and towards the end of 1941 he was able to proceed to New Zealand as a convalescent walking case. He returned in a hospital ship under the eyes of the medical staff and walked ashore at Wellington, where he was examined by a Medical Board, but no complaint of headache or other symptoms was made. Proceeding home that night he arrived the next day apparently well, but before the end of the day he complained of headache and rapidly became drowsy. He was taken to hospital, and a subdural chronic abscess was evacuated. He made a rapid recovery, but since 1943 has suffered from Jacksonian epilepsy.

(2) In August 1952 a soldier died who had sustained a penetrating wound of the frontal lobe in Libya on the same day, 26 November 1941, as Case 832. He had little in the way of symptoms after being unconscious for not more than fifteen minutes following the wound, for which he had no primary operative treatment. X-rays at the base hospital in Egypt disclosed several in-driven fragments of bone, and he was first operated on twenty-four days after wounding. He then contracted diphtheria followed by polyneuritis. A freely-discharging sinus persisted, and two further operations were performed in June 1942 and the in-driven bone fragments removed, but the wound did not finally heal till December, shortly after which he was evacuated to New Zealand. In July 1943 a chip bone graft was inserted to close the skull defect. In the succeeding years he complained of recurrent headaches, and in May 1950 had epileptic seizures, but neurological, including X-ray, investigation showed no indication for surgery. Chronic spasms of the left hand and arm were noted in July 1952, followed by vomiting, increasing headaches, and mental confusion. A ventriculogram disclosed a lesion of the frontal lobe, and at craniotomy an abscess was found which was aspirated and penicillin injected several times. He died a fortnight after craniotomy, and the presence of a right frontal lobe abscess was confirmed.

EPILEPSY

In the survey of 953 cases made by Dr. Macdonald Wilson only 60 cases developed epilepsy—16 from simple concussion, 10 from accidental fractures, and 34 from penetrating wounds in battle. As it is inconceivable that any man with fits should not have applied for a pension, the figures are doubtless very accurate, and New Zealand's isolated and small population makes it much easier to obtain accurate figures of this kind. As there were only 16 cases at the end of 1950 still suffering from fits due to penetrating missiles, the problem is not a very serious one.

Fractures of Skull due to Penetrating Missiles

The results show that injury to the brain tissue is the usual precursor of epilepsy following war wounds. An incidence of 17.3 per cent (34 cases out of 196) has occurred with penetrating wounds of the skull involving fracture. By the middle of 1950 there had been 2 deaths and only 16 were then having epileptic seizures. Thus the incidence had been nearly halved.

The group has been classified:

Year of Injury	Number	Suffered from Fits	Continued to Suffer, 1950
1940	2	1	1
1941	32	7	5
1942	35	6	1 (2 died in seizures)
1943	37	5	1
1944	65	9	7
1945	25	6	1
	——	——	——
	196	34 *	16

Of the 3 cases with intact dura, 2 continue to have fits, while the third case, wounded in 1945, ceased to have fits in 1947.

Forty-seven cases had either retained metal foreign bodies or bone fragments within the brain, and eleven, or 23.4 per cent, have developed epilepsy. Of the 149 cases without retained foreign bodies or bone fragments 23, or 15.5 per cent, had developed epilepsy. Of the 16 cases which had ceased to have fits, 7 had, and 9 had not, retained foreign bodies within the brain. Those still having fits, including 2 dying in seizures, were 4 with retained bodies (8.5 per cent) and 14 without (9.6 per cent).

Accidental Fractures of the Skull without Penetration of the Brain

Of the 157 cases, 130 occurred during service, and with these were associated seven cases of epilepsy, all arising from vertex fractures which had been operated on for the removal of depressed bone. Two cases had ceased to have fits, one two years after injury and the other four years after. The fits commenced in two cases within the year, in one case in the second year, in two cases in the third year, and in two cases after three years.

In three cases history was given of pre-service injury and fits.

Cerebral Concussion

In the 16 cases associated with cerebral concussion the relation between the alleged head injury and the fits was in most cases very obscure. There was often very slight injury and again a long period of years before the onset of epilepsy. Only four of the cases started within a year of injury, and unless epilepsy occurred soon after a very definite concussion there appeared no reason to associate the two conditions. Three of the cases died of cerebral tumour.

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* 31 of the 34 suffered penetration of the dura.

Head Injuries

	Invalided from 2 NZEF
battle casualties—	
Concussion	19
Cerebral contusion	7
Simp fract with concussion	3
Fracture skull	43
Comp fract penetrating brain	15
Comp fract penetrating brain with retained FB	1
Comp fract base skull	3
Simp fract base skull	1
Penetrating head involg brain	108
Penetrating head retained FB	14
Penetrating head wound	10
Post-concussional syndrome	4
associated lesions—	
Cerebral contusion	10
Cerebral laceration	6
Hemiplegia	14
Hemiparesis	8
Aphasia	8
Hemianopsia	6
Frontal sinus	4
Intellectual impairment	2
Paralysis nerves	5
Other	20
complications—	
Meningitis	2
Cerebral abscess	1
Extra-dural abscess	1
Herniation brain	1
Diphtheritic infection	1

Jacksonian epilepsy	1
Paroxysmal headaches	2
causation—	
Shell	95
Mortar	26
Gunshot	23
Bomb	19
Mine	8
Machine-gun	4
Rifle	1
Grenade	1
Other and undefined	16
date of medical boarding–	
1941 (PW)	8
1942	34
1943	29
1944	79
1945	41
accidental injuries—	
Cerebral concussion	5
Comp fract skull	8
Comp fract skull involg brain	6
Depressed fracture	3
With haemorrhage	3
Simp fract skull	3
Other and undefined	37

Admissions to Hospital, 2 NZEF, 1941-45

Concussion	391
Fract with depression	87
Fract without depression	105
Penetrating cranium	479
Perforating cranium	34
Contusions, etc.—	
Parietal region	70
Occipital region	51

Temporal region	36
Frontal region	137
Undefined	238

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CHAPTER 8
Spinal Injuries

THE history of the treatment of war wounds of the spine does not reveal any marked advances. In serious wounds surgery has not been able to reduce the mortality rate appreciably.

First World War

During the 1914–18 War the wound itself was treated on similar lines to wounds elsewhere in the body in the attempt to counteract infection. Excision, the application of antiseptics, and finally secondary suture, were carried out.

Operation on the spinal cord itself was recognised as of little or no avail and was seldom carried out, and that only for the relief of pain or for other special indications. Large metallic fragments were removed if possible. Suprapubic cystotomy was routinely carried out for bladder retention, and bladder lavage for urinary infection. Several patients are known to have survived for long periods, but urinary infection was a constant cause of death.

Second World War

Spinal injuries were not uncommon in the Second World War. The lack of specialists in 2 NZEF made the Force largely dependent on British and American hospital facilities. In the Middle East the cases were mostly treated by the neurosurgical unit in Cairo. In the forward areas, in the early part of the war, operation was seldom performed, except when a large wound demanded attention. Supra-pubic cystotomy was generally carried out in the complete lesions. Stress was laid on the necessity to examine the wounded for signs of paraplegia, as there was a danger of the condition being overlooked in the presence of other serious wounds or when the patient was unconscious. On the other hand, there might be other more serious conditions, such as abdominal injury, present associated with paraplegia. There was fortunately little impairment of stability in gunshot wounds of the spine, quite different from the fracture dislocations. It was important, however, in every case of paraplegia to avoid extra damage during transport, and to have constant care of the paralysed bladder and bowel and the insensitive skin.

Observations made during the Alamein battle showed that spinal injuries were unusually common. It was considered advisable not to operate on these cases till an X-ray was taken, so that foreign bodies in relation to the spine might, if possible, be removed. The patients stood transport very well, especially by air. These patients, when followed up at the Base, were observed to have done very well indeed, with only an occasional septic case.

In total lesions it was observed there was complete flaccid paralysis, absence of reflexes and rectovesical paralysis, which signs continued till death. Oedema of the legs and scrotum was also usually present. It was stated in 1942 that no cord lesion which had signs of a complete lesion after forty-eight hours would show any useful degree of recovery.

Recovery could be expected in partial lesions and was usually ushered in by a return of movement. Spastic paralysis also had a better prognosis. Pain was not commonly observed early, but was often intense in caudal lesions. Lumbar puncture and X-rays, except for the location of foreign bodies, were of little value. Complications were often associated with the urinary tract, and bed sores were very common. Meningitis was generally fatal within two to three weeks. Urinary retention was the usual accompaniment, but incontinence sometimes occurred. Surgical intervention was recommended only where there had been deterioration after an initial improvement, in caudal lesions, and for nerve root pain. Operation, if indicated, was best undertaken within ten days. It was not without its own serious dangers. Plaster casts for the treatment and transport of the spinal cases were found to be unnecessary, and they led to a multiplicity of bed sores as well as giving rise to abdominal distension and even vomiting.

Major Weinberger, US Army, who treated the New Zealand cases in the Cassino area (1944), operated as a prophylactic against infection, and removed the foreign bodies when they involved the spinal theca. He combined tidal drainage with the suprapubic. The foot of the bed was raised to relieve pressure on the back and legs. This lessened the incidence of bed sores, and assisted in their treatment. Plaster casts were not used during the transport of patients.

Major Shoreston, RAMC, in the British hospital at Lake Trasimene, dealt with

New Zealand spinal casualties during the advance to Florence. He treated them on ordinary principles, removing damaged muscle, loose bone and foreign bodies, and repairing the dura, using grafts when necessary. He also carried out primary wound closure and used chemotherapy following operation. In all complete lesions he carried out a suprapubic cystotomy, but postponed operation, using expression of the bladder, in cauda equina lesions.

During the same period several spinal cases were under treatment at 2 NZ General Hospital at Caserta. All were seriously ill and all had large sacral bed sores. Observations at the base neurosurgical unit at Naples confirmed the opinion that, under war conditions, sacral bed sores were inevitable and that no practicable measures of prevention seemed possible. The conditions of warfare involving frequent and prolonged evacuations of the wounded were largely responsible. There was insufficient medical personnel to ensure the constant movement and the meticulous attention necessary for the spinal cases. Perhaps in the future special rotary beds could be provided for- the spinal cases and thus enable constant change of position to be carried out. The Stryker frame would be suitable. The nursing of the cases was made more difficult by the attention required to dress the bed sores.

In the later stages of the war in Italy treatment was directed to the healing of the bed sores and to the urinary complications. The bed sores were closed, either by suture, by rotation flaps, or by using free skin grafts, after infection had been eliminated by penicillin. The closure of the bed sore led to marked improvement in the general condition of the patient. Bladder infection was dealt with by washing out the bladder and by chemotherapy. Regular bowel movement every two days was arranged and distention relieved by enemata and pituitrin. Urinary calculi and bladder stones were commonly met with later. Late exploration of the spine met with no success.

Summary

To sum up the position at the end of the war, little success was claimed in the treatment of these serious injuries. The prevention of infection was successful, especially in the latter part of the war. Infection had been largely eliminated in war wounds by early and efficient surgery and chemotherapy. Suprapubic cystotomy was the regular treatment for the paralysed bladder. Bed sores were inevitable, but were healed by plastic repair and skin grafting. The abolition of plaster jackets, especially for transport, reduced the number of bed sores, especially in the more serious cases.

The mortality was heavy and urinary complications frequent. Operation on the spinal cord was indicated only where there had been deterioration after an initial improvement in caudal lesions, and for nerve root pain, and it was best undertaken within ten days of wounding.

It is suggested that spinal injuries could be reduced by the wearing of metal shields for protection of the spine, just as the steel helmet is used for protecting the head.

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Invalided from 2 NZEF, 1940–45

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Fract transverse processes, lumbar	1
Fract spinous processes	1
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Fract cervical and brachial plexus injury	1
Fract dorsal vertebra	1
Fract dorsal vertebra and paraplegia	6
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References

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[SECTION]

THE history of the treatment of war wounds of the spine does not reveal any marked advances. In serious wounds surgery has not been able to reduce the mortality rate appreciably.

First World War

During the 1914–18 War the wound itself was treated on similar lines to wounds elsewhere in the body in the attempt to counteract infection. Excision, the application of antiseptics, and finally secondary suture, were carried out.

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CHAPTER 9 — NERVE INJURIES

Contents

WAR SURGERY AND MEDICINE

FIRST WORLD WAR

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D uring the First World War considerable progress was made in the treatment of peripheral nerve injuries. Sir Robert Jones was indefatigable in the institution of special orthopaedic centres, and surgeons trained by him or chosen by him were appointed to look after these cases.

Great enthusiasm was evoked, with the result that the quality of the work performed reached a very high standard, and the surgeons associated with the centres later became the leaders of orthopaedic surgery in Great Britain in the period between the wars, and also in the Second World War. One of them, Brigadier W. R. Bristow, was consultant orthopaedic surgeon to the British Army throughout the 1939–45 War.

During the First World War there were the same two schools of thought with regard to the operative treatment of nerve injuries as there were during the Second World War, in fact as still exist.

One school considered that there was a much better chance of recovery of function if no operation was performed, and that no case should be subjected to operation till ample time had been allowed for spontaneous recovery to take place. This school was influenced very much by the teaching of the famous Frenchmen, Leriche and Tinel, the name of the latter having been perpetuated by the sign he advised to evaluate nerve recovery. Leriche at that time taught that nerve tissue was very readily damaged even by gentle handling, and that operation in itself would inevitably cause injury to the nerve tissue, with the inference that the nerve had much better take its chance of recovery without the added insult of the surgeon. Cases were therefore not referred for surgery till as a rule some months after injury, and the bias was against exploration.

The other school was in favour of exploration in all doubtful cases after the wound had been soundly healed for some weeks, and when there were signs of complete loss of function. It was pointed out that nerve tissue was very vital tissue, as shown by its survival in septic wounds and amputation stumps, and its wonderful powers of regeneration. The danger of damaging nerve tissue during operation, as stressed by Leriche, was not believed in, especially as, in any case, the damaged and scarred area had to be excised before suture was undertaken. It was held that nerve recovery was more satisfactory the sooner the suture was performed, and that if the operation was delayed for long the chances of success were minimal.

The knowledge of the signs of nerve injury developed rapidly, and many masseurs were trained to test the muscles by means of electrical reactions, both faradic and galvanic, and also to evaluate changes of sensation. The reaction of degeneration in paralysed muscles was utilised fully, and the physiotherapists became highly skilled in both diagnosis and treatment. Regular stimulation of muscles, both by faradic and galvanic current, was instituted, and massage employed to encourage circulation in the part. Splints were used and much ingenuity displayed in designing splints to combine an optimum position with preservation of mobility. The objectives aimed at were:

(1) Prevention of stretching of paralysed muscles.
(2) Prevention of deformities at joints due to overaction of non-paralysed muscles.
(3) The utilisation of elastic tension to produce the optimum position and yet allow of muscular action and joint movement.

Examples of positions and appliances were:

(1) Cock-up splint for musculo-spiral paralysis, combined with elastic bands to the fingers, keeping them in light tension.
(2) Plaster or papier mache splint keeping little and ring finger extended in ulnar paralysis.
(3) Shoulder abduction splint for paralysis of shoulder girdle.
(4) Plaster or tin splints to dorsi-flex the ankle in paralysis of peroneal nerve.

The splints were removed daily during the physiotherapeutic treatment by massage and electricity. The relative greater importance of voluntary movement as against electrically stimulated movement was well understood.

New Zealand Forces

Well organised and equipped physiotherapy departments were attached to the hospitals in England, especially the hospitals at Brockenhurst and Walton-on-Thames, and the Convalescent Depot at Hornchurch. The personnel in charge were well trained and highly skilled in the treatment of nerve injuries. Lieutenant-Colonel M. Macdonald was appointed to take charge of the physiotherapeutic work in England and was stationed at Brockenhurst. He had had special experience of the work and had been attached to Leriche's and Tinel's clinics in France for some time, and he brought to his work unbounded enthusiasm and energy, as well as sound judgment in the evaluation of the cases. All New Zealand personnel were admitted to our own hospitals from France and were not evacuated to New Zealand till the condition was stabilised. This allowed of ample time to evaluate the prospects of recovery in nerve lesions, and to submit suitable cases to operation. A knowledge of, and experience in, the treatment of nerve injuries was thus gained by the neurologists and surgeons in 1 NZEF that their successors in 2 NZEF were unable to obtain owing to the early evacuation of patients to New Zealand in the Second World War.

Operative Treatment

This was undertaken some weeks after the wound had healed, when physiotherapeutic examination had shown that there was a complete nerve block showing no signs of recovery. The period allowed for recovery naturally depended on the judgment of the neurologist and the surgeon, but generally in England operation was not delayed very long, and, following the introduction of secondary suture of wounds, the waiting period was very much shortened.

Our New Zealand routine was a reasonable compromise between the conservative attitude of the neurologist and the enthusiasm of the surgeon. A large number of nerve sutures were performed in both our main hospitals, the technique being that adopted by the leading British orthopaedic surgeons. This technique consisted of:

(1) Careful skin preparation before operation.

(2) Extensive skin incisions with excision of scar.

(3) Definition of the nerve trunk well above and below the site of the injury, and placing of a tape under the nerve to allow of gentle traction.

(4) Careful dissection of the nerve from above and below towards the damaged area, dissecting the densely scarred neuromatous tissue between the normal portions of the nerve as part of the common nerve track.

(5) Freeing of the nerve well above and below the site of the injury.

(6) Evaluation of the damaged and scarred area of nerve. If excision deemed advisable, then resection by a sharp knife (generally a tentatome) till normal looking nerve tissue showing nerve bundles was shown and hard scar was no longer present—and a healthy nerve sheath was available. The general appearance of the scarred area, the density of the scar, and the probability that complete division had taken place, were all taken into account. With experience the surgeon had confidence in his judgment, which, of course, was backed by the opinion of the neurologist, founded on frequent and meticulous examinations beforehand.

(7) Before dividing the nerve, fine stay stitches were generally introduced so as to retain the normal line of the nerve, and as far as possible reconstitute it in perfect apposition, allowing the nerve fibres to grow again in their original

sheath in the peripheral part of the nerve.

(8) Freeing the nerve again above and below to allow of suture without tension, help being given by flexion of the joint.

(9) Suture by separate fine thread stitches in the nerve sheath. Stay stitches were also inserted in the sheath above and below to counteract tension. No stitches were placed in the nerve itself.

(10) The sutured nerve was placed in as healthy a bed as possible, all scarred tissue being removed and a muscle bed being preferred. (Many different methods were used to protect the nerve from adhesions. The junction was wrapped in many materials, both foreign and tissues from the body such as fascia, fat, or muscle. These were all given up as they proved unsatisfactory. They were never used in New Zealand hospitals.)

(11) The wounds were sutured, healthy tissues being drawn over the nerve when possible.

(12) The limb was splinted in a position allowing of no tension on the nerve. This generally meant the placing of the joint in flexion, sometimes fairly extreme flexion. This position was corrected gradually in the course of some six weeks till normal position could be attained without risk to the union.

After operation the splinting and physiotherapeutic treatment by galvanism, massage, and joint movements was regularly carried out till function returned—a long, tedious business.

The results obtained during the 1914–18 War were only moderately satisfactory, and varied considerably in the different nerves. This was dependent on several factors:

(1) The time of suture after the injury. It was determined that very late sutures gave little hope of any success.

(2) The extent of damage to the nerve, especially the length of nerve involved.

(3) The extent of the muscular atrophy, especially in relation to the smaller muscles such as the intrinsics of the hand.

(4) The condition of the joints and the presence of any deformities.

It was found that the sensory nerves recovered on the whole better than the motor nerves, but that it was rare to get complete recovery. Motor recovery was frequently rendered impossible by the complete atrophy of the involved muscles, especially those of small size.

When nerve repair was impossible or had been unsuccessful, some functional activity was restored by means of tendon transplantation and arthrodesis. This was found especially useful in paralysis of the radial nerve, and tendon transplantation gave, as a rule, such good results that nerve suture was abandoned in cases of extreme difficulty. Tendon transplants in the foot, on the other hand, did not give the same success, largely because of the extra strength required. Arthrodesis was found of use in the ankle.

At the end of the 1914–18 War the surgery of peripheral nerves had reached a very high standard.

Between the wars the development of orthopaedic and neurological specialism continued steadily, but no very marked changes occurred in treatment or in knowledge.

SECOND WORLD WAR

At the beginning of the Second World War Great Britain was in the fortunate position of still having available the orthopaedic surgeons who had laid the foundations of the work during the previous World War. They not only had vast experience of these cases, but had been able to watch and evaluate their results over the years. It was possible, therefore, to lay down early in the war detailed information concerning the diagnosis and treatment of neive injuries for the information of the younger generation of neurologists and surgeons.

The methods advised were similar to those used in the First World War. Primary suture was not advised in war wounds because of the fear of infection, and suture was delayed till at least six weeks after healing of the wound. When it was uncertain whether the nerve had been actually divided, exploration was advised only after careful evaluation of the signs of loss of nerve function. Full opportunity was given for spontaneous recovery to take place. Exploration was generally delayed for five to six months, but it was realised that any delay longer than a year made recovery problematical.

Research

Interest was also focused on the problem in the neurological centres, which began to carry out researches in the physiology and pathology of nerve injury and repair. Oxford was particularly active in this direction. It was shown that shortly after injury the nerve was friable and the sheath in an unsatisfactory condition for suture. Then the Schwann cells regenerated and within about ten days the sheath became thicker and stronger and suture was much facilitated. It was found that, in keeping with these changes, suture of the nerve at the time of injury gave worse results than suture two or three weeks later. This observation seems to have been accepted by others. Studies of later changes showed that the axons sprouted strongly and rapidly from the proximal end of the severed nerve, but that after several months there was not such a strong action. The distal end of the nerve underwent degeneration throughout its course, with loss of the axon cylinders and steady and progressive shrinkage of the nerve, with resultant constriction of the channels through which the regenerating axon cylinders would have to make their way. The nerve ending in the muscle plates would, in the meantime, be degenerating, and the muscle fibres themselves losing their structure and becoming fibrous tissue. It was only logical, if these observations were correct, to assume that the earlier operative repair of severed nerves was carried out the better the chance of recovery of function. It was also certain that if repair were too long delayed, the recovery of function would be impossible.

Opinions on Operation

Conflicting opinions arose somewhat similar to those held in the First World War —the conflict of the ultra-conservative and the radical. Gradually the conservative view, deprecating early operation and maintaining that better results were obtained by non-operative treatment, lost ground. Strong support, however, was given to this view by Foerster of Germany, who, in a series of 3079 cases, had 1320 complete and 660 partial recoveries without operative treatment. Another German report stated that delay in operation was adopted after noting the favourable results in cases from the Russian front which had not been seen for long periods after wounding. Brigadier Cairns, consultant neurologist to the British Army, had stated that a high percentage of nerve injuries recovered spontaneously.

The more radical group noted the degenerative changes in the limb, and, for that reason, wished to operate early, and start the recovery of the nerve so as to allow of the return of nerve function before muscle function was completely lost by atrophy and fibrosis, and the joints probably stiffened.

Seddon, Nuffield professor of orthopaedic surgery at Oxford, definitely aligned himself and his team in favour of radical exploration of nerve injuries associated with war wounds. He explored all cases showing signs of complete division, except when an intact nerve had been noted at the original operation. In his opinion half of the cases of nerve injury were associated with division of the nerve, and exploration alone decided the matter, unless one was prepared to wait a long time for the possible signs of recovery. He asserted that he would explore even if there were an even chance that the nerve was not divided, and declared that the results proved the wisdom of doing so. The harmful effects of delay on the nerve, the muscle, and the joints were amply demonstrated.

Optimum Time of Operation

The time of operation depended first of all on the condition of the wound and also on the presence of associated injuries, especially fractvires. Primary suture was not carried out because of the risk of infection. Although theoretically at the end of the war it would have been possible to suture the nerve safely in a clean wound, this was not attempted and the operation was postponed till the wound had been soundly healed for two to three weeks. This generally meant that nerve suture could be carried out in straightforward cases about six weeks after the injury. As the ideal time for suture had been determined and agreed upon as two to three weeks, suture at six weeks in war wounds was as near the ideal as possible. By that time the nerve had become stabilised and reparative changes had commenced, and the perineurium had become firm and suture was easy.

Maximum Delay with Successful Operation

The period of delay in operation after which recovery was possible had not been clearly laid down, some putting it at eighteen months, some at three or four years. Brigadier Cairns had had success following suture up to two and a half years after injury. Our experience would definitely lead us to place the figure near the lower limit.

Seddon stated that, as far as motor recovery in the median nerve was concerned, nine months was the period of critical delay for intermediate and high lesions. For all lesions there was a definite deterioration in results, relative to the delay in suture, after the optimum period of two to three weeks following injury.

The Determination of the Nature of the Nerve Injury

The diagnosis of nerve division often caused great difficulty and the tests available did not permit at an early period of a distinction between anatomic and physiological nerve block. The signs of nerve division were loss of motor and sensory function, wasting of the muscles supplied by the nerve, loss of tendon reflexes, and alteration in the response to electrical stimulation. This latter consisted in lack of response to faradic current and sluggish reaction to galvanism, the so-called reaction of degeneration. More elaborate methods of electrical stimulation and electromyography were utilised in special clinics. The loss of sweating in the anaesthetic areas was used as a test. Tinel's sign of sensation on tapping over the nerve below the lesion was utilised and was thought of benefit by some but not by others.

The more simple determination of nerve injury of the different main nerves available for rapid clinical use was: in the median nerve the loss of the opponeus action of bringing the thumb across the palm, in the ulnar the loss of grip between the thumb and the index, in the radial the loss of extension of the thumb, in the peroneal the loss of extension of the hallux, and in the internal popliteal the loss of flexion of the hallux. A definite diagnosis could be made only by the return of function, proving that no gross injury to the nerve had taken place, or by exploration of the nerve. Most surgeons of experience agreed that early operation was essential for diagnosis in any doubtful case.

Reasons for Exploration

Exploration was carried out when the nerve was known to have been divided. It was also carried out when signs of complete loss of function were present and no signs of recovery had taken place in five to six months.

The opinion of leading neurosurgeons finally was that operation should be undertaken early in all cases showing loss of function, because in over half these cases suture was necessary and the time lost by watching for functional return would seriously jeopardise the chances of recovery. Exploration was also carried out for a partial lesion of the nerve and sometimes to place the nerve in a healthier bed. Re-exploration was also undertaken in cases showing no signs of recovery.

Nerve Repair

The question of what was to be done when a nerve was found divided in the wound naturally arose. There were some who definitely favoured immediate suture, but they were in a small minority because of the natural objections concerned with possible infection. Professor Platts, of Manchester, in 1940 considered that suture should be done in six weeks after the wound had healed and the mobility of the limb restored. Cairns in 1942 recommended immediate suture if possible, but generally waited five to six months before exploring. With the improvement in the results of wound treatment, partly associated with the introduction of penicillin, our outlook had somewhat altered, but the evidence already adduced of the improved condition of the nerve two weeks after injury seemed to point to the necessity for delay, even if infection could be ruled out. Seddon definitely stated that in clean wounds, such as those produced by a sharp instrument, when primary suture of the wound was carried out, he would not suture the nerve at the time but would deliberately leave this for an operation two to three weeks later. It was found of advantage, however, to draw the ends of the nerve together by a simple stitch in the sheath, so as to make the later exploration easier. If the ends could not be brought together, then lightly fixing them to adjacent muscle was of value.

The subsequent exploration and suture of the divided nerve was undertaken by the same technique as that developed during the First World War: the same free exposure, the same liberal freeing of both ends of the nerve, the same suture of the sheath, and the same utilisation of flexion at the joints to relieve tension.

The decision as to whether to resect and suture the nerve at the operation itself still remained a question of the experience and judgment of the surgeon. Electrical stimulation of the nerve to test its conductivity during operation was utilised by Bristow and others. Often the decision was easy as there had been obvious gross division and separation of the ends of the nerve, with the formation of a mass of nerve scar tissue in between. When the nerve was anatomically intact, except for some thickening at the site of the injury, the decision rested mainly on the feeling of induration in the nerve. On cutting out the thickened and hardened area the presence of scar tissue and the absence of nerve fibres could be demonstrated. Seddon came to utilise what he called a -trial incision as the most valuable diagnostic aid at his command, and he resected the nerve if more than half the nerve was involved by scar tissue.

There was no change in technique except the introduction of fibrin clot as a method of suture in relation to the smaller nerves and in nerve grafting. Seddon stated that the utilisation of plasma rendered the repair by cable grafts easy and satisfactory. The use of a tourniquet was considered inadvisable, certainly as far as the arm was concerned, and probably also for the lower limb, as ischaemic changes were so much to be dreaded in association with nerve injuries.

Partial Suture

At times only a portion of the nerve was divided and it was possible to separate the two portions and suture the damaged part, leaving the rest intact.

Removal of Bone

This was sometimes done in order to shorten the limb and so render possible suture of the nerve when the ends of the divided nerve could not be approximated without undue tension. The humerus was the bone usually involved.

Neurolysis

In many cases of late exploration the nerve was found to be imbedded in scar tissue, the nerve itself not being seriously injured. Careful dissection of the nerve with removal of the surrounding scar and the formation of a new bed, preferably of muscle, for the freed nerve was carried out. In suitable cases the results of this treatment were very satisfactory, and often quite a rapid recovery of function took place. Bristow, however, considered that the removal of the nerve from a bed of scar tissue made little difference to its recovery.

Nerve Grafting

During the 1914–18 War nerve grafting was tried as a means of bridging gaps in nerves which could not be repaired by the usual technique of nerve suture. Grafts of many kinds were tried, but with no success. During the 1939–45 War the consensus of opinion was that nerve grafts for the main nerves were generally completely useless. Spurling reported that there had never been a successful large nerve graft in the American Army. Bristow had never seen any useful function restored. Seddon recorded some satisfactory results in autogenous nerve grafting, using cable grafts from small cutaneous nerves, the employment of plasma instead of suturing having added much to the ease and the success of the technique. He employed a pedicle nerve graft in repairing the sciatic nerve. There were no successes in homogenous grafting.

Tendon Transplantation

As in the First World War, tendon transplants gave very good results in musculo-spiral paralysis so that it was performed in cases where suture was difficult or had been a failure. The transplantation of the palmaris into the thumb was of some use in median paralysis. In peroneal paralysis the results were not generally of permanent value.

Splints

The treatment of nerve injuries, apart from operative repair, changed to a certain extent. The accentuation placed on splinting and galvanic stimulation of paralysed muscle had gone. Stress was now laid particularly on the preservation of the general nourishment of the limb, and especially of the supple movements of all the joints. There was common agreement that active and passive joint and muscle movements should be regularly carried out. Heat and massage were also used. Splints, especially plaster splints, were found at the early stage of the war to lead to atrophied stiff limbs, and many surgeons on that account advised the complete discarding of all splints. However, removable splints, if properly designed and intelligently used, were still valuable in preventing overstretching of the paralysed muscle, in retaining the position of optimum function, and in the prevention of deformities. Splints of the elastic type were favoured as they allowed of functional use of the limb, and could be readily removed for physiotherapeutic treatment.

Highet, a New Zealander working in England, stated that in the application of splints the following conditions should be observed:

(1) No paralysed muscle should be subjected to stretching.
(2) All joints should have as full movement as was compatible with (1).
(3) No pressure should be allowed on an anaesthetic area, and there should be no interference with circulation.
(4) The patient should be able to do occupational or ordinary work.
(5) The splints should be removed twice daily for half an hour for physiotherapy and every joint put through a full range of movement.

He described the following splints:

(1) For median nerve palsy cases: Elastic splint to hold the thumb in palmar abduction and opposition with a broad wrist strap and a band round the thumb.
(2) For ulnar cases: Knuckle-duster type of splint holding the fingers in slight flexion at the metacarpo-phalangeal joints.
(3) For radial cases: An elastic extension splint with bands to each finger, the finger never being immobilised.
(4) For circumflex and brachial plexus cases: The usual abduction splint but movement allowed at the elbow and rotation at the shoulder.
(5) For sciatic cases: Side-irons with toe-lifting spring and a mobile ankle.

Electrical Stimulation

Electrical stimulation of muscle was not utilised to the same extent as in the First World War, many considering it of little use, and some that it was distinctly harmful in many cases. Experiments carried out at Oxford showed that daily galvanic treatment was most beneficial in the treatment of small muscles but of little use in the large muscles. Eventually, however, it was agreed that galvanic stimulation was of definite use in preserving the muscle volume. Many considered that the manipulation of the limbs through all the normal movements of the joints was of much more importance, and that this was the main factor in the preservation of the nutrition and potential function of the limb. The main difficulty in treatment was due to the very long period of recovery, necessitating continuous daily treatments for eighteen months or more. This meant attachment to a physiotherapeutic department for that time. In cases where the recovery was very problematical it often appeared advisable to adopt some less tedious course, such as tendon transplantation in the case of an injured radial nerve.

Signs of Recovery

These normally occur in some degree in about six months, but success is possible up to two and a half years. Sensation is the first to recover, the tactile sense first and pain later. The reaction of degeneration is then lost and there is an arrest of atrophy and a return of tone. Faradic response then appears and finally muscular power. The return of muscle function is the most reliable sign of recovery. Tinel's sign was held to be useful by some observers and unreliable by others. In unaided recovery touch and pain return together and all the muscles may regain power at the same time. Trick movements have to be guarded against and also the overlap of sensory areas from other nerves.

Spontaneous Recovery

This was said to be very common by some observers, particularly the Germans, and one writer quotes as high a percentage as 50. In the larger series a figure of about 10–12 per cent is given. In quite a considerable number of cases there is only a temporary disturbance with a rapid and complete recovery. (After the second Libyan campaign the DMS 2 NZEF ordered all cases of nerve injury to be evacuated to New Zealand by hospital ship. A considerable proportion of these completely recovered on the journey to New Zealand.) Slower recovery took place in the majority of the cases and often the recovery was incomplete.

Recovery after Suture

It had been known before the war that the later the suture the worse the recovery, and this was entirely substantiated during the Second World War. It was found that the results became worse when suture was delayed for ninety days and that after six months the results were poor. Recovery of some function after two and a half years was reported by Cairns. In general, all results of suture were relatively bad in that normal function never returned. The return of sensation was much more satisfactory than muscular recovery. The muscles underwent degeneration with the destruction of the terminal motor bundles and became fibrosed. The smaller muscles were particularly affected. Injuries of the median and ulnar above the elbow, and of the sciatic high up, were particularly unfavourable.

Recovery of Different Nerves

The radial nerve often showed good recovery with only slight disability. The ulnar showed fair sensory recovery, but the intrinsic muscles generally atrophied and became useless; the disability, however, was slight. The median nerve gave somewhat similar results, the intrinsics again degenerating; sensory loss was a serious disability, the main muscular disability being due to the loss of opponens action. The sciatic nerve results were not good nor were those of the external popliteal branch. The internal popliteal and post-tibial gave better results.

Delay in Operation

In the first three to four years of the war there was considerable delay in the treatment of nerve injuries. This was largely due to the closed plaster treatment obscuring the nerve lesion and to the very long time taken to obtain healing, especially in fracture cases. There was considerable wound sepsis in the earlier periods, and there can be little doubt that suture of divided nerves was very seriously delayed. There are many reports of contractions and atrophied limbs, stiff and immobile joints, and withered, paralysed muscles. Our New Zealand cases were all evacuated to New Zealand in plaster splints and it is likely that operative treatment was delayed, and what results we have support this view. The introduction of delayed primary suture and penicillin brought about a radical change in the situation and enabled early suture to be undertaken.

Function in Nerve Paralysis

The loss of nerve function is a very serious disablement. So much so that the loss of all nerve function, such as the loss of all three nerves in the arm, makes that limb worse than useless. The loss of ulnar and median function gives rise to a useless anaesthetic hand. The loss of the radial and median leads to severe crippling, but the loss of radial alone is not serious, as tendon transplantation is generally successful. Complete sciatic disability is greater than that of loss of the limb as the limb cannot tolerate weight bearing on the anaesthetic foot. The loss of main nerves often determines the question of amputation.

Complications

Serious complications arose in the limbs as a result of injury to the nerves, apart from the loss of power and sensation. Reference has already been made to the marked atrophy, and also to the deformities which had to be guarded against. More serious changes arose as a result of interference with sensation, and trophic sores readily developed. Injuries such as burns can be suffered in limbs devoid of sensation. Trophic ulcers were especially liable to occur in sciatic nerve injuries involving the internal popliteal nerve. These were so severe and intractable that amputation through the thigh might be called for. Irritative symptoms also arose, sometimes by pressure on, and foreign bodies in, the nerve trunks. Causalgia, a condition of severe pain, generally associated with partial lesions of main sensory nerves, also arose, though fortunately this condition was noted much less frequently during the Second World War than it was in the First World War.

Causalgia

Causalgia was first described by Weir Mitchell during the American Civil War, and our knowledge of the condition is not very much greater than it was then. There were two types, one a true causalgia and the other more transient and milder. The milder condition arose shortly after the injury and persisted for some weeks and then completely cleared up. This was frequently noted in our cases. The more severe true causalgia arose later and was an infinitely more severe condition. The pain was burning in nature and continuous. It was increased by any movement, by touch, and also by heat or cold. There was a loss of epicritic sensation, especially light touch. Moisture definitely gave some relief, and the patient applied wet cloths to the part. The skin became dry, smooth, and red. It was a truly lamentable condition. No local treatment except rest and the application of moisture gave any relief. Various operative measures were carried out in an attempt to cure this condition. The nerve was freed from any scar. It was cut across and resutured, or cut across without suture. The nerve was injected with alcohol. The nerve roots were divided. Finally sympathectomy was adopted as the most certain and efficient form of treatment when temporary sympathetic block had demonstrated its efficacy. Seddon stated that upper thoracic sympathetic ganglionectomy had proved the most reliable form of treatment. This procedure had been very successful in the majority of cases, but did not give full relief. Pain was relieved, though some discomfort remained. A somewhat similar condition was present in amputation stumps, and again sympathectomy had proved the best form of treatment. However, there were cases which had resisted any form of radical surgery of the limbs and spinal roots, and the division of tracks in the brain had been carried out with some success. Milder forms of irritation were relieved by local operation at the site of nerve injury if spontaneous cure did not take place in a reasonable time.

Closed Injuries of Nerves

Traction Injuries: These injuries, as a rule, caused widespread damage to the nerve involved, often extending for a distance of several inches. In some cases where the damage was limited spontaneous recovery occurred, but this did not happen in the severe cases for which, in addition, operative treatment was useless.

Injuries associated with Fractures: Fractures of the long bones were a frequent complication of nerve injury, and led to delayed treatment. These were most commonly seen in association with fracture of the humerus. It was realised that repair of the nerve was of more importance than that of the fracture, but that nerve repair could not be undertaken till wound healing had taken place. In the earlier part of the war that meant very considerable and hopeless delay in many cases. An attempt to plate the fractures at the same time as the suture of the nerve was not successful, as in 40 per cent of the cases the plates had to be removed. Fortunately in the majority of cases the damage was slight and early recovery took place. Exploration was required only where recovery did not occur in the expected time.

Ischaemia

The severe destruction of the function of a limb caused by ischaemia is well known. This is especially shown in regard to the loss of function of the nerves. Not only is there serious disturbance, but all the nerves in the limb are usually affected. There is associated with this profound atrophy and fibrosis in the muscles, and stiffness and contraction in the joints, a condition for which no treatment is of much avail. The diagnosis of the condition is made on the basis of the combination of disability of nerve, muscle and joint, and the involvement of more than one nerve.

The condition may arise following destruction of the main vascular supply to the limb by severing of the main artery, or it may be brought about by constriction of limbs by tight bandages or splints. The danger was realised early in the war in association with the treatment of wounds by the closed plaster technique. Very soon direction had to be given to cut up plasters in the forward areas to relieve any tension, and also to prohibit bandaging under a plaster splint.

The utilisation of non-padded splints was prohibited, in spite of some resistance by civilian orthopaedic surgeons who had been so long accustomed to use these splints in their treatment of simple fractures, and who could not easily readjust their ideas to war conditions.

Cases can be vouched for in which amputation had to be carried out in consequence of gangrene resulting from tight plaster splints, and a severe ischaemic condition of the limb is only slightly less destructive than an amputation. In severe ischaemia there is present not only gross interference with nerve function, but a functional destruction of muscle which is converted into fibrous tissue. There is also serious joint disturbance with marked rigidity, and unless early and efficient treatment is instituted marked deformities arise. There is little to be done in treatment except the prevention of deformity and the preservation by physiotherapy of what muscle may remain.

Treatment in 2 NZEF

In the 2 NZEF there was little scope for treatment of nerve injuries as cases were evacuated promptly to New Zealand, so promptly that at times transient paralysis recovered on the voyage home. In the first years of the war the majority of the severe wounds were either unhealed, or quite recently healed, at the time of evacuation by hospital ship. Physiotherapeutic treatment was also difficult to carry out as so many of these wounds were enclosed in plaster splints in addition to the dressings.

This arrangement delegated the prolonged treatment of nerve injuries, including their operative repair, to the civil hospitals in New Zealand, where the orthopaedic surgeons were called upon to deal with the problem. There were relatively few cases operated on overseas, though when satisfactory conditions arose there was no hesitation in dealing with them by surgical means. One operation on a lesion of the median nerve above the elbow demonstrated the division between a motor and sensory portion of the nerve at that level. The sensory portion had been completely severed and the motor portion was quite intact. Suture was readily carried out without any interference with the intact motor portion. The nerve might well have been left alone to recover spontaneously, as all the motor functions were normal, but it was felt that the sensory function of the nerve was all-important and with complete loss of sensation exploration was advisable, a very fortunate decision. Later in the war, as wound healing became more rapid and certain and sepsis became rare, more opportunity arose to explore the nerves.

Surgeons in the 2 NZEF were very concerned as to the period of time that would necessarily elapse before the patient evacuated to New Zealand would be operated on. The break between the army and the civil hospital would provide difficulties in keeping an accurate check on the men, especially if they were sent to their homes away from orthopaedic centres. As general opinion gradually veered round to the necessity for early operation, it was felt that the patients had a worse chance under these conditions than they had in the First World War, when they were operated on in England and sent to New Zealand later. The prolonged plaster treatment carried out in the early stages of the war increased the difficulties.

Treatment in New Zealand

The operative and late treatment of peripheral nerve lesions was undertaken by the civil hospitals in New Zealand. There were no military orthopaedic hospitals such as were set up at the end of the 1914–18 War at Trentham and at the Chalmers Annexe of the Christchurch hospital. At that time there were no orthopaedic departments in the public hospitals, and no orthopaedic surgeons in New Zealand and no physiotherapists. As a result of experience gained in the First World War, departments were set up in the main hospitals in New Zealand. At Wellington a physiotherapist trained in the Army was appointed to the public hospital and afterwards became an orthopaedic surgeon. In Christchurch and Auckland the same thing happened, and in Dunedin an orthopaedic surgeon with war experience was appointed to the staff.

The special orthopaedic centres at the end of the 1914–18 War were able to do work which the public hospitals at the time could not have done, having neither the staff nor the equipment. During the Second World War conditions were quite different. Special orthopaedic and physiotherapeutic departments were available in all four main centres well able to deal with the work, though some of it was largely new to civil surgeons. The soldier patient on landing in New Zealand at once became a civilian as far as medical treatment was concerned and lost his identity as a soldier. The treatment given was in conformity with that already described and it was carried out by the orthopaedic surgeons in the main centres.

Rehabilitation

The treatment demanded by these cases, either with or without operation, was prolonged physiotherapy, and continuous observation and social help. For this it was necessary to ensure attachment to a special centre where physiotherapists and specialist personnel were available. Special provision for employment and occupational training were also required in many cases. In New Zealand all treatment was given in the civilian hospitals and occupational training was arranged by the Rehabilitation Department.

Results

The results of nerve suture in the Second World War are difficult to evaluate. Many surgeons have reported their opinions as to results, and generally it can be stated that many results following nerve suture are good, but, as Bristow said, none are perfect.

The results were followed up carefully in the special neurological and orthopaedic centres, especially in the United Kingdom. They showed that the factors affecting the prognosis were:

(a) The level of the lesion.
(b) The delay between injury and operation.
(c) The extent of the gap after resection.

Progressive improvement took place till beyond the third year. The results of high division were much worse than low divisions of the nerve. Satisfactory results could not be expected if the gap was more than 7 centimetres.

Seddon summed up the position as follows:

As a practical summary of the value of nerve repair, it may be said that, provided the interval between injury and operation does not exceed a year, and that end-to-end suture is not employed where the gap in a nerve is more than 7 cms., a worthwhile result is obtained in most cases of radial, median, and internal popliteal nerve injury. Repair of the lateral popliteal component of the sciatic nerve is rarely successful (that is, enabling the patient to dispense with a toe-raising spring) unless the lesion is situated distally and the gap after resection of the stumps is less than 5 cms. Repair of the ulnar nerve is hardly worth attempting if the lesion is proximal to the elbow; and successful repair of the brachial plexus is limited to lesions of the upper trunk, cervical 5 and 6.

In a small series of cases investigated in New Zealand in 1949 the results were poor. In practically all the cases the joint function was good but the general functional activity of the limb was poor. The average pension granted was 53 per cent, including the nerve injury and associated injuries. When more than one nerve was involved the average was 65 per cent, and when associated with fracture of the humerus 57 per cent. When only one nerve was involved the average pension was 48 per cent.

Late Results: Pensions Survey in New Zealand

In 1951 Dr. D. Macdonald Wilson made a survey of results of peripheral nerve injuries occurring in New Zealand servicemen in the Second World War. There were 416 gunshot wounds, which caused 473 nerve injuries, and 29 accidental injuries producing 37 nerve injuries. Very few cases had been operated on overseas, and operation on the nerve was not carried out, except in one or two cases, till the wound was satisfactorily healed. Associated fractures had led to marked delay in nerve repair.

The operative procedures employed in New Zealand were simple, and practically no attempts were made to use artificial materials or grafts of other nerves to bridge gaps. Nerves were operated upon for suture, for excision of neuromata before suture, for freeing of adhesions, transplantation to shorten their course and so allow approximation of divided ends, and for the relief of pressure.

Details concerning the individual nerves injured, and the results of treatment, are given below. In the results of treatment the nerves were classified into three categories: those with complete restoration of function; those with sufficient restoration to give the patient useful function, but with restoration of either or both motor and sensory power not complete; those with no restoration of function of the nerve, or in which the return of function was so slight that there was no practical benefit to the patient.

Many of the cases where restoration of function occurred had no operation to the nerve, and it is evident there was no solution of continuity of the nerve by the missile causing wounding and that temporary loss of function was due to concussion of the nerve with spontaneous recovery.

Results of Treatment of Gunshot Wounds

Nerve	Complete Recovery	Good	None	Total
Brachial plexus	3	3	12	18
Ulnar	24	22	75	121
Median	8	21	48	77
Radial	27	12	35	74
Post-interosseus	5	1	2	8
Sciatic	7	14	48	69
Popliteal	0	4	8	12
Peroneal	9	4	17	30
Tibial	8	2	27	37
Others		3	24	27
	91	86	296	473

Results of Nerve Suture—all Wounds

Nerve	Complete Recovery	Good	None	Total
Brachial plexus			1	1
Ulnar		9	26	35
Median	1	2	9	12
Radial	2	5	13	20
Post-interosseus				
Sciatic			6	6
Popliteal		1	3	4
Peroneal			2	2
Tibial			3	3
	3	17	63	83

Evaluation of Results shown by Survey

Of the actual sutures of nerves performed in the series the results are very disappointing. In all, 83 sutures were carried out, and in 63 cases no improvement was shown. The good results are set out below:

Ulnar: Good functional results in 3 cases of accidental injury and in 6 cases of gunshot wounds.

Median: Complete recovery in 1 partial suture for accidental injury and 2 good functional results in gunshot wounds.

Radial: Two complete recoveries (GSW) and 5 good functional results. Sixteen of the radial cases had tendon transplantation carried out, 13 of them after unsuccessful suture.

There is no improvement following suture of the sciatic nerve, 1 good recovery in suture of the popliteal nerve, but no successes in operation on the peroneal or tibial nerves.

Nine cases of accidental injury had suture performed, with 1 complete recovery and 3 good functional recoveries. Seventy-four cases of gunshot wounds had suture performed, with 2 complete recoveries and 14 good functional recoveries. Of the 20 cases recovering some useful function, 16 were either ulnar or radial injuries. Five of them were operated on on the day of injury, 13 within nine months, and two (both ulnar injuries) after a year. In the 63 unsuccessful cases 41 were operated on under fourteen months and probably 15 of these under six months.

In spite of the fact that the large majority of the sutures were carried out within the optimum period, the results were very poor.

From the results it would appear that nerve injuries should in future either be kept in the theatre of operations overseas for operative treatment or be segregated immediately after arrival in New Zealand in special centres under the control of experienced neurosurgeons.

Recommendations for the Future

1. At the primary operation in the forward areas nerve suture should not be performed, but a simple approximating stitch, if necessary, introduced.
2. When it is known that the nerve has been divided, suture should be performed as early as the condition of the wound will admit, but not earlier than two to three weeks following injury.

3. When signs of recovery do not appear within a period of five to six months exploration should be undertaken in any case where satisfactory results are deemed possible, recognising the hopeless prognosis in certain types of injury.
4. At operation free exposure is essential. Simple suture of the nerve sheaths following excision of the area of fibrosis is the routine operative procedure, and freedom from tension is essential.
5. The use of splints should be strictly limited and the function of the limb preserved by regular movements of the limb and electrical stimulation of the muscles both before and after operation, and when no operation is performed.
6. The cases should be segregated at the earliest possible moment under the care of physiotherapists and surgeons with experience in neurosurgery, and this segregation is imperative when the patients are evacuated to New Zealand.
7. Rehabilitation is a major question in the treatment of these disabilities, and special provision should be made for employment and occupational training.

Nerve Lesions

Battle Casualties Invalided FROM 2 NZEF, 1940–45

Upper Limb

	Battle Casualty	Accidental Injury
Ulnar	94	3
Musculo-spiral	71	
Median	47	7
Median and ulnar	21	1
Median and another	16	
Brachial plexus	24	2
Cervical plexus	2	
Post-interosseous	10	
Facial	5	
Other	4	2
	294	15

Lower Limb

	Battle Casualty	Accidental Injury
Sciatic	93	2
Ext. popliteal	50	1
Post. tibial	34	2
Ant. tibial	5	
Ant. crural	8	

Saphenous	5	
Other	6	1
	201	6

Missile Causing

Upper Limb		Lower Limb	
Shell	78	Shell	65
Mortar	20	Mortar	11
Gunshot	22	Gunshot	21
Bomb	8	Bomb	15
Rifle	5	Rifle	1
Mine	4	Mine	5
Machine-gun	4	Machine-gune	9
Grenade	1	Grenade	2
		Other	3
	142		132

Year Medically Boarded

1941	9 (PW)	1941	6 (PW)
1942	34	1942	28
1943	18	1943	22
1944	67	1944	53
1945	14	1945	23

Admissions to Hospital, 2 NZEF, July 19411–July 1945

Ulnar	154	Sciatic	84
Median	87	Femoral	2
Musculo-spiral	65	Ext Popliteal	21
Radial	57	Tibial	55
Brachial plexus	22	Peroneal	55
Post-interosseous	17	Nerve injury: general	33
Other	19		

APPENDIX
INJURIES TO PERIPHERAL NERVES IN SERVICEMEN OF SECOND WORLD WAR

Details of Survey of Late Results in 445 Cases involving 510 Nerves (By Dr D. Macdonald Wilson, 1951)

injuries to the brachial plexus

The 21 cases included three due to accidental injury and 18 to gunshot wounds.

(a) Accidental Injuries (3 cases).—Only one case recovered function; this was a contusion of left axilla with temporary loss of function. One case resulted from a fall from a cycle, and the remaining case occurred when lifting a heavy weight. This latter case was operated upon to remove adhesions and the stellate ganglion seven months after injury without improvement.
(b) Gunshot Wound Injuries (18 cases—9 right and 9 left).—Three cases resulted in complete recovery without operation, 1 was described as a partial lesion, and 1 was associated with torn axillary vessels requiring ligation. Another 3 cases, 1 a partial lesion, resulted in almost complete recovery without operation. Twelve cases of the 18 showed no recovery of nerve function.

Three cases were operated upon for the nerve lesion.

In 1 case the median nerve trunk was sutured without benefit, while the ulnar and radial nerve trunks were not sutured. The brachial artery and vein also required ligation. Another case was operated upon seven months after injury, when a cable graft was inserted without benefit, and subsequently an arthrodesis of the shoulder was performed to improve the function of the arm. The third case received novocain injections for the relief of pain two months after wounding. One year later a posterior rhizotomy was performed which gave relief to causalgic pain.

the ulnar nerve

This nerve was that most frequently injured, there being 137 cases, all but 16 being due to gunshot wounds. In 71 cases the right ulnar nerve was injured, in 64 cases the left, and in 2 cases both right and left were involved.

In 79 cases the nerve was injured above, and in 60 cases below, the elbow, while in 27 cases the lesion was described as partial division of the nerve.

There were associated nerve injuries as follows: median, 32 cases; radial, 6 cases; median and radial, 3 cases; radial nerve of opposite arm, 1 case; sciatic, 2 cases; external saphenous, 1 case.

Associated bone injuries of the arms were: fractures of humerus, 15 cases; ulna, 9 cases; radius, 4 cases; ulna and radius, 2 cases; humerus, ulna, and radius, 1 case.

Associated injuries of main blood vessels occurred as follows: axillary artery, 1 case; axillary vein, 1 case; brachial artery, 8 cases; radial artery, 1 case; ulnar artery, 3 cases; radial and ulnar arteries, 1 case.

Results of Treatment

(a) Accidental Injuries (16 cases).—In 10 cases there was an incised or lacerated wound, while in 6 cases there was no open wound, the nerve injury being associated with a fracture or bruising about the elbow. In one case only was there complete recovery. This was a case with a history of an injured elbow as a child who gradually without obvious cause developed neuritis with sensory and motor changes in 1943. In 1944 the nerve was transplanted to the front of the elbow with relief of the neuritis and return of normal function. In 4 cases there was return of good function, but not complete recovery. In 3 cases operation with suture was carried out on the day of injury, while the fourth case was one associated with a bruised elbow in which the nerve was transposed some five years later. Of the 3 sutured cases two were forearm and one upper arm injuries. Eleven cases showed no evidence of recovery, although 7 of these cases were incised wounds, in 5 of which operation with suture of nerve and muscle tendons were carried out on the day of injury. In 4 cases there was associated ligature of either the brachial, ulnar, or radial arteries.

(b) Gunshot Wounds.—Out of these 121 cases of gunshot wounds 44 were operated upon with the following results:

(1) Full recovery, 2 cases (one forearm injury with neurolysis 34 months after wounding. One upper arm injury operated on 52 months after wounding, when the nerve was transferred to the front of the elbow). In

neither case was the nerve divided.

(2) Good functional recovery, 10 cases (7 upper arm and 3 forearm injuries). Six cases (4 upper and 2 forearm) were sutured. Upper arm cases were sutured: 1 on day of wounding, 1 nine months, 1 thirteen months, and 1 two years after wounding. Forearm cases were sutured: 1 four months and 1 five months after wounding. The remaining 4 cases were operated upon as follows:

1 forearm case, explored only, one week after wounding.

1 upper arm case neurolysis after five months.

1 upper arm case neurolysis after fifteen months.

1 upper arm case neurolysis after four and a half years for hyperaesthesia.

(3) No recovery, 32 cases (23 upper arm and 9 forearm injuries).

In 21 cases suture was attempted at various periods after injury.

Cases operated within six months were 6; within twelve months, 7; within two years, 2; within three years, 2; within four years, 2; within five years, 2.

Two cases of suture subsequently had a neurolysis performed. In 6 cases a neuroma was removed and subsequently sutured. In 7 cases the nerve was transposed to the front of the elbow, either to allow suture or associated with neurolysis to relieve pain in the nerve distribution. In 2 cases neurolysis only was carried out, and in 1 case a tendon transplant only in an attempt to improve the function of the hand.

MEDIAN NERVE

There were 84 cases, including 7 due to accidental injury and 77 to gunshot wounds. Forty-six were above and 38 below the elbow. There were 37 right and 47 left nerve injuries. Twenty-five cases were described as partial division of the nerve.

Associated nerves injured were: brachial plexus, 1; ulnar, 32; ulnar and radial, 5: radial, 7; internal cutaneous, 2.

Associated injuries to bones of upper limb were: fractures of humerus, 9;

humerus and ulna, 1; humerus and radius, 1: radius, 8; ulna, 2; radius and ulna, 5; metacarpals, 2.

Associated injuries of main blood vessels were: brachial artery, 9 (with aneurysm in 1 case); brachial vein, 1; axillary artery, 2; radial and ulnar artery, 2.

Results of Treatment

(a) Accidental Injuries (7 cases).—Complete recovery in 2 upper arm cases and no recovery in 5 cases. Of the recovered cases, 1 was an accidental partial laceration of the nerve operated six months after injury for removal of a neuroma and suture. There was full recovery two years after injury. The second case of recovery was merely a contusion with temporary paralysis of the median and radial nerves.

(b) Gunshot Wounds:

(1) Complete Recovery (8 cases): 1 after operation (neurolysis within one year) upper arm; 7 cases without operation, 5 forearm and 2 upper arm.

(2) Good Recovery (21 cases): 5 cases operated on (2 sutures within six months of injury, both upper arm cases, and 3 cases of neurolysis, 1 forearm after five months, and 2 upper arm five and fifteen months after injury). Sixteen cases had no operation, 12 upper and 4 forearm cases.

(3) No Recovery (48 cases): 31 cases were not operated on (19 upper and 12 forearm cases). Seventeen cases (8 upper and 9 forearm) were operated on (6 cases were explored, but owing to the gap being too wide nothing more was done. Nine cases were sutured at periods varying from one month to four years (average eight months) from date of injury. Two cases underwent neurolysis).

injuries to radial nerve

There were 81 cases, 7 due to accidental injuries and 74 to gunshot wounds. Seventy were lesions in the upper arm and 11, including 1 accidental injury, were forearm injuries.

Forty-five were right and 36 left, while 19 were described as partial lesions.

Associated lesions of nerves were: median, 9; ulnar, 5 and 1 opposite arm; median and ulnar, 5; external-internal popliteal, 1.

Associated bone injuries were: fractures of humerus, 34; humerus and ulna, 4;

radius, 3; scapula, 1; humerus and radius, 1; radius and ulna, 1.

Associated injuries to main blood vessels: brachial artery, 2; axillary artery and vein, 1.

Results of Treatment

Complete Recovery: Occurred in 32 cases (5 caused by accidental injury and 27 from gunshot wounds):

(a) Of the 5 cases of accidental injury 3 were lesions in the upper arm, 2 in the forearm, and none were operated on. These injuries consisted of contusions or were associated with fracture of the humerus.
(b) Of the 27 cases of gunshot wounds, 25 were not operated upon, while 2 underwent operations. In 1 case the nerve was sutured in the upper arm on the day of injury, and in the other case freeing and suture of the nerve was carried out eight months after injury, with complete recovery from wrist drop.

Good but Not Complete Recovery: Occurred in 12 cases, all gunshot wounds. In 5 cases suture of the nerve was carried out after periods of one to eight months from date of injury, while in 7 cases there was no operation on the nerve.

No Recovery: Occurred in 37 cases, including 5 forearm injuries, all of which were partial lesions only of the nerve. Thirteen of these 37 cases were operated upon in an attempt to restore nerve function by suture (3 cases within one year of injury), 2 had neurolysis, and 2 exploration. No improvement following these operations, tendon transplants were carried out at a later date, while operations on the tendons were also carried out on 3 cases without previous exploration of the nerve.

injuries to other nerves of upper extremity

Several of the smaller nerves were injured by gunshot wounds as follows: long thoracic, 1; circumflex, 2; musculo-cutaneous 3; internal cutaneous, 1; and posterior interosseous, 8.

Five of the posterior interosseous nerve cases made a complete recovery, 1 a fair recovery, and 2 of the musculo-cutaneous nerve injuries recovered. There was no recovery in any other case.

injuries to sciatic nerve

There were 69 cases, 32 being injury to the right and 35 to the left sciatic nerve, while in two cases both right and left were injured. All injuries were due to gunshot wounds, and 26 were described as partial lesions. Two cases were associated with wounds of upper limbs involving the ulnar nerve.

Associated bone injuries were fractures of pelvis, 3 cases; femur, tibia and patella, 1; femur, 5; patella, 1; tibia, 1.

Associated injuries to main blood vessels which required ligation were femoral artery, 4 cases, and popliteal vein, 1 case.

Results of Treatment

(a) Full recovery was made in 7 cases, including 3 partial lesions, 1 of which affected both right and left nerve.
(b) Good results but not complete recovery occurred in 14 cases, including 9 partial lesions.
(c) No recovery was made in 48 cases. These included all the cases associated with main blood vessel injuries.

Operations for Sciatic Nerve Injuries

Twenty-four cases underwent operation:

(a) Nerve Suture, 6 cases, without recovery (all operated on from four to fourteen months after injury).
(b) Exploratory, 6 cases (gap too wide to allow approximation and nothing further done).
(c) Neurolysis for nerve irritation, 3 cases.
(d) Procain Block of lumbar ganglionated chain -for causalgia, 1 case.
(e) Ganglion-ectomy for neuritis, 3 cases.
(f) Ultimate Amputation, 3 cases: One below-knee amputation, seven years after injury for complete nerve lesion with trophic sores. One below-knee amputation two and half years after injury following burns and skin grafting. One above-knee amputation eight months after injury.
(g) Arthrodesis of Metatarso-phalangeal Joint big toe, 2 cases.

Of the 7 recovery cases only 1 was operated upon (ganglionectomy three years after for neuritis). In the 14 cases of good but partial recovery there was only 1 operation (neurolysis for irritation was performed one year after injury).

injuries to popliteal nerve

Twelve cases of gunshot wound injuries affected the following popliteal nerves: external right, 7 cases; external left, 2 cases; internal left, 1 case; external and internal right, 2 cases.

Results of Treatment

There was good recovery in 4 cases, and no recovery in 8 cases.

Associated injuries were: fractured femur, 1; fractured fibula, 4; and popliteal vessels, 1.

Operations performed were: 1 suture day of injury (no recovery); 1 suture eight months after injury (good recovery); 1 suture four months after injury (no recovery); 1 suture one year after injury (without recovery and followed six years later by an arthrodesis of foot).

injuries to peroneal nerve

There were 30 cases of gunshot wounds and 3 accidental injuries, 15 being the right and 18 the left nerve, while 9 cases were described as partial lesions.

Associated bone injuries were: fractures of tibia, 2; fibula, 5; and tibia and fibula, 1.

An associated vascular injury produced an arterio-venous aneurysm of popliteal artery and vein.

Results of Treatment

Fully recovered, 9 cases (2 partial injuries); good recovery, 4 cases (1 partial injury); no recovery, 20 cases (6 partial injuries).

Operations

Two cases were sutured within one year of injury without recovery; 1 case was simply explored; tendon transplants were done in 3 cases; and in 1 case a neurolysis was performed eighteen months after injury, with subsequently lumbar ganglionectomy eighteen months later to relieve neuritis.

injuries to the tibial nerves

There were 36 cases caused by gunshot wounds, and 1 was a pre-war accidental injury. (Thirteen lesions were described as partial). The tibial nerves affected were: posterior right, 10 cases; posterior left, 17 cases; anterior right, 3 cases; anterior left, 4 cases; posterior right and left, 1 case; anterior and posterior, 2 cases.

Associated bone injuries were: fractures of tibia, 2 cases; fibula, 2 cases; tibia and fibula, 2 cases.

Associated injuries to blood vessels were: torn posterior tibial artery, 2 cases; torn posterior tibial vein, 1 case; arterio-venous aneurysm of anterior tibial vessels, 1 case.

Results of Treatment

Fully recovered, 8 cases; good recovery, 2 cases; no recovery, 27 cases.

The fully recovered cases include the pre-war accidental injury case. This man suffered a laceration of tendons and anterior right tibial nerve and made a complete recovery. In 1945 he developed a dropped foot without obvious cause, but made a complete recovery.

Operations undertaken were:

(a) Suture 3 (without recovery, and all carried out from six to twelve months after injury).
(b) Exploration without any action on nerve, 5.
(Neurolysis, 2 (one operation carried out fourteen months after injury for the relief

(c) of causalgia was followed by a good but not complete recovery).

(d) Sympathectomy for relief of pain, 1 case (pain was partly relieved).

(e) Tendon transplant, 1 case.

injuries to other nerves supplying the lower limb

Lumbar-sacral plexus, 1 (no recovery); anterior crural nerves, 5 (2 right and 3 left, with 1 fair recovery); saphenous nerve, 5 (4 right and 1 left with 2 cases of fair recovery); and external plantar nerve, left, 1 (no recovery).

Only 1 of these cases was operated upon, when a saphenous nerve was dissected out of a scar in an attempt to relieve pain.

injuries to cranial nerves

A few cases of injury to branches of cranial nerves occurred in the 445 cases of nerve injuries. There were 5 cases of facial nerve injury, 1 being accidental and 4 due to gunshot wounds. The accidental injury, caused by a blow on the face, was the only one to recover function. In 1 case nerve exploration was carried out fifteen months after wounding, without benefit.

Other nerves injured were the inferior dental, 1; spinal accessory, 1; and infraorbital, 2, with fractured maxilla. No operations were done, and no recovery occurred in these cases.

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CHAPTER 10 — CHEST INJURIES

Contents

FIRST WORLD WAR

FIRST WORLD WAR

I N the early stages of the First World War chest injuries were treated conservatively and little was done apart from the treatment of the external wound. The wound itself was not treated by radical excision in the same way as wounds of the trunk and buttocks, as there was not the same danger from anaerobic infection of muscle.

Chest surgery, as we now know it, had not been developed. The mortality from chest injuries was high (it still is for that matter), but infection was a common and dangerous complication. During the bloody and prolonged battle of the Somme, with its heavy and continuous casualties, the problem of sepsis in relation to penetrating wounds of the chest became an insistent one, and Cask, then working in a CCS at Heilly, came to the conclusion that an attempt should be made to treat wounds of the chest and lung by full exposure and radical excision on the same principles as that applied to other gunshot wounds. He courageously tackled the problem and developed a technique of early operation which consisted of excision of the wound of the chest wall, opening the chest, freely excising wounds of the lung, and removing foreign bodies and blood from the pleural cavity. He closed the chest by suture and aspirated afterwards. His capacity as a surgeon enabled him to get satisfactory results, especially as regards the prevention of infection, but the mortality was naturally high. Chest cases were then sent to him from the whole area—the first development of a forward chest centre. The necessity for special training of the surgeon, special anaesthetists, and equipment restricted the development, and the majority of surgeons continued to treat the chest cases conservatively.

Gask, however, continued his work and undoubtedly gave a great stimulus to chest surgery. Moynihan at the end of the war was convinced that chest surgery had a great future before it and that marked progress would be made as a result of experience in war. His vision has proved correct. It was strange perhaps that experience in the Second World War showed that early radical exploration of the chest was undesirable, and that the best results were obtained by conservative methods.

During the First World War there was much severe and prolonged sepsis with chronic empyemata. Treatment by the instillation of the hypochlorites was undertaken with beneficial results when the Carrel-Dakin treatment was introduced. (Thoracoplasty. was required later in some of the cases.)

In the First World War the New Zealand forces had no special chest surgeon, nor did they have one during the 1939–45 War. They relied when necessary on the British centres.

Between the Wars

The after-results of war wounds of the chest were evaluated as time went on. There were serious disabilities left behind by chronic infection, with lack of expansion and so of function of lung.

The retention of foreign bodies in the lung was found to give rise to complications, especially if the foreign body was large and irregular, though the large majority of the smaller foreign bodies caused no trouble. Haemoptysis sometimes occurred and there were some cases of bronchiectasis and also of abscess of the lung.

These cases so impressed the Pensions authorities in New Zealand that eventually the Pensions Boards decided to grant a 10 per cent pension to all ex-soldiers who had a retained foreign body, irrespective of the presence of any symptoms or disability. This decision seems to be founded on possibly undue pessimism, and the principle of granting a pension when no disability was present for what might be called a potential disability is open to criticism. The experience of trouble following retention of foreign bodies after the First World War influenced treatment during the Second World War.

A specialised branch of surgery with its own equipment and anaesthetic technique sprang up between the wars and major chest operations became a routine in civilian practice.

SECOND WORLD WAR

At the commencement of the Second World War, due to the initiative of Professor Cairns and Mr. Tudor Edwards, special provision was made for the treatment of head and chest casualties, both in hospitals in the United Kingdom and in the theatres of war. Elaborately equipped mobile surgical units were organised with all the essential equipment for head and chest surgery, including instruments, appliances and theatre furniture, and special vans were built to house the equipment.

The Sims Mobile Surgical Unit of 2 NZEF was assembled in the United Kingdom and British experience was used and similar equipment procured, but this was expanded to cover all types of casualties.

The New Zealand Medical Corps did not have any special chest unit or surgeon, either in the forward areas or at the Base. A special unit was developed, however, in the Middle East Force by the RAMC and attached to one of the Cairo hospitals. British chest units were then developed as part of the staff of a base hospital in a similar way to orthopaedic units, and not, as at first constituted, as separate mobile field units.

It was the established policy of the 2 NZEF for all New Zealand patients to be treated in our own hospitals. As far as chest cases were concerned, we never arranged for our men to be treated in the British units, but we always availed ourselves of their advice and special knowledge, and our consultants and many senior officers paid frequent visits to the units.

The first experience of wounds of the chest as far as 2 NZEF was concerned were Australian casualties admitted to 2 NZ General Hospital during the first Libyan campaign in 1940. Then followed the campaigns in Greece and Crete, when the large majority of seriously wounded men were taken prisoner and so never reached our base hospitals.

Experience of war wounds had by that time been gained by surgeons in Britain in connection with the campaign on the Continent and the bombing of England, and also by the British and Australians in the MEF. It was soon realised that in the forward areas major operative procedures were impossible in the severe chest cases and unnecessary in the less severe injuries, which formed the large majority of the cases. Most deaths occurred in the first twenty-four hours and were due to the severity of the injury, and any treatment was unavailing. The cases demanding urgent treatment were the sucking wounds and the rare tension haemothorax. The sucking chest required immediate closure, and a firm pad, kept in place with strapping, was first tried as a first-aid treatment.

The British approach to gunshot chest injuries at the beginning of the war was an attempt to apply Cask's ideas of radical operative treatment in some cases, but with the realisation that more conservative treatment was indicated in the majority of the cases. Barrett reported that 40 per cent of his cases required immediate surgery for early excision of wounds, for bleeding, for sucking wounds, and for haemothorax with retained foreign body.

In the MEF a radical approach was never adopted, partly possibly because the conditions for forward surgery were unsuitable, partly because experienced chest surgeons were not available in the forward areas, and also because the first chest specialist from the outset adopted a conservative attitude. The NZEF hospitals, with no special chest surgeon, always employed conservative methods.

The Australians had considerable experience of acute cases at Tobruk in 1940–41. Their treatment was markedly conservative and, apart from the early suture of the sucking chests, was largely concerned with early aspiration, and drainage for the relatively few cases of empyema. Chest cases were retained in the forward areas for seven to ten days. The removal of foreign bodies was carried out in their base hospitals if the foreign bodies were of sufficient size to warrant it, over half of them being removed.

During the second Libyan offensive in November 1941 the New Zealand Division had severe casualties, including many chest cases. At that time the vaseline pack was utilised for the early treatment of sucking wounds, and aspiration was carried out after forty-eight hours. Some cases which had been sutured in the forward areas were found to be very septic at the Base.

A swing-over from the more radical procedures of the First World War to a more conservative attitude was the most striking feature of the discussion at the Surgical Conference, Cairo, in 1942, on penetrating wounds of the chest. In haemothorax the general opinion expressed was that, although the ideal treatment was early aspiration with air replacement, under prevailing conditions the best procedure in forward areas was simple wound toilet only and evacuation, provided the Base was likely to be reached within a week. The great majority of patients with haemothorax did not exhibit dyspnoea at rest and travelled well. In a minority early aspiration was required. The risk of infection was greatly lessened by sulphonamide therapy along the line of evacuation, and by delaying aspiration until it could be done under the optimum conditions at the Base. Removal of intra-thoracic foreign bodies was rarely required in forward surgery; even for later removal the indications were probably few.

During the Battle of Alamein (23 October to 3 November 1942) observations showed that severe shock was frequently present in chest cases and that blood transfusion as well as tapping of the chest was almost routine in the serious cases, which often had to be retained in the CCS for forty-eight hours. Sucking wounds were dealt with by vaseline pack kept in position by a loose stitching of the skin after excision of the wound.

At the end of the Tunisian campaign it was again emphasized that the serious chest cases gave rise to much anxiety in the forward areas, showing great distress from respiratory and cardiac embarrassment. Aspiration frequently gave little relief, and blood transfusion was fraught with danger and was normally limited to one pint. These cases deteriorated seriously on shifting and had to be held in the forward areas. The light cases gave little trouble. A high incidence of infection was noted by the chest centre in Tripoli in cases tapped in the forward areas. The only cases demanding early surgery were large chest wounds, open sucking wounds, and occasionally bleeding from an intercostal artery. Aspiration was being done earlier and more frequently, air replacement still being carried out at the first aspiration, if done in the first twenty-four hours. Some surgeons, especially in the First Army, were urging the early frequent and thorough evacuation of all haemothoraces. A number of men recovered rapidly from large haemothoraces and were retained in the Middle East.

In Italy at the Sangro the serious cases were still a difficulty; repeated tapping was carried out and intercostal drainage for infected haemothorax was being used at the CCS. Penicillin then became available and was especially set aside for the chest cases. Infection had become more frequent and severe in the Italian campaign than it was in the Desert. Early and repeated aspiration, followed by the introduction of penicillin into the pleural cavity, then became the routine treatment of haemothorax. At the same time the necessity for careful excision of the chest wound, especially the sucking wound, was realised.

Much improved results were obtained during the Cassino battle following treatment by wound excision, penicillin, and early aspiration. The formation of fibrin clot in a small proportion of the cases gave rise to much thought at that time and the removal of the clot by decortication was practised by the chest units. A review of chest cases in the 2 NZEF was undertaken by the Consultant Surgeon at that time, and this brought out clearly the main problems and the results of treatment.

It was found that there was a mortality of 39 per cent and that over four-fifths of the deaths took place in the first: twenty-four hours. The large majority of the deaths were due to the severity of the injury and occurred during the initial stage of shock. Infection had become uncommon, very few cases requiring drainage of the chest.

At the end of the Italian campaign the treatment of chest cases had become stabilised as regards early treatment. The chest wounds, particularly the sucking wounds, were adequately excised and injured rib and foreign bodies removed from the wall and pleura. Suture of muscles closed the chest, and a pad was anchored by a few loose skin sutures. Penicillin was then instilled, no drain being used, but the chest kept dry by repeated aspiration. Blood transfusion was still limited in amount to replace actual blood loss and shock largely treated by rest, warm drinks, and the removal of fluid from the chest, the patient being nursed flat till the condition of the circulation warranted the sitting posture. The serious cases were held in the forward areas till the stormy initial crisis was over.

The importance of respiratory exercises as a preventative and curative treatment of atelectasis and the patchy pneumonic changes that occurred in chest wounds was stressed and the exercises became a routine in these cases. The removal of foreign bodies at the base hospitals was carried out commonly from the seventh to the fourteenth day in about half the cases reaching the special centres. Decortication for clotted haemothorax was frequently done between the third and fourth week, though in our series only one patient required operation. Convalescence was accelerated by high protein and vitamin diet, and blood transfusion in anaemic cases.

In England similar measures were adopted and infection became much less common. Operating for foreign bodies was undertaken about six weeks after wounding, but in the presence of marked infection the operation was postponed until a sinus formed or several months after healing. Just as in our cases, clotted haemothorax had become uncommon following aspiration and penicillin. Morphia in moderate dosage was held to be beneficial, as was oxygen if efficiently administered.

Chest Wounds in 3 NZ Division

There were 20 cases of chest injury admitted to 2 NZ CCS, and in 9 of these grenade or mortar bomb fragments produced a haemothorax. No case of open or tension haemothorax was seen. Aspiration was not carried out before admission to the CCS, but this was done at the CCS and sometimes later at 4 General Hospital. Dark fluid blood, or less commonly blood-stained serous fluid, was withdrawn. Clotting or infection was not observed. At the time most casualties were received no X-rays were available at the CCS. In three cases metallic foreign bodies were removed at the base hospital. All cases recovered satisfactorily.

We now pass from the chronology of developments to a discussion of separate problems in the management of chest wounds.

Evacuation of Chest Cases from the Field

The evacuation of the severe chest casualty to the forward operating centre called for the gentlest of handling, as these cases were severely shocked and had both respiratory and cardiac distress. Breathing was relieved by slightly propping up the patient if his circulatory condition warranted this. Blood transfusion had to be given with the greatest caution unless serious external bleeding had been present. Moderate warmth and warm fluids were generally the only treatment necessary except attention to a sucking wound, which had to be adequately dealt with at the earliest possible moment. Lieutenant-Colonel Button observed that 'chest cases on arrival at a CCS tended not to travel well by comparison with other types of injury. They frequently showed considerable dyspnoea and shock.'

Resuscitation

The severe chest cases were generally suffering seriously from shock accentuated by respiratory distress. At times this was due to deep-seated injury of heart, main blood vessels, or of lung, and there was a heavy mortality among such cases on the battlefield. Moreover, wounded who survived to reach a medical unit were often suffering from such grave injury that they did not live much longer.

In our series of cases in Italy, 40 per cent of the deaths were brought in dead to a medical unit, and another 43 per cent died in the first twenty-four hours after admission, so that 83 per cent of deaths in those with chest wounds not buried on the battlefield died in the first twenty-four hours. Most of these cases had hopelessly severe injuries. Resuscitation was very difficult. If a sucking wound was present, its closure was of first importance. It was necessary as a rule to keep the patient lying down till the severe circulatory disturbance had subsided sufficiently to warrant sitting up for the relief of respiratory distress. Oxygen was administered when required in the serious cases by means of a BLB mask.

Transfusion of blood was indicated when definite blood loss had occurred, but there was some doubt as to whether blood was otherwise desirable, and many were of the opinion that any excess of transfusion above the amount of blood actually lost was definitely harmful to the patient. At first blood was given in quantity similar to that given to other shocked cases, but by the Alamein period it was realised that blood transfusion to any degree was fraught with danger and that normally only a pint should be given. Excess of transfused blood was held to be harmful and unnecessary, tending to put strain on the already overloaded heart and liable to overtax the pulmonary circulation. In blast injuries, particularly, blood transfusion was contra-indicated, and plasma or serum given in small quantities instead, along with general treatment by oxygen, rest, and morphia.

Primary Operation

This was carried out in 22 per cent of our New Zealand cases. This consisted essentially in wound excision of the sucking and other large chest wounds with suture of muscle layers, but not of the skin. The lesser penetrating or perforating wounds were not operated on. Operation for other conditions was rarely performed by our New Zealand surgeons. At one time extensive operative procedures in the forward areas, such as Gask carried out in the First War, were practised by the Americans, but they found the mortality was high and the results did not warrant the continuance of the radical procedures. There were certain conditions, however, that did call for operation, such as:

(a) Foreign Bodies in the Wound or in the Pleural Cavity contiguous to the Wound: Large foreign bodies in these situations often caused trouble through sepsis, and their removal was desirable. With X-ray examination the suitable cases could be chosen, but often the foreign bodies were located and removed during the treatment of the chest wound.
(b) Bleeding from the Chest Wall: This arose most commonly from a damaged intercostal or internal mammary vessel, when bleeding would occur either externally into the wound or into the thorax, giving rise to respiratory distress and being unrelieved by aspiration. The presence of fresh blood on re-aspiration and general signs of blood loss pointed to continued bleeding. The vessel was exposed in the wound, removal of a portion of the rib being carried out if necessary.
(c) Thoraco-abdominal operations have been dealt with elsewhere.

The Sucking Chest: This condition was for obvious reasons recognised right from the beginning of the war as one demanding urgent treatment. The serious respiratory and cardiac distress caused by the open chest made it imperative to close the hole at the earliest possible moment.

In Britain at the time of the Dunkirk withdrawal this was accomplished by means of a firm pad kept in place with strapping till such time as operative treatment could be undertaken. Excision of the wound and muscle and skin closure were carried out later in early cases and an intercostal drain inserted for thirty-six hours. In the case not seen for thirty-six hours a vaseline pad was strapped on and an intercostal tube inserted but no operation undertaken on the wound.

The Australians during the first Libyan campaign in 1940 considered the pads unsatisfactory and inefficient. They carried out immediate closure with a few deep silkworm stitches even at the RAP, and they continued the same treatment in the Pacific campaign.

During the second Libyan campaign in 1941 the New Zealand Divisional units utilised the vaseline pack. Some cases which had been sutured in the forward areas were found to be very septic on arrival at the Base. As a consequence of this, early suture was given up and the vaseline pad became the routine treatment, but better fixation was obtained by using skin sutures to anchor the pad. The progress of the wounds treated in this way was generally satisfactory, though some sepsis still occurred. It was then realised that the usual excision of the wound as applied to wounds elsewhere in the body was just as necessary in chest wounds if infection was to be prevented.

During the Alamein period in 1942 surgical toilet of the wounds was carried out and then a vaseline gauze pack applied and kept in place by sutures. Sepsis was then seldom troublesome and the wound was found to become rapidly sealed off in a few days.

It was reported by the NZ CCS at the Cassino period in 1944 that only 4 cases out of a series of 30 had become infected. Lieutenant-Colonel Button, NZMC, writing of his experience at the CCS at that time stated:

Sucking wounds of the chest required early operation to relieve distress. The wound was excised down to the ribs and the rib ends were trimmed. The haemothorax was emptied by suction. No attempt was made to remove the missile at this stage, unless X-rays showed it to be easily accessible. A stab wound was made in the dependent part of the pleural cavity and a self-retaining catheter introduced and clamped off. The wound in the chest wall was closed by the approximation of the soft tissues—a vaseline gauze dressing was then placed over the muscle layers and the skin approximated over this by one or two silkworm gut sutures. Penicillin, 15,000 units, was instilled into the pleural cavity daily for four days, or as necessary, following the aspiration of the haemothorax. The self-retaining catheter which allowed of closed drainage for forty-eight hours was removed after this time. With this technique these patients did well. The incidence of infection, pneumonitis and intra-pleural infection became minimal and re-expansion of the lung occurred early.

This treatment gave excellent results, and New Zealand forward surgeons then practised thorough excision of the sucking chest wound, followed by suture of the muscles and the application of a pad. Delayed primary suture was then performed as in the ordinary flesh wound. In wounds of the lower part of the chest suture of the pleura to the diaphragm was of value in closure of the chest. Sepsis was often associated with a sucking chest wound until, with the introduction of penicillin and the thorough excision of the wounds, it became infrequent. The immediate temporary closure of the wound by pad till the operation centre was reached was still an urgent matter.

Tension Pneumothorax: This condition, which can give rise to serious respiratory disturbance, was given great prominence in the early period of the war. Pneumothorax was caused by an injury to the lung by means of which a valvular action occurred and air was forced into the pleural cavity on inspiration. It proved, however, to be very uncommon and was of little importance.

In a review of 192 cases, including 44 thoraco-abdominals, in Italy, pneumothorax was mentioned in only 6 cases, and in none was it of any significance. It was recognised by the hyper-resonance of the chest and the absence of breath sounds associated with respiratory distress. Treatment consisted in needling with a wide-bored needle, generally in the second intercostal space, but sometimes in the sixth space in the axillary line.

Emphysema: This complication was not common and generally was not of much importance except when it was a sign of some deep-seated injury.

In the majority of cases the condition was of minor degree, but in New Zealand casualties in Italy 2 severe cases were seen, 1 dying from severe mediastinal injury. Altogether 9 cases were reported in the series of 192 in Italy. No special treatment was called for, and rapid absorption of the air took place.

Haemothorax: This was the most common complication of wounds of the chest and one normally calling for treatment. The treatment changed in some important aspects during the war. At first aspiration was carried out in the forward areas only when some respiratory embarrassment was present, and after an interval of forty-eight hours following wounding. It was thought that any earlier withdrawal of blood from the pleural cavity would lead to a recurrence of the bleeding. When the fluid was withdrawn air replacement was carried out so as to ensure the continued collapse of the lung, again to prevent further bleeding. Normally air replacement was done only at the first tapping. It was found, however, that recurrent bleeding did not take place unless there was present some special serious mediastinal injury, except from vessels in the chest wall, generally the intercostals, in which case the air replacement was useless. Then air replacement was used only to a small extent to relieve any distress occurring at the end of the aspiration of a large quantity of fluid. Finally no air replacement was done, and the aspiration was stopped for a few minutes if there was distress, or repeated the next day. It was also realised that early tapping did not give rise to fresh bleeding and that, in fact, fresh bleeding from the lung was very uncommon. Some surgeons, notably the Australians, were impressed by the desirability of early tapping of the haemothorax so as to permit of rapid expansion of the lung. There was some fear that this might lead to infection of the pleura, and Major Nicholson drew attention during the Tunisian campaign to the presence of infection in nearly 40 per cent of patients following tapping in the forward areas. Early aspiration, however, gained in popularity and was done earlier, especially in cases showing respiratory distress. The blood-taking sets combined with a Higginson's syringe proved very efficient for withdrawing blood from the chest. It was not only done early, even during the first twenty-four hours, but tapping was repeated till the chest became dry. The interval between the tapping was also reduced so as to bring about as quickly as possible the full expansion of the lung. Tapping every second or third day was commonly carried out and thorough evacuation was aimed at.

The advent of penicillin and its introduction into the pleural cavity brought about a marked change in the progress of this type of case and a very marked diminution in infection. It became the routine to introduce penicillin into the pleural cavity after each tapping. Early tapping was adopted in every haemothorax, and was repeated daily if the chest refilled. It was proved conclusively that no complication such as fresh bleeding followed the early tapping and that, on the contrary, the return of function to the lung and convalescence were much accelerated. Regular breathing exercises were instituted at an early stage to assist in the return of function. It was generally agreed that the routine of early and repeated aspiration led to a marked diminution of such complications as infection and clotted haemothorax, with their associated serious effects on lung function.

Atelectasis: This condition was given much thought during the war. The idea that the collapse of the lung was due to mechanical disturbance in the thorax by the presence of fluid or air in the pleural cavity was not considered the true explanation. It was commonly agreed that the condition was due to the presence of bronchial secretion producing obstruction in the bronchii and thereby leading to massive or localised collapsed areas in the lungs. Preventative treatment consisted in the care in operating in the presence of respiratory infection, in the preservation of a clear airway during anaesthesia, and in the suction of any excessive secretion through the bronchoscope. Active treatment by suction through the bronchoscope was held to be not very satisfactory, but all agreed that forced respiration was of great value. This was ensured by immediate regular deep-breathing exercises, especially following any anaesthesia, and by the encouragement of coughing. The relief of pain by the injection of local anaesthetic into the lower intercostal nerves facilitated both deep breathing and coughing. Major Hodgkiss, NZMC, at the Rome conference in 1945 said that atelec-tasis showed a high incidence and that catarrh of the upper respiratory tract and bronchial tube was very common in Italy even in summer, and tenacious mucous sputum was found in the mugs in the ward. To combat this he recommended light anaesthesia with quick recovery, and also the passage of a gum elastic catheter into the bronchial tube with suction at the end of the operation. Cyclopropane, if available, was the best anaesthetic. He advised regular movement of the patient in bed two to three times a day, lying him first on one side and then on the other, and then returning him to the sitting-up position. This facilitated the coughing up of sputum. In atelectasis more prolonged posturing was required to drain the bronchus. Intercostal anaesthesia was introduced when pain was preventing the effective coughing up of sputum. Expectorant mixtures were also given. Small doses of morphia were also helpful.

Major Nicholson, RAMC, found that regular aspiration of the bronchus at the end of late operations was unnecessary as little mucus was present.

Closed Injuries: The stove-in chest was treated by strapping the chest, and the blast injuries by oxygen, rest, and morphia.

Infection of the Wound

This was a common complication of chest wounds during the earlier part of the war, except in the small penetrating and perforating wounds, which generally healed up satisfactorily. The larger chest wounds were very prone to infection, especially the sucking wounds. This was partly because the urgent need of treatment was the closure of the hole in the chest and the risks of infection were not so obvious. The wounds were at first often sewn up or a pad strapped or sewn over the hole without surgical toilet. The wounds frequently became septic and suturing was given up. Later it was shown that careful excision of the wound was essential if sepsis was to be avoided, and that wounds in the chest, as elsewhere in the body, should not be sutured primarily.

Injuries to the ribs added to the risk, and careful trimming of the bone had to be undertaken. At first sulphonamides were used both locally and by mouth, and later penicillin was utilised locally and parenterally. Associated injury of the liver often led to infection of the wound.

Six cases in our series of New Zealand cases in Italy had wound sepsis:

(1) One case had suture for a sucking wound at the RAP, and two days later the wound was again sucking and pouring pus.
(2) Two cases, one of them being almost moribund at the time, were stitched up over a pack. One of these developed cellulitis in the wound and the other serious wound sepsis.
(3) One had septic wound associated with a large foreign body in the pleura.
(4) One had a chest wall abscess.

Infection of the Haemothorax

Infection of the haemothorax was very common during the First World War and also at the beginning of the Second World War. The Australians, however, reported a very low incidence following the first Libyan campaign and the defence of Tobruk. The incidence was still relatively low at the special chest centre in Cairo at the end of the second Libyan campaign early in 1942. A higher incidence was reported from the chest centre in Tripoli during the Tunisian campaign in 1943. In the early part of the Italian campaign infection was much more frequent, but with the introduction of penicillin a very marked improvement took place. In our New Zealand series of 148 cases rib resection was necessary in only 3 patients, an incidence of 2 per cent. All 3 cases were associated with sucking wounds. In no case was there any question of a chronic empyema or permanent non-expansion of the lung.

In a group of 44 thoraco-abdominal cases reviewed during the same period rib resection was carried out in 4 cases. Three of the cases had had sucking wounds and 2 had injuries of the liver. Foul fluid was present in the cases with liver injury and in 1 of the chest cases. The main factors in the production of sepsis in the pleural cavity were sucking chest wounds, associated wounds of the liver, and foreign bodies in the pleural cavity.

Mr. Tudor Edwards reported a low incidence of infection of 8.7 per cent in cases admitted from the north-west European front to chest centres in Britain. He considered that early aspiration had reduced the incidence of infection at the 1943 period and that penicillin had been responsible for the marked improvement in 1945.

The treatment of infected haemothorax depended on the severity of the infection and the time after wounding. In early cases with mild infection repeated tapping with instillation of penicillin was often successful. When infection was more marked and tapping unsuccessful, drainage was instituted. At first a Malecot catheter was introduced through a trocar and cannula between the ribs at the lower part of the chest, and the drainage made airtight by leading the tube under water. Penicillin, when it became available, was run in daily, the tube being clamped for six hours. This type of drainage proved satisfactory up to a period of ten days, when it was found that, if the infection still persisted, rib resection and ordinary tube drainage was necessary though still rendered airtight to prevent collapse of the lung, and attached at times to a suction apparatus. It was thought advisable to evacuate to the Base patients requiring drainage, and not to persist in the treatment in the forward areas. If repeated tapping did not bring about a rapid improvement, then the decision was made either to evacuate at once to the base hospital so that immediate drainage should be instituted there or, in the infection was serious, to introduce a Malecot catheter and then evacuate to the Base. Evacuation after rib resection was not so satisfactory.

Resection of rib at a dependent part of the chest was generally carried out at the base hospital and drainage continued till the cavity was obliterated. Loculation was very apt to take place, especially in cases of infected clotted haemothorax, and vigilant observation assisted by X-rays was necessary in these difficult cases, which were often gravely toxaemic. Such cases were rarely seen at the end of the war. If the infection was associated with a foreign body of any size removal was often undertaken early, especially if the foreign body was in the pleural cavity and of easy access. In the case of a chronic empyema, removal of the foreign body was postponed till the empyema had cleared up and a sinus only remained.

Illustrative Cases

1. Sucking wound, patient almost moribund at forward operating centre. A pack was stitched on to the wound. Aspiration was carried out and 20 oz. of fluid removed —aspiration was subsequently repeated frequently, penicillin being instilled each time. A week later the rib ends were trimmed, the clot sucked out of the pleural cavity, and the wound closed with a superficial drain. Aspiration was continued. The wound became infected and a multilocular infected pleural collection developed. Rib resection was carried out, and tube drainage instituted posteriorally. Later a large anterior pocket was drained. Collapse of the lung was marked and expansion was slow, but eventually satisfactory expansion was assured before patient's evacuation to New Zealand.
2. Sucking wound sutured at the RAP though the wound was noted to be infected. Two days later again sucking and pouring pus. Wound was excised and sutured, but pyopneumothorax, as well as lobar pneumonia, developed. Rib resection and suction drainage was instituted, and the chest cleared up steadily. An acute gangrenous appendicitis necessitated appendectomy during convalescence.

[If penicillin had then been available, and had been given locally and parenterally, the case would undoubtedly have been saved from infection of this type. The suturing of the infected wound at the second operation was ill advised.]

Infection of the Lung: This was very rare. In our New Zealand series in Italy no such case was recorded. It was generally a late complication.

Anaerobic Infection: No case occurred in our New Zealand series nor were cases reported in the MEF or in Italy. The clinical diagnosis of this condition depended on a crimson purple colour of the chest fluid and the foul odour.

Evacuation to the Base

The severe chest cases travelled badly and they also took a long time to recover from the initial injury. The minor cases without any respiratory distress, on the other hand, travelled well, and were shifted readily by air if the plane was kept at a low altitude.

Major D'Abreu, RAMC, stationed at Bari, was of the opinion that cases evacuated from the forward areas early (from second to eighth day) arrived in good condition if the first effects of shock, haemorrhage, open pneumothorax, and large haemothorax had been corrected by resuscitation, closure of the sucking wound, and aspiration of haemothorax fluid and air. On the other hand, those with infected pleural cavities, especially with septic open pneumothorax inadequately closed by dressings, travelled badly. It was noted by the Australians in New Guinea that cases travelled well during the first week, but not when infected. Air transport was very satisfactory, and even at 8000 feet no calamity occurred.

Major Hodgkiss, NZMC, on the other hand, thought that few of the serious cases could be evacuated in less than seven to ten days and that air evacuation of patients with a pneumothorax was dangerous at high altitudes. He considered that for that reason chest centres should not be too far removed from the forward areas. There was general agreement that the severe chest wounds go through a stormy initial crisis and must be held in the forward areas till this subsides. Those in the forward areas considered the bad cases should be held for from seven to ten days.

Here is a case illustrating the danger of early evacuation:

Operation was performed at the CCS for a chest wound and for fracture of the radius and ulna. The patient's condition appeared satisfactory and he was transferred by road to another CCS on the lines of communication. He developed a haemo-pneumo-thorax during transit and died of heart failure within 72 hours of wounding. Blast injury of the other lung was also present.

Late Operation

Operation was undertaken at the base hospitals, and at the special chest units stationed there, for infection, for clotted haemothorax, and for the removal of foreign bodies, as well as for the secondary suture of wounds.

In our series there were 13 cases subjected to late operation, 1 of these being for amputation of the thigh, leaving 12 for conditions associated with the chest:

(1) Foreign bodies were removed from the lung in 2 cases.
(2) Foreign bodies were removed from the chest wall in 2 cases.
(3) Fibrin clot was removed in 1 case.
(4) Wound suture was done in 4 cases.
(5) Drainage was carried out in 3 cases.

Clotted Haemothorax

In some of the haemothorax cases clotting occurred to a marked degree. This not only prevented the proper expansion of the lung, but also acted as a nidus for infection. The clot became organised and often formed a dense layer adherent to the pleura. Its presence was suspected when dullness and signs of pleural effusion were present, but tapping failed to draw off anything but very small quantities of fluid. X-rays showed density, generally of an irregular patchy type, with irregular air spaces. The cause of the clotting was not clear. At first infection was held not to be an important factor, but later this view changed and infection, especially by the staphylococcus, was often observed to be present. Other factors were also thought to be responsible.

Major Scadding, RAMC, and Major Nicholson reported 6 per cent of cases with clotted haemothorax in their series. They operated by a thoracotomy in the sixth space, removed the clot, and provided temporary drainage of the pleura through an intercostal stab drain. Major D'Abreu, RAMC, found that uninfected clotted haemothorax cleared up quickly, but when infection was present he either operated or instilled penicillin.

Nicholson operated on many of these cases in Italy and reported an incidence of 9 per cent. He stated that infection was present in three-quarters of his cases, the staphylococcus being the commonest organism.

The common type was multilocular with fibrin webs dividing the pleural cavity; rarely was there a solid haematoma. Clotting was twice as frequent on the right side, probably associated with wounds of the liver.

Nicholson favoured operative treatment to aspiration and the instillation of penicillin, so as to ensure lung expansion and to combat infection. He carried out decortication, stripping the fibrous layer from the visceral pleura so as to allow satisfactory expansion of the lung, which could be expanded by the anaesthetist.

Intercostal drainage was utilised for the first two to three days at the apex, at the anterior costo-phrenic angle, and at the base. The decortication facilitated the removal of lung foreign bodies and the suture of bronchial fistulae. It was considered that lung healing was aided by expansion, especially as the operation was usually carried out in the third or fourth week.

Major Nicholson considered that decortication involved no danger even when sepsis was present. He had had no infection in 30 out of 47 cases. Penicillin was given both locally and parenterally in all cases.

Mr. Tudor Edwards considered that decortication should not be done if tears occurred in the lung, and that a small airtight intercostal tube should be inserted at operation. He reported that in cases admitted to chest centres in Britain from the North-Western European front 6 per cent had had operation for turning out clot and 5.5 per cent had had decortication.

In our series of cases in Italy (of 90 living cases) only 1 operation for decortication was carried out and in only 2 other cases was clotting suspected. All these cases cleared up satisfactorily. Observation also showed that in most haemothorax cases expansion of the lung had taken place in a remarkable manner.

The treatment of haemothorax in the latter stages of the war by early and repeated aspiration, combined with the instillation of penicillin into the pleural cavity, had undoubtedly markedly diminished the number of cases of clotted haemothorax, and in the absence of infection operation as a rule appeared to be unnecessary and expansion of the lung took place. In infected cases the clearance of the clot and drainage seemed to be desirable.

A typical case showing clotted haemothorax was recorded as follows:

An inspiration of 25 ozs. of fluid was followed by four negative aspirations (nil, few ccs., one 0z., a few ccs.). There was associated dense opacity of the base. In spite of this the condition gradually cleared up without operation.

The case operated on is of some interest:

Was first in a German CCS as prisoner of war, then in an Italian hospital, and then through an Italian civil hospital, and then on to a Polish hospital. He had a laparotomy performed by right Kocher's incision, and states that he had haematuria. He later developed dyspnoea and the chest was aspirated, 400 ccs. being removed on three occasions. Admitted to 3 NZ General Hospital six weeks after wounding and had 1200 ccs. removed (slightly infected). X-ray disclosed density to 5th rib. Thoracotomy was performed to remove fibrous clot. His progress afterwards was excellent. [It is probable that this was really a thoraco-abdominal injury involving liver and kidney.]

Foreign Bodies

Interest was focused on the retained foreign bodies because of the history of complications following the First World War. There had been reported haemoptysis, some cases of bronchiectasis, and also of abscess of the lung. The large majority of retained foreign bodies, however, had given rise to no trouble, especially if they were relatively small and smooth. The general opinion at the beginning of the war was that all foreign bodies, if of any appreciable size, should if possible be removed, and the Australians in the MEF did remove all large foreign bodies in their base hospitals. The approach of the British special centres at that time was more conservative, and few foreign bodies were removed in Egypt in the early stages of the war. In Italy at the special centres foreign bodies were freely removed, and Major D'Abreu carried out removal of all accessible foreign bodies at an early stage, generally between the seventh and tenth day. All were in agreement that foreign bodies of more than 1 cm. in diameter present in the wound or in the pleural cavity should be removed, but there was no agreement with regard to the foreign bodies in the lung.

The necessity for the removal of large foreign bodies from the pleura is illustrated by the following case:

The patient had a large sucking wound and was gravely ill both at the MDS, where he was retained for some days, and at the CCS. An infection developed in the wound and drainage of the pleural cavity was carried out at the CCS, and he was then evacuated to the base hospital. He stood the journey badly and the infection became more marked. X-ray disclosed a large foreign body deep in the wound and it was removed from the pleural cavity, but he died of the severe prolonged infection from the pyo-pneumo-thorax.

In our New Zealand series of 90 lung cases, foreign bodies were removed in the forward areas in 4 cases and at the base in 4 cases, 2 from the lung, and 2 from the chest wall. There were 26 foreign bodies retained in the lung.

Major D'Abreu reported that he had removed just over half the missiles from the lung; all but one of the pleural missiles; just over half of those in the mediastinum and heart; and nearly all those in the mid-thoracic fascia. He removed them between the seventh and fourteenth day for two reasons: firstly, the severe physiological disturbances following the wound had ceased; and, secondly, the dangerous period of complications such as lung or pleural infection, organisation of haemothorax clot, and development of broncho-pleural fistulae had not yet arrived.

Radiological localisation and assessment were considered all-important and were carried out with the greatest care, and X-ray was taken on the day of operation as the foreign body tended to shift. Anaesthesia employed was pentothal induction followed by cyclopropane, but positive pressure and dilatation of the lung were not practised.

Excision of rib was preferred to intercostal incision and drainage was avoided whenever possible. Penicillin was utilised both parenterally for lung and chest wall infection and prophylaxis, and intrapleurally and locally for the same reasons.

The usual incision employed was in the seventh or eighth space, with resection of ribs and incision of pleura, according to the site of the foreign body. Anterior thoracotomy by rib and costal cartilage resection, and subscapular approach through fourth interspace (and for pleural and superficial lung missiles a small intercostal incision) were often used. The lung was sutured with catgut after incision for removal of the foreign body, bleeding requiring ligation only being encountered twice. The chest was closed without drainage, unless gross pleural infection were present, and aspiration was carried out later. Pleural missiles, because of their tendency to produce infection, were removed as early as possible, and X-ray was necessary on the day of operation because of the tendency for the foreign body to shift.

If an empyema was present the pleural cavity was cleared of clot at the same time as the foreign body was removed. After all operations air was removed by an artificial pneumothorax apparatus.

For mediastinal and cardiac missiles the approach was generally extra-pleural, but if necessary the pleura was opened and left open to enable drainage to take place into the pleural cavity. No cardiac missile had been successfully removed, and Major D'Abreu considered that these cases should not be dealt with at that stage. There were several foreign bodies in the extra-pleural tissues, sometimes associated with fractured rib, and the rib fragments were resected at the same time, drainage being provided only in the case of large cavities. Finally, he considered that removal of the missiles was safer than leaving them in situ.

Mr. Tudor Edwards advised removal of foreign bodies over 1 cm. square about six weeks after wounding. In infected cases he advised leaving the foreign body, unless easily detected, until a sinus formed leading to it, or after a period of several months.

It would seem that an evaluation of cases with retained foreign bodies in the lung following the recent war will be necessary before we can decide whether removal of at least the smaller foreign bodies is justified. The relative absence of infection in the latter part of the war may determine that very little trouble will be caused by the retained missiles, and they can well be left alone. The larger and especially the irregular foreign bodies should be removed if this can be done with safety. (Up to 1952 little trouble had arisen in New Zealand cases from foreign bodies in the lung, as a survey later in this article shows.)

Wounds of the Heart

Wounds of the heart were very uncommon in cases living more than twenty-four hours, and in our cases consisted of small retained foreign bodies. Later in the war many foreign bodies were removed successfully, with a low mortality, in chest centres in England.

X-rays

The importance of X-rays in the diagnosis and control of chest cases cannot be overemphasized. In the forward areas at the CCS the knowledge obtained of the location of a retained foreign body and the condition of the chest as regards the presence of a pneumo-or haemothorax was very valuable, though operative measures were mainly required for the sucking chest, and the taking of an X-ray in this condition was generally contra-indicated. Later the treatment of the ordinary haemothorax was controlled by X-rays, and this was of special value in cases of clotted haemothorax. The removal of foreign bodies depended on their size and position in the chest, and very accurate X-ray films taken immediately prior to operation were essential to success in the operation.

The presence of atelectasis and patches of bruised lung was also demonstrated by X-rays. Clinical signs by themselves were apt to be very misleading in the estimation of chest pathology in the wounded cases.

The value of X-rays in the diagnosis of chest conditions was stressed by many during the war, especially the physicians. The site of needling was best determined by X-rays, the general tendency being to needle too low in the chest. Progress was best ascertained by repeated X-ray examination.

Sulphonamides

In the earlier period of the war sulphonamides were administered so as to combat infection both in the wound and pleura as well as in the lung. They were given by mouth and also applied to the wound. With the introduction of penicillin the sulphonamides were utilised only in special cases, such as a complicating pneumonia.

Penicillin

This was first used intra-muscularly in cases of chest infection, but with incomplete success, as the cases relapsed when the penicillin was stopped. It was then found that penicillin retained its potency, when injected into the pleural cavity, for twenty-four to forty-eight hours. This led to the suggestion that the early introduction of penicillin into the pleural cavity would tend to prevent the onset of infection in cases of haemothorax. Penicillin was therefore set aside at the beginning of the Italian campaign for this purpose and was thus used in casualties from the Sangro battle at the end of 1943. It was stated at that time that 'the ideal treatment of haemothorax would be early tapping and complete emptying of the chest with instillations of sodium penicillin into the pleura at the end of tapping. Tapping should be repeated daily, if necessary, if the chest refills and penicillin again introduced.' There had been some frequency and severity of infection noted during the early stages of the Italian campaign and this had focused the attention of surgeons on the early treatment of these cases.

The quantity introduced after each tapping was 30,000 units and this proved satisfactory, but doses of 60,000 units were also given. Penicillin was also used in the treatment of infected haemothorax. In early cases aspiration was performed, followed by penicillin instillation into the pleural cavity, and this process was repeated till the infection cleared up. When drainage was carried out penicillin was introduced daily through the tube, which was clamped for about six hours after the injection. Penicillin was introduced after any Operative procedure on the chest. Parenteral penicillin was also used in infection of the chest wall and to combat toxaemia. It undoubtedly was of great value and its use led to the marked reduction of infection.

Respiratory Exercises

Early in the war use was made of breathing exercises in the later treatment of lung injuries (to bring about expansion of the lung). As time went on more and more attention was paid to the exercises and special staff was set aside to ensure their regular and efficient performance. The realisation that atelectasis was due to the plugging of bronchii by secretion led to the institution of breathing exercises at an earlier stage as a preventative and curative treatment of this condition.

Coughing was also encouraged as the natural and most efficient method of getting rid of any retained bronchial secretion. In the abdominal cases also breathing exercises were early and regularly employed as a preventative of lung complications.

Colonel Boyd, Consulting Physician, 2 NZEF, drew attention to the variable degree of pulmonary contusion with parenchymatous haemorrhage and oedema and some tracheo-bronchial exudations in the majority of penetrating chest wounds. The Americans called the condition 'wet lung'. Any pain impeding normal respiration caused shallowness of breathing and an increase in the condition of wetness, increasing the patient's distress and delaying the recovery from shock. The Americans relieved the condition by instituting intercostal blocks on the affected side, enabling the patient to breathe deeply without discomfort and to cough freely. Colonel Boyd considered that extra measures adopted by the Americans, such as the giving of large intravenous doses of atropine and intra-tracheal suction, would be rendered superfluous if the patient could breathe deeply and coughed up his secretions.

Major Telling, RAMC, a physician, recommended at the Rome conference in 1945 breathing exercises for all cases, starting in forty-eight hours after the temperature had become normal in ordinary haemothorax and forty-eight hours after drainage in infected cases. After clean thoracotomy a start was made in twelve to eighteen days after operation, and a similar period was observed for large chest wounds. Immediate exercises were recommended in cases of pulmonary contusion and atelectasis. There was universal recognition of the importance of regular respiratory exercises, particularly in chest and abdominal conditions during the latter part of the war.

Late Treatment

Blood and plasma transfusion was of value to counteract the loss of blood and the breakdown of body tissues. A high protein and vitamin diet with ample nourishment was also required to ensure adequate resistance to infection and rapid convalescence.

Special Centres

Our New Zealand force did not have any special chest centre, though chest cases were segregated to some degree and put under the charge of surgeons with most experience of these cases. At the CCS level the cases were, except for the actual surgical operation, placed under the charge of a physician, who controlled the after-treatment and arranged aspirations, breathing exercises, and any medical treatment required.

At the Base the chest cases were put under the charge of a surgeon with experience of chest surgery, who worked in association with a physician. The British chest centres were visited frequently by our consultants and senior surgeons and physicians, but normally we treated our own cases. The British centres were sited at the base hospitals, removed a considerable distance from the forward areas, though with air transport access was satisfactory.

Chest teams were not attached to the trinity of neurosurgical, facio-maxillary, and ophthalmic units which worked close behind the CCS. As forward surgery in chest cases was largely restricted to the treatment of the wounds, the closure of the sucking wound and the thoraco-abdominal cases, all of which could be satisfactorily done by the general surgeon, there seemed no necessity to send the special chest teams to the forward areas. Their best location would appear to be at a forward base hospital so as to shorten the line of evacuation, and this location was favoured by Mr. Tudor Edwards and other chest surgeons.

As far as a N'ew Zealand force is concerned, the attachment of a chest surgeon to the best-sited base hospital would be satisfactory.

Statistics

A review was made of chest injuries in the 2 NZEF in Italy. This included all patients recorded in any medical unit whether admitted dead or alive, and so gives a clear picture of the severity of these injuries. There was a total of 148 patients with 58 deaths and 90 survivors, a death rate of 39 per cent.

Of the total cases:

BID [1] were	15.5 per cent.
Died in twenty-four hours	16.9 per cent.
Died in twenty-four to seventy-two hours	2.0 per cent.
Died after seventy-two hours	4.7 per cent.
	39.1 per cent.

Of the total deaths:

BID	39.6	82.7	per cent
Died in twenty-four hours	43.1		
Died in twenty-four to seventy-two hours	5.2	17.3	per cent
Died after seventy-two hours	12.1		per cent

Location of deaths:

In Field Ambulances	74.1 per cent.
In CCS	19.0 per cent.
In General Hospitals	6.9 per cent.

Cases Surviving

Associated injuries were:

(a) Fractures—

Rib, 24.

Scapula, 6.

Clavicle, 3.

Sternum, 1.

Humerus, 4.

Femur, 2.

Other bones, 7.

(b) Other—

Amputations, 4.

Nerve injuries, 4.

Vascular injury, 2.

Heart or pericardial injury, 4.

Foreign bodies retained in lung, 26.

Symptoms and Signs:

(a) Shock was specially noted in 10 cases; of these it was severe in. 3 cases.
(b) Distress was noted in 10 cases.
(c) Blast was noted in 3 cases.
(d) Haemoptysis noted in 26 cases; of these it was severe in 3 cases.
(e) Emphysema, 7 cases; of these it was severe in 2 cases.
(f) Pneumothorax was noted in 6 cases.
(g) Bleeding was noted in 9 cases.
(h) Sucking wounds were noted in 25 cases.
(i) Haemothorax was aspirated in 60 cases.

Treatment:

Early:

(a) Operation was carried out in 19 cases.
(b) Aspiration was carried out in 60 cases.
(c) Penicillin was used in 37 cases.
(d) Sulphadiazine, 3 cases.
(e) Foreign body removal, 4 cases.

Late: Late operation was carried out in 13 cases.

(a) Foreign bodies were removed from lung in 2 cases. Foreign bodies were removed from chest wall in 2 cases.
(b) Rib resection and drainage in 3 cases.

Sepsis was noted in the wound in 6 cases.

Sepsis was noted in the pleura in 5 cases.

Fibrin clot was noted as probable in 3 cases. (Operation was carried out in 1 case.)

Grading: The large majority were considered unfit for further service overseas; possibly in many cases this was too gloomy a prognosis.

Graded A, 14; B, 1; C, 2; D, 6; E, 64; unrecorded, 3: total, 90.

Thoraco-abdominals

Associated with the series of chest cases recorded in our Force in Italy from November 1943 to August 1944, from which our data are derived, there were 44 thoraco-abdominal injuries. These are dealt with in the article on abdominal injuries. There were 21 deaths and 23 recoveries. If the chest and thoraco-abdominal cases were treated as one group, the thoraco-abdominals would constitute 23 per cent of the total. Twenty-seven of the thoraco-abdominals were operated on primarily; 4 had subsequent rib resection carried out for empyema.

Campaign in North-West Europe

Tudor Edwards gave details of 1683 casualties admitted to chest centres in Britain from North-West Europe. The great majority were treated by aspiration for haemothorax; the other less common treatments were for the removal of foreign body (15 per cent), turning out clot (6 per cent), decortication (5.5 per cent), and empyema (8.7 per cent). Deaths totalled 9, of which 5 occurred in a group of 251 earlier cases, and 4 in 1432 later cases.

Incidence of Infection in the Chest Noted at Different Periods

		Empyema	
Series of cases, 1914–18		37	per cent.
Julian Smith (A), December 1941	63 cases	5	per cent.
King (A), December 1941	66 cases	3	per cent.
Logan (CC), Cairo, February 1942	49 cases	18	per cent.
Nicholson (CC), Tripoli, 1943	59 cases	30	per cent.
Button CCS, Cassino (NZ), 1944	34 cases	12	per cent.
D'Abreu (CC) Bari	260 cases	30	per cent.
Stout, Italy (NZ)-1944	148 total	2	per cent.
1944	90 living	3.3	per cent.
Tudor Edwards (CC), Britain 1944	1683 cases	8.7	per cent.

A, Australian. CC, British chest centre. NZ, New Zealand.

It will be noted that the higher figures are from chest centres, where presumably all the serious cases were sent; most of the less serious cases went to the ordinary base hospitals. The Australian figures probably cover the same group and are from a base hospital. Button's figures are from our CCS at Cassino. Stout's figures cover all New Zealand cases in Italy from November 1943 to August 1944, the lower overall figure being due to most of the deaths occurring in the first twenty-four hours.

Multiple Injuries

Multiple injuries were present in the majority of our cases; only one-third had injuries limited to the chest.

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[1] Brought in dead

EVALUATION

EVALUATION

Finally it can be stated that the results achieved in the final stages of the war were very satisfactory, and that sepsis, the most serious complication of the surviving cases, had been reduced to a very small percentage of the total (3.3 per cent in our own Italian cases).

The majority of deaths from chest injuries in war are the result of severe irrecoverable injuries for which no treatment will probably ever be available. Over four-fifths of our fatal cases died in the first twenty-four hours and 74 per cent died in the Field Ambulances. On the other hand, there were very few deaths at the base hospitals. It would seem that any reduction in mortality must come from the protection of the individual from the missile, and efforts to introduce protective shields were made during the war.

An investigation of 100 fatal and 100 non-fatal gunshot wounds of the chest in a civilian population by Hardt and Seed of Chicago showed that in the fatal wounds the heart or great vessels were penetrated in 85 per cent of the cases. They concluded that a shield covering the anterior portion of the chest approximately 24 cms. square would have prevented 63 out of 66 fatal wounds entering the anterior part of the chest.

A survey made of deaths from wounds in 2 NZ Division in Tunisia shows the high immediate mortality from chest wounds. In 82 men killed in action or dying almost immediately from wounds, the regional classification of the main injury was: chest 32, head 26, abdomen 12, and other areas 5, with multiple wounds 7. This shows how vulnerable is the region of the chest in battle, and some fatal wounds of the chest are caused by small pieces of metal which could be deflected by a body shield. If such a shield were made of light material it would inconvenience the wearer only slightly.

Perhaps in another war some protection will be devised for the chest and abdomen just as the helmet has been introduced to protect the head.

Summary of Important Points:

1. Reduction of mortality by the introduction of protective shields.
2. Special chest units to be sited at forward base hospitals.
3. Sucking wounds an urgent problem calling for immediate closure by pad or temporary suture, by wound excision and closure, by muscle suture at the forward operating centre, and by delayed primary suture of the skin later.
4. Haemothorax treated by early and repeated aspiration till dry, penicillin being injected into the pleural cavity after each aspiration.
5. Conservative primary surgery restricted to wound treatment, removal of superficial foreign bodies and thoraco-abdominal injuries.
6. Pleural infection dealt with by:
   (a) Aspiration and penicillin,
   (b) Intercostal sealed drainage for not more than ten days,
   (c) Rib resection and tube drainage till cavity closed. (Penicillin therapy given both locally and parepterally.)
7. Foreign bodies if in the chest wall or pleural cavity removed at first operation; if in the lung removed later if over 1 cm. in diameter in two dimensions.
8. Blood transfusions restricted to the replacement of actual blood loss.
9. Severe cases not evacuated till stabilised, generally seven to ten days after wounding.
10. Breathing exercises and the encouragement of coughing a regular routine in all cases.

PENSIONS REVIEW OF PENETRATING CHEST WOUNDS

In 1952 Dr. D. Macdonald Wilson, of the War Pensions Department, examined the files of all ex-servicemen who had applied for pension on account of war wounds of the chest. There were 307 cases with intra-thoracic injury, of whom 299 were gunshot wound cases penetrating the thorax due to missiles of various types. The remaining 8 cases consisted of 5 cases of haetnothorax due to bomb blast injuries, 2 cases of accidental trauma of chest wall with associated haemothorax, and 1 case of a foreign body in the lung which will be described in detail later.

Of the 299 gunshot wound cases, 295 occurred in the Army in the Middle East, 3 in the Pacific, and 1 in Japan (J Force).

The vast majority of cases from the Middle East arrived back in New Zealand with the wounds of the chest healed and not requiring further treatment. Indeed, there appear to have been only 4 cases which required treatment on return to New Zealand for discharging sinuses in the chest. Unless there were other disabilities requiring treatment, these chest cases on return to New Zealand were fit to return to civil life. If followed up for a year or two it was found they had not sought treatment. Few complained of any severe disablement. Occasional stabbing pains in chest, shortness of breath on exertion, or slight cough were common complaints upon inquiry. Cases which had suffered from haemothorax or infected pleural effusions with displaced mediastina showed no evidence of any cardiac displacement. X-ray examinations in the main revealed only some slightly thickened pleura but few changes in the parenchyma. Even where a metal foreign body was retained within the thorax (77 cases), only in one or two cases was any parenchymatous change shown round the foreign body. Haemoptysis occurring since return of the patient to civil life had been rare. Cases with unusual complications are referred to below.

All 307 cases, except 1 who died of another unrelated disability and 5 other cases, were employed in 1952. None of these unemployed was prevented from working by any chest wound disability. The types of employment in which these men were engaged were farming (20.5 per cent), labouring (14.5 per cent), truck driving (6 per cent), various trades (28 per cent), clerical and professional (20 per cent), and employed but details unknown (11 per cent). While 13 per cent of these cases suffered no disablement in 1952 warranting any pension, 75 per cent received pensions for disablement varying from 10 per cent to 25 per cent, and only 12 per cent of the cases received pensions at a higher rate. Thirty-eight per cent of all cases received a pension assessed at 20 per cent disablement.

Of the 299 cases of gunshot wound of the chest, 77 had metal foreign bodies retained within the thorax, usually within the lung. There was no evidence at that stage (1952) that the presence of a foreign body in the lung substance caused any increase in disablement. All these 77 cases were then employed, 11 per cent not receiving any pension, 80 per cent on pensions varying from 10 per cent to 25 per cent, and only 9 per cent receiving pension for a higher assessment of disablement. Forty per cent of these 77 cases received a pension for disablement assessed at 20 per cent. Three cases with retained metal foreign bodies suffered from haemoptysis up till the year 1948, 1 case leading to bronchiectasis and lobectomy in 1948. This last case was wounded in 1943 and the other 2 in 1944 and 1945 respectively.

Thirty-eight of the 299 cases suffered an intra-abdominal injury associated with the gunshot wound of the chest. Of these, 6 were associated with liver injury and there were retained metal foreign bodies within the liver in 2 cases. Six suffered splenectomy, 3 had had colostomy for lacerated bowel, and 2 then had a ventral hernia and 1 a diaphragmatic hernia with large gut in the thorax.

Two cases originally suffered symptoms of associated brachial plexus nerve injury, but one case had made a complete recovery while the other still suffered from 'winged scapula'. One case suffered an arterio-venous aneurysm of the left subclavian vessels, while another had the subclavian vein ligated through a divided clavicle.

After return to New Zealand 4 cases suffered from slight bronchitis, while in 2 cases (1 with retained metal foreign body) bronchiectasis developed and lobectomy had been successfully employed. In 1 case any chest symptoms were then masked by those of Addison's Disease. Four cases (including one of bomb blast injury only of lungs) had developed pulmonary tuberculosis.

The following case deserves special attention:

A soldier was wounded in 1941 in Greece while leaping from a truck which had come under machine-gun fire. The wound was in the upper part of the right thigh and bled profusely. He was taken prisoner and was not repatriated until 1945. He did not remember much about the first twenty-four hours after being wounded; except that he bled profusely and that a few days later there was some blood in his sputum. At no time was he wounded in the chest, and there was no exit wound in thigh. On return to New Zealand in 1945 at routine chest X-ray examination a metal foreign body was revealed lying in the right lower lobe. This foreign body resembled the top of a metal screw. He had no recollection of ever inhaling a foreign body. Subsequently he developed a bronchiectasis and the lobe of lung was resected. The foreign body proved to be the top of a screw. It is thought that this man was wounded in the thigh by this piece of metal from the truck splintered by gunfire. The screw top entered the femoral vein, was subsequently carried to the right side of the heart, and thence to the lungs. Years later it ulcerated through a bronchial wall.

Chest Injuries

Battle Casualties Invalided to NZ from 2 NZEF

penetrating wounds—	
With haemothorax	96
With haemo-pneumothorax	11
With retained FB in chest	24
With haemothorax and retained FB	15
With removal FB from chest	2
With haemothorax and retained FB in heart	2
With retained FB in pericardium	2
With pericardial effusion	1
With pneumothorax	4
With other	7
Undefined	71
Chest wall	18
	253

accidental injuries invalided to nz—	
Penetrating injuries with—	
Retained FB	3

Haemothorax	1
Haemo-pneumothorax	2
Pyopneumothorax	3
Fracture rib and haemothorax	1

infected—

Haemothorax and empyema	13
Empyema	2
Haernothorax and abscess lung	2
Pyopneumothorax	9
Abscess chest wall	1

thoraco-abdomina l—

With haemothorax	1
With empyema	3
Other	2

admissions to hospital, 2 nzef, july 1941 to july1945—

Penetrating chest	467
Perforating chest	95
Haemothorax	160
Pneumothorax	29
Pyopneumothorax	7
Empyema	8
Fracture ribs	71
Injury to lung	73
Contusions, etc., chest wall	480
Contusions, chest, undefined	143
	1533

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CHAPTER 11 — ABDOMINAL INJURIES

Contents

FIRST WORLD WAR

AT the commencement of the First World War army tradition was in favour of conservative and non-operative measures of treatment of abdominal wounds. During the Spanish-American and South African campaigns, and also the Russo-Japanese war, operative measures had been attended by an alarming mortality. Many men had also recovered following wounding by high-velocity bullets when treated without operation. This had so impressed the medical service that operation was given up by the Russians and actually prohibited by the Japanese.

The considered opinion of the British surgeons in the South African War was similar. MacCormac, the consultant surgeon, went as far as to say' a man wounded in the abdomen dies if operated upon, he lives if left alone.'

This was naturally a gross exaggeration, but it does give very clearly the outlook during the South African War. It also reminds us that cases can and do recover under conservative treatment-a fact that is apt to be overlooked by civilian surgeons accustomed to the normal happy outcome of abdominal surgery.

Figures are quoted showing the very high mortality in the different periods and campaigns, but it is essential to be certain of a full enumeration of all cases followed through to complete recovery before comparison can be made. The fact that operation was discarded is sufficient evidence of its lack of success up till the period of the First World War.

At that time the conservative treatment of abdominal infection was popular with some surgeons. Murphy had made well known his treatment by complete abdominal rest, combined with morphia and fluid given by rectal tube. Associated with this he also used a suprapubic stab drain with pelvic drainage and Fowler's position.

On the other hand, there had been a marked development in abdominal surgery prior to the First World War, and early operation had proved to be the most satisfactory method of preventing the onset of peritonitis in cases of appendicitis.

Surgeons were accustomed to immediate operation on such cases, and it seemed logical to carry out the same type of treatment in war injuries. The development of surgery in the forward areas which, in spite of some objections by higher authority at the beginning, quickly came into favour made it possible for early operation to be carried out in abdominal cases. Young surgeons were eager to grasp the opportunity, and their early success was such that a complete change in outlook developed in the British Army.

Once embarked upon, early surgical treatment became the routine in all cases seen at an early stage, and which were deemed fit for operation. The results, though still leaving much to be desired, were much better than those following conservative treatment.

It was recognised at that time that haemorrhage was a serious complication of war wounds of the abdomen, and that this complication demanded early surgery. The treatment adopted consisted of free abdominal exploration with suture of the intestinal injuries, combined as occasion demanded with drainage of the peritoneum. Injuries of the liver were dealt with by packing and suture, those of the kidney by repair or nephrectomy. Bladder and rectal injuries were treated by free drainage. The operative treatment was carried out generally by specially selected surgeons in the Casualty Clearing Stations. Professor Gordon Bell, then attached to the RAMC, was considered one of the leading surgeons in this field.

Overall, a survival rate of about 30 per cent of cases operated on was achieved, though naturally figures varied considerably. At the end of the war early operation had become recognized as the standard treatment of these cases.

Between wars abdominal surgery became still more established and developed.

The treatment of diseases of the colon had attracted much attention, and the conservative method of Paul had been developed further by Devine and others to obviate the dangers of infection. Primary suture of colonic excisions had been proved more dangerous than the conservative methods associated with primary drainage and secondary closure.

Blood transfusion had been developed and was available for resuscitation of the generally seriously shocked abdominal case. Gastric drainage both by Kyle's tube and Abbott's tubes was being frequently employed in cases of threatened ileus. Bio-chemical investigations with regard to water balance and chloride and other mineral balance had become regular methods in clinical treatment.

There was thus available for the treatment of the abdominal wounds in the Second World War well equipped and experienced surgeons and accessory methods peculiarly suited to the conditions to be encountered.

SUMMARY OF DEVELOPMENTS IN SECOND WORLD WAR

SUMMARY OF DEVELOPMENTS IN SECOND WORLD WAR

From the beginning of the war simple techniques of suture were used for injuries of the small intestine, and end-to-end anastomosis was carried out for irreparable damage. Suturing of serious liver wounds was attempted at times, but was not often found to be satisfactory, and packing was generally resorted to when bleeding was still continuing. Bladder wounds were sutured and suprapubic drainage instituted, while kidney wounds were treated conservatively.

Early in the war Brigadier Ogilvie, RAMC, made a strong plea for the exteriorisation of the colon in all large bowel injuries, and his advice was followed. A proximal colostomy, combined when necessary with free perineal drainage, was used for wounds of the rectum. Though opinions varied at first as to the necessity for drainage of the abdomen, almost unanimous agreement was reached that drainage should be used in colonic wounds, in retro-peritoneal wounds, and for any peritoneal collection.

The ample provision of blood and plasma in the forward areas and of trained and energetic transfusion officers resulted in resuscitation being developed to a high degree. Post-operative treatment was developed early, and by gastric suction, intravenous saline, and glucose administration ileus was practically eliminated and fluid balance ensured. Major Giblin, AAMC, operating in the forward areas in the pre-Alamein and Alamein periods, at first did not employ gastric suction and found ileus common. Then he used Ryle's tube, and later much larger tubing combined with a Solivac apparatus, and got no ileus.

Some changes in treatment took place as experience was enlarged. In mid-1942 sulphadiazine was introduced into the peritoneum at the end of the operation with, it was believed, beneficial results. Evacuation of abdominal cases from the forward areas after operation was always a difficulty, and experience showed that these cases should be held where they were operated on until all possible danger was over, thus placing full responsibility on the forward surgeon. In Italy at the latter stage of the war the treatment of wounds of the colon began to be reviewed, and many surgeons treated the right colon and first part of the transverse colon in a similar way to the small intestine, though usually instituting drainage, especially in the retro-peritoneal areas. Suturing of small wounds in the caecum and ascending colon became common, and early secondary closure of caecal wounds was practised.

In massive injuries an ileo-transverse colon anastomosis was utilised with excision of the damaged colon. Even in injuries to the splenic flexure in an occasional suitable case, suture was performed with or without a proximal colostomy.

In the left colon, however, and in nearly all severe colon injuries elsewhere, exteriorisation remained the routine procedure. There arose a disinclination to carry out the radical freeing of the fixed colon which at one time was done almost by routine. It was learned that the large majority of liver wounds needed no operative treatment and that bleeding soon stopped—massive wounds generally meant an early death. There was another marked change in that, following operation, Fowler's position was abandoned in favour of the ordinary horizontal position, with great benefit in cases of shock and increased comfort and ease of nursing.

The early and regular administration of parenteral penicillin was held to have made an appreciable difference in the incidence of peritoneal infection.

Gastric suction continued to be used, but water was given by the mouth immediately after the operation, and, if circumstances permitted, nourishing fluid was given after forty-eight hours.

The administration of the different types of intravenous fluids was regulated according to the loss of chlorides by gastric suction, and plasma was given regularly to make up protein loss. Blood was also found to be necessary in the majority of cases at about the seventh day, when a critical phase often developed. The lower bowel often required attention by means of enemata and even at times by the manual removal of constipated faeces.

Thoraco-abdominal cases, which had an evil reputation before the war, still carried a high mortality, but as time went on surgeons learnt that approach through the chest was satisfactory in the majority of cases and that it carried a much lower mortality.

There were many changes, and there came a realisation that the optimum time for operation was not at the earliest moment that the patient could be put on the operation table, but immediately after optimum recovery from the primary shock had taken place. Some delay was beneficial, but long delay was still fatal.

Operation shock was realised to be a very serious condition which demanded measures of resuscitation, in a similar manner to the pre-operative routine.

Although loss of blood was generally very much less than that suffered in limb wounds, yet in the majority of cases a moderate loss was present, and in some cases, such as injury to mesenteric vessels, dangerous continuing bleeding occurred. Diagnosis of this condition was of the utmost importance, as was the diagnosis excluding intestinal injury. The presence of audible peristalsis generally determined the absence of injury to the intestine and therefore saved laparotomy, which had been proved to have in itself a serious mortality. The X-ray was also used to determine whether there was abdominal injury.

An experienced surgeon proved of great value in the early diagnosis of these cases and in the settling of operation priorities. Accurate diagnosis before operation was considered an unfair responsibility to be placed on the transfusion officer.

It was agreed finally that the best place to do abdominal surgery was at the CCS level, where stability was possible, where conditions were satisfactory and relatively comfortable, where nursing sisters were available, and, particularly, where cases could be held till all danger was over.

The analysis of the results obtained in Italy in the 2 NZEF showed that half the men wounded in the abdomen, apart from those buried on the battlefield, died. It also showed that of those who were operated on (which meant practically all those, actually over 96 per cent, reaching the CCS), 64 per cent lived. Other forces had similar results, as was shown in the figures produced at the end of the war.

It is a much brighter picture than that of the First World War, and of course incomparably better than the results of the South African War. Some further improvement may be possible, but not very much, as it has been clearly shown that the majority of the cases die in the first twenty-four hours from the severity of the trauma. Operation will save few of these. The standard of resuscitation was at a high level throughout the war, so there seems little chance of any radical improvement in that regard. Our best chance seems to be prevention, and the utilisation of body armour must be seriously considered in any future war.

From this general summary of abdominal surgery during the war we turn to special problems which will be dealt with in more detail.

PRE-OPERATION FACTORS

PRE-OPERATION FACTORS

Priority and Optimum Time for Operation

Early operation in abdominal cases was carried out during the 1914–18 War and the considered opinion at that time was that the earlier the operation the better the results. This was in accord with the results obtained in civil surgery in such conditions as perforated gastric or duodenal ulcer and in acute appendicitis.

At the beginning of the Second World War this opinion was strongly held by all surgeons, and Brigadier Ogilvie advocated operation within six hours, with a maximum of two hours spent on resuscitation. During the first campaigns in Libya in 1940 the rapidity of movement in the desert prevented the proper functioning of the CCS in the performance of early operation on the abdominal cases, and a few surgical teams were attached to Field Ambulances for urgent surgery.

In Greece the conditions during the retreat and evacuation militated against early operation. In Crete, again, orderly treatment was impossible and operation was carried out under great difficulties. Major Christie, who was attached to the Field Ambulances in Greece and Crete as a surgical team, reported that the abdominal cases were operated on as soon as possible.

During the second Libyan campaign in 1941, again, though provision had been made for the attachment of surgical teams to Field Ambulances to enable early abdominal surgery to be undertaken, and the Sims Mobile Surgical Unit had been attached to the New Zealand Division for the same purpose, the disorganisation of evacuation by the enemy armoured attack prevented the carrying out of our plans. Even at the forward operating centre which was set up by our Field Ambulances with the MSU attached, few of the abdominal cases were operated on within twenty-four hours of wounding.

Abdominal cases, however, along with cases with active haemorrhage and sucking wounds of the chest, were looked upon as first priority.

Conditions for surgery were more favourable when the Division was holding the Alamein line in 1942. Surgical teams from British CCSs, and later on from our own CCS, were attached to our MDSs and dealt with the abdominal cases as soon as rapid resuscitation by means of blood and plasma transfusions had been carried out.

The abdomens continued to be dealt with as first priority cases during the battle of Alamein and throughout the advance to Tunis. The forward position of the NZ CCS at different times, especially in Tunisia, rendered it possible for the operative treatment to be carried out almost as soon at the CCS as it could have been done at the MDS, and operation was therefore carried out at the CCS. Special arrangements were made for performing abdominal surgery in the Field Ambulances during the left hooks at Agedabia, Nofilia and Mareth, and in the final advance to Tunis.

During the Sangro battle in Italy at the end of 1943 all the abdominal cases were operated on at the MDS. The CCS was not far away at Vasto, but evacuation was very difficult, except during the latter part of the battle. It would have been possible to do the operations at the CCS at this later period, but it was still considered that the time-lag before operation was of primary importance. The conditions at Cassino early in 1944 were fortunately quite different, the CCS being sited on a good road so that cases could be rapidly evacuated to it. Operation could thus be undertaken almost as quickly as at the MDS, and the CCS dealt with the abdominal wounds. It was then found that a longer period of rest and resuscitation enabled the patients to stand the operation better and definitely improved the results. Operation within six to eight hours, as previously adopted as a standard, was held not to be of primary importance as against the giving of adequate time for full resuscitation before operation. The only exceptions to this fresh outlook were cases deemed to have continuing intra-abdominal haemorrhage or profound toxaemia from serious wounds elsewhere, such as traumatic amputations and large muscle wounds.

The average period spent in the pre-operation ward for resuscitation before operation was three and three-quarter hours, nearly double the period advised previously. There were only 11 deaths in 50 cases operated on in our CCS at that time, and cases operated on at a comparatively late period did well. Lieutenant-Colonel Button, the CO of 1 NZ Mobile CCS, stressed the fact that the men died of shock and that infection was rare at that stage, so there was not the same urgency as in the treatment of large flesh wounds. This opinion was supported by Major Lowdon, RAMC (attached for a considerable period to our CCS), who found that cases operated on between ten and twenty hours after wounding had a lower mortality than those operated on under ten hours; although elimination of some of the more serious cases had some effect on the figures, he stressed the necessity for adequate resuscitation and rest before subjection to the further trauma of operation.

Button's observations radically altered our outlook and the abdomens were placed lower on the priority list, and thereafter were normally dealt with at the CCS; but they were still considered by us to demand urgent operation at this level as soon as satisfactory resuscitation was assured. There was danger, however, in considering that the time lapse was no longer of paramount importance, especially if the decision as to the priority of the case was not made by an experienced surgeon with full knowledge of war injuries, and especially in those cases difficult to resuscitate. Figures for our New Zealand cases in Italy show that cases operated on in the first twelve hours still had a much lower mortality.

Table Showing Relation of Time of Operation After the Receipt of the Wound to the Death Rate

Time of Operation	Total	Dead	Percentage Mortality
Under twelve hours	79	39	49.3
Over twelve hours	26	18	79.2
On third day	4	2	50.0

In a small group of 36 cases operated on by Major Harrison at the CCS level from July 1942 to May 1943 in North Africa the mortality rate showed the effect of shock and haemorrhage in that the cases operated on in the first six hours carried the heaviest mortality (44 per cent), while those operated on from six to twelve hours after wounding had a mortality of 31 per cent, and those over twelve hours 28 per cent. (Major Stead's survey of British cases in Italy gave a mortality of 32 per cent for those operated on under six hours, 46 per cent between six and twelve hours, and 46 per cent between twelve and eighteen hours.)

It was considered by forward surgeons that abdominal cases should be evacuated normally straight back without stop from the ADS to the forward operating unit responsible for abdominal surgery so as to save time and movement.

In-ambulance drips would provide any resuscitation required during the journey.

Place of Operation

It has already been pointed out that the peculiar condition of the early desert warfare rendered it impossible to utilise the CCS for first priority cases, including the abdomens. Surgical teams, later given an adequate establishment as Field Surgical Units, were therefore attached to the MDSs of the Field Ambulances to deal with these cases. They laboured under considerable difficulties. The Field Ambulance's normal function was to collect and evacuate casualties and to remain mobile ready to move off at any moment. Its function was not to operate on and nurse serious cases, and it was not equipped or staffed for this purpose. The surgical teams brought the staff and equipment necessary for the operative treatment, but not for the nursing and other care of the patients after operation. The presence of serious casualties hamstrung the Field Ambulances to some extent during phases of active movement if the evacuation of the cases was held to be inadvisable or was otherwise impossible. The nursing of the serious cases threw a great responsibility on the personnel of the ambulances, comparatively untrained for this work. In the early periods it was the custom to attach a single surgical team to a Field Ambulance, partly because there were few teams available, but also because of the desire of medical units and even senior combatant officers to have teams rigidly attached to their own separate forces. This frequently led to the single team having more cases to deal with than it was possible to operate on within a reasonable time, and the team carried on till it was exhausted, and the optimum time of operating on abdominal cases could not always be observed. This condition was improved by the attachment of more than one team, as was arranged in our MDS in the pre- Alamein period. It was also met to some extent in our own Field Ambulances by the attachment to each Field Ambulance of at least one surgeon capable of performing major surgery, so that the Field Ambulance itself could, and normally did, set up and staff an operating unit of its own. The nursing still remained a difficulty, though the Field Ambulance orderlies did their best and quickly learned the essentials of nursing.

The difficulties under which abdominal surgery was undertaken at the Field Ambulances during the earlier campaigns is illustrated by the following observation by one of our forward surgeons:

The treatment of abdominal injuries was undertaken under these circumstances as it was felt that the cases would otherwise surely have died. We had to depend on comparatively untrained orderlies for postoperative nursing; we had no beds, and only an odd bottle of saline or glucose. The blood transfusion service was not then functioning, and we had to depend on what blood we could collect locally. I used to start the morning of each day by taking blood from donors from the nearby Divisional Headquarters, usually half a dozen at a time, and the blood had to be used the same day as we had no refrigeration or cold storage. We had no autoclave, and our sterilisers were constructed from petrol tins.

Conditions improved considerably just before Alamein when some beds were provided in the Field Ambulances and nursing orderlies were attached from the CCS. Field transfusion units were also attached at the same period and remained thereafter a regular attachment to our active MDS. X-rays were not available at the MDS, and this lack assumed some importance in the diagnosis of obscure cases. Generally it was possible to give reasonably efficient treatment to the abdominal cases at the MDS when conditions demanded that operation should be carried out at that level. Even when surgical teams were attached to the Field Ambulances it was difficult for them to cope with all the abdominal casualties. When the teams became exhausted during a rush of casualties they were forced to send on some of the abdominal cases to the CCS for operation there. It was, however, the considered opinion of consultants and forward surgeons alike that abdominal operations were better dealt with at the CCS. The energy, initiative, and enterprise displayed in carrying out, at times, very successful abdominal surgery in the Field Ambulances was often misplaced and not in the real interests of the patients. It was done because the delay of a couple of hours was thought to be really serious and to override other considerations. The CCS possessed certain distinct advantages, and when it was decided that, within reasonable limits, the time-lag was not of supreme importance there was no longer any necessity for operation at the MDS. The CCS was in every respect better equipped. It was normally better staffed both as regards surgeons and especially as regards nursing sisters and orderlies. It had more elaborate equipment of all kinds, including beds and bedding, and an X-ray was available.

Sterilisation of theatre supplies was possible. Above all, however, the CCS provided rest and quiet, freedom from anxiety, and extra comfort. As a forward surgeon stated,' One has often seen the terror of the patient, anchored to his bed with intravenous apparatus and gastric suction, when the vicinity is being shelled'. Finally, and most important, the CCS had the ability to hold and nurse the abdominal cases till complete stabilisation had taken place, a period normally of about a fortnight. The best position of a CCS was as far forward as the provision of the above conditions and the presence of nursing sisters allowed.

Staffing for Abdominal Operations

This was satisfactorily arranged, as far as the surgical operation was concerned, by the attachment of well-trained young abdominal surgeons to Field Surgical Units in the forward areas, either attached to the Field Ambulances or to the CCS. The surgeons were chosen with prior experience of abdominal surgery, with an adequate background of sound training in a first-grade hospital, and also with some experience of war surgery. The middle thirties was the most suitable age, and courage, initiative, resource and stamina were essential. As already pointed out, there were weaknesses in the attachment of lone teams, and at no time in rush periods was there ever sufficient surgical potential to deal quickly with all the cases.

Well qualified and experienced anaesthetists were in short supply in the forward areas, and stress was laid by all surgeons on the value and necessity of having the very best anaesthetists and the best available apparatus for the benefit of these very serious cases.

Nursing sisters proved of the utmost value both as theatre sisters and in the nursing of cases after operation. Orderlies became very efficient in the pre-operation ward and in the theatre.

Diagnosis

The diagnosis of an injury to the abdomen was generally obvious, but at times was very difficult, and the services of a surgeon of wide experience were invaluable. It was of considerable importance to make sure that abdominal operation was really necessary, as a serious mortality attended negative exploration. As Major Rob, RAMC, pointed out in 1945, a full clinical examination was essential, and the abdomen should never be opened until a sound diagnosis had been made. This epitomised what was our New Zealand approach to the problem. It was also of importance to determine beforehand the possible extent of the intra-abdominal injury and so be able to restrict the extent of the exploration, especially in seriously ill patients.

Normally the diagnosis of abdominal injury would be made in the forward divisional areas, and the case sent back clearly labelled as an abdominal casualty.

The diagnosis depended on:

(a) The site of the injury and probable course of the missile.
(b) Local signs of intra-abdominal injury, such as rigidity of the abdominal wall, lack of audible peristalsis, abdominal distension, dullness in flanks or the pelvis.
(c) General symptoms of abdominal injury: shock and appearance of distress, signs of internal bleeding (pallor and rapid, thin pulse).
(a) Site of Injury: The wound of entry was at times far removed from the abdominal cavity. Buttock wounds were notorious for their abdominal complications, which might include intra-peritoneal lesions of the rectum or bladder, or injury to the urethra, and even thigh wounds were associated with abdominal injury. Fortunately a perforating wound of the abdominal wall or the loin very commonly traversed only the superficial structures, the missile being often deflected from a straight course.
(b) Local Signs: Abdominal rigidity in the left upper abdomen was often present in diaphragmatic and also in retro-peritoneal injuries, but the absence of intra-abdominal injury was generally recognised by the rigidity being less marked and more localised, and by the lack of other signs of peritoneal involvement. Lack of Audible Peristalsis: This sign was of great importance, especially in injuries in the region of the liver. This was stressed at the Rome Surgical Conference, 1945, by Major Rob, who considered auscultation essential in diagnosis, the absence of peristaltic sounds being conclusive of intestinal injury. By this means he had excluded from laparotomy 51 cases, including practically all the liver and kidney injuries, out of a total of 162 cases showing definite abdominal symptoms and signs. Captain Douglas, NZMC, however, considered that peristalsis might sometimes be present in cases with small lateral colon and intra-peritoneal rectal wounds. Retro-abdominal Haematomata: Large accumulations of blood in the loin and pelvis were common, and it was at times difficult to decide whether penetration of the abdominal cavity and possible injury to a hollow viscus had occurred. One case operated on at our CCS during the battle of Mareth had a

large retro-peritoneal haema-toma, and a moderately large foreign body lay directly behind the peritoneum. X-ray Examination: This proved of very great value in doubtful cases by showing whether a foreign body had probably traversed or was lying in the general abdominal cavity. For instance, if an entry wound was in the left flank and the missile was shown by X-ray to be well to the left of the mid-line, there would be no need to explore the right colon and pelvis, and handling and retraction would be saved. Operation was often negatived by localising the foreign body in the region of the diaphragm or in the retro-peritoneal tissues. In both of these positions marked abdominal signs were often present.

(c) General Symptoms: Shock and haemorrhage were the pre-operative problems. The general symptoms relating to abdominal injury were at first almost entirely due to the extent of the intra-abdominal bleeding, provided there was no gross trauma elsewhere in the body. When there had been little bleeding the abdominal signs were often very slight, and injury, especially to the small intestine, was easily overlooked. There might be progressive deterioration due to continued serious haemorrhage which prevented satisfactory resuscitation by blood transfusion and which constituted a definite indication for immediate operation.

A casualty was noted at the MDS to be in quite good condition some hours after wounding, but when he arrived at the CCS he was pulseless and gravely ill. He was given blood, but his condition did not improve very much, and a very experienced transfusion officer doubted his ability to stand any operation. The surgeon, however, diagnosed mesenteric haemorrhage and counselled immediate operation with continuous blood transfusion. A large, freely-bleeding mesenteric vessel was found with minor injury to the small intestine. The patient made a rapid recovery.

Vomiting was unusual, especially in the early stages. Lack of bowel movement was naturally not of much moment under battle conditions. Approaching the twenty-four hour period there was present a general deterioration, which became accelerated as the time after wounding increased and the toxaemia due to peritoneal infection became manifest. The signs of peritonitis from faecal contamination were seen only in the late, generally hopeless, cases. Peritonitis was rather a post-operative than a pre-operative problem.

The following case illustrates difficulty in diagnosis:

Soldier wounded in left buttock on 23 October 1942 at opening of battle of Alamein. Wound dressed at ADS, and re-dressed at ⅔ Australian CCS. The MO on ambulance train noticed' abdominal distension, vomiting and rigidjty'. Patient admitted 2 NZ General Hospital on 26 October with a history of vomiting for two days. He was still vomiting with a distended abdomen especially in caecal area; there was no audible peristalsis but the abdomen was not rigid. X-rays showed a perforation of the wing of the ilium and a large foreign body apparently in the abdominal cavity. Intravenous drip and gastric suction was started, and after some hours audible peristalsis was noted and wind was passed. Later the bowels acted and stools became frequent. The local abdominal signs appeared satisfactory, but patient's general condition deteriorated steadily and he suddenly collapsed and died on the eighth day. On the day before his death he had a white count of 21,000. Post-mortem disclosed localised purulent peritonitis with pus between coils of small intestine, apparently originating in region of the descending colon. The FB was not found. There were small pyaemic abscesses in the lung.

This is a very interesting case showing: (a) the danger of overlooking abdominal injury in buttock wounds in a rush of casualties; (b) the value of recording signs and symptoms as shown by the accurate diagnosis of abdominal injury on the hospital train; (c) the deterioration in abdominal cases following early evacuation; (d) that information given by X-ray in obscure cases is often of great value; (e) the difficulty in diagnosing late cases of peritonitis when positive local signs such as rigidity are often absent and general signs of toxaemia predominate, and when loose bowel movement is often seen; (f) the danger and severity of infection arising from wounds of the large intestine; (g) the unusual frequency of vomiting, possibly associated with the constant movement due to the non-recognition of abdominal injury.

Special Diagnostic Measures

1. X-ray has already been mentioned. Experienced surgeons were emphatic on the value of X-rays in difficult cases.
2. Auscultation has also been discussed and its value stressed.
3. Catheterisation was a routine procedure both for the diagnosis of urological injury and for the comfort of the patient.
4. Suprapubic incision. Brigadier Donald, RAMC, during the Alamein battle carried out, and advised, a limited suprapubic laparo-tomy to determine whether blood was present in the pelvis, as this was almost a constant sign of intra-abdominal

injury warranting laparotomy. In seriously ill cases particularly, the limitation of the exploration was of considerable value.

5. If there was any doubt as to whether a missile had penetrated the peritoneum the wound was debrided and enlarged to make certain, and, if necessary, a fresh exploratory incision was made to deal with the intra-abdominal injuries.
6. Percussion was of special value in determining the presence of fluid in the flanks or in the pelvis as well as the loss of liver dullness from intestinal gases.
7. Rectal examination. This was carried out in all suspected rectal and pelvis injuries. Proctoscopic examination was sometimes added.

Resuscitation

As in other casualties the administration of blood, plasma, and serum was invaluable in the resuscitation of abdominal patients. Other measures such as rest, quiet, comfort, and reasonable warmth were also of great value, and it was learnt as the war went on that some time must be allowed for recuperation from the wound trauma before operation should be undertaken. The centra-indications of fluid by the mouth increased the difficulties of resuscitating the abdominal cases which suffered, like all seriously wounded men, from dehydration. This rendered the administration of intravenous fluid particularly valuable.

There was considerable difference of opinion as to the importance of blood loss in abdominal injuries. Lieutenant-Colonel Grant, RAMC, considered that, whereas in serious limb injuries a blood loss of 50 per cent was common, the blood loss in abdominal cases was much less serious. This was corroborated by the Canadian research unit, which found that the average blood loss in the abdominal cases was 25 per cent against a 50 per cent loss in other serious cases. Forward surgeons, however, were agreed that serious blood loss was common and that the abdominal cavity was often full of blood, and our results show that the mortality in the cases with marked blood in the abdomen was very high. Most experienced forward surgeons strongly stressed this, and Major S. Wilson, NZMC, drew particular attention to the cases associated with severe bleeding and the necessity for urgent operation and the bad prognosis of these cases. Many of the patients who died on the table or during the first few hours after operation were those in whom severe bleeding had taken place. Forward surgeons expressed the opinion that marked loss of blood was much more serious in the abdominal case than it was in a limb injury. There was no doubt, however, of the value of blood transfusion in these cases. Lieutenant-Colonel

Grant recommended the giving of plasma in the field units and blood immediately before operation. Patients differed considerably in their ability to withstand loss of blood, and some cases were found to have efficient circulation after a loss of a third of their blood volume. There was common agreement that loss of circulatory fluid was the main factor in the production of shock, and fluid replacement by blood and plasma was found to relieve cardiovascular collapse satisfactorily in practically every case. If a case failed to respond to resuscitation by blood, it usually meant either continued internal haemorrhage or else irreversible shock, the result of gross irrecoverable injury.

Illustrative Case: Patient admitted five hours after accidental wounding in lower chest by grenade. Condition very grave; BP 60/30. Three pints of blood given rapidly, but condition failed to improve and continuing bleeding diagnosed. Urine was blood stained. Abdomen opened by left upper rectus-splitting incision; massive retro-peritoneal haemorrhage found coming from a ruptured kidney with completely severed pedicle. Rapid nephrectomy performed, but patient collapsed and died before bleeding could be properly checked, dying ten minutes after the induction of anaesthesia.

The management of resuscitation proved to be of the utmost importance. It was quickly realised that a patient could not be satisfactorily resuscitated more than once. Preliminary treatment, especially in the severe cases, was often necessary in the field units, and plasma proved of grear benefit at that stage. Continuation of the transfusion, either of plasma or blood, as an in-ambulance drip was sometimes advisable during evacuation to the operating centre. The final preparation and full resuscitation was only given in the pre-operation ward immediately preceding the abdominal operation, the timing of the operation being carefully judged by the transfusion officer in charge. The amount of blood and plasma given was on an average two pints of blood and one of serum, but there was considerable variation, some cases requiring little blood, whereas others with severe intra-abdominal haemorrhage were given large quantities. (A case is recorded in which seven pints of blood and two of serum were administered before and during operation. The abdomen was full of blood coming from severed arteries at the root of the mesentery. There were three holes in the small intestine. The patient recovered, though resuture of a ruptured wound was required later.) Sometimes only plasma was required. The rate of transfusion was of great importance. This was pointed out by Major Giblin, AAMC, who first gave blood very slowly with unsatisfactory results, and then allotted a maximum period of one and a half hours for the administration, giving serum followed by a pint of blood in ten minutes. The rapid administration of the first pint or two of blood was soon the regular practice, any further blood generally being given more slowly. As already stated, stress was laid at the beginning of the war on the performance of operation at the earliest possible moment after wounding, but experience showed that the more important factor was the obtaining of adequate resuscitation, and that a little extra time spent for that purpose paid handsomely in results.

The Indication for Laparotomy: Abdominal exploration was indicated when the diagnosis of intra-abdominal injury involving a viscus or associated with haemorrhage was made, or when the diagnosis was seriously in doubt. Expectant treatment was only justified when the opinion was strongly against any such involvement.

Operatability

Very early in the war the difficult decision was arrived at by our forward surgeons that an operation should be performed if there was any vestige of hope for the patient. It was impossible to operate on every wounded man when casualties were heavy, and the more patients operated on the more delay in the individual case.

A surgical team could, as a rule, perform only twelve operations a day. It was a question of priority, and some rightly argued that time spent in operating on a hopeless abdominal case would have been better spent in dealing with other serious wounds in patients likely to recover and also likely to be of further use in the Army. The training and outlook of medical men, however, has always been to give a patient a chance however poor it may be, and this outlook led to our surgeons operating on practically all patients able to be brought to the operating table. Only three abdominal patients admitted to our CCS were not operated on during the Italian campaigns, and (including cases operated on in CCSs other than our own) over 96 per cent of our New Zealand cases were operated on at that level. This naturally vitiated the results as far as recovery after operation was concerned, but fortunately results were not allowed to enter into the question, each patient being dealt with as a separate problem. A tenth of our cases in Italy remained in a very serious condition at every stage and were probably hopeless from the beginning, and possibly should not have been operated on, but surprising recoveries sometimes did take place.

The prolapse of bowel was a very grave prognostic feature. Major Giblin, in reporting 90 abdominal cases at the Alamein period in which he obtained excellent results, stated that all his prolapsed bowel cases died. However, we have records of recovery in two of these cases, both necessitating resection of small intestine, at an FSU attached to a Field Ambulance in the final battles in Italy.

Illustrative Case: Operation five hours after wounding by a bazooka. Most of the small intestine prolapsed on the abdominal wall through a large deficiency in the right lower recrus muscle with considerable burning of the abdominal wall. Twelve inches of small intestine was non-viable due to damage to the base of the mesentery. Resection and end-to-end anastomosis was performed and burnt appendix also removed, as also was a piece of bomb. The defective abdominal wall could only be closed by peritoneum. The condition of the patient was critical for forty-eight hours. Peristalsis returned on fifth day. Some sloughing occurred in the abdominal wall, but patient's general condition was satisfactory. The abdomen was enclosed in a plaster cast and he was evacuated on the tenth day and recovered.

The decision as to the optimum time to carry out the operation was determined by close observation of the patient's condition and by particular attention to the circulation as shown by his pulse and blood pressure. The vitality of patients differed considerably, and this was associated with their mental attitude and their will to live and their co-operation as patients.

The pulse was a valuable indication both in its volume and rate. A fast thready pulse was an indication of serious circulatory disturbance. Pallor also indicated blood loss. The blood pressure was of the greatest importance as it was possible to make accurate determinations not subject to individual judgment.

Lieutenant-Colonel Wilson, RAMC, who carried out research work at the time of Alamein, considered that a systolic blood pressure of 80 mm. Hg. was the minimum of operatability. A minimum of 100 mm. was aimed at by the transfusion officer before listing for operation unless special conditions, such as continued bleeding preventing full resuscitation, were present. The limits were not, however, rigidly enforced. Major Blackburn, RAMC, wrote,' generally it is courting disaster to begin operation with a systolic pressure of less than 90 mm. Hg., but it is courting death not to begin at all. At times an unexpected reward will be gained in an apparently hopeless case.' That epitomises the approach of our own forward surgeons to the problem. Normally operation was undertaken when the blood pressure was 100/80 and rising and the pulse and colour correspondingly improved. This usually took three to four hours.

The Late Case

There was considerable discussion with regard to the treatment of the late cases admitted to the operating centre more than twenty-four hours after wounding. It was held by some that the chances of survival of these cases were so poor that it would be better to leave them and operate on earlier cases or on other types of injury where definite good could be done. In spite of the logic of this approach the forward surgeon could not bring himself to discard these cases, even if the chance of success was very slight. Operation was therefore undertaken, unless the patient was obviously moribund. Normally the usual operative procedures were carried out.

It was not uncommon for evisceration of bowel, a grave prognostic feature, to be present. This was normally replaced and the abdomen closed. Sometimes the operative procedures entailed considerable manipulation and added to the already severely shocked condition of the patient. The results of treatment were very disappointing, most of our surgeons stating that they had had only a very occasional success and some had had none in the late cases. One surgeon states,' I never had any success with the very late abdomens. I think they should be rejected, especially if other abdominal cases are waiting.' Another records,' A very old abdomen in my opinion is best left alone.' Button at our CCS at Cassino recorded that none of the long-term cases (twenty, twenty-four and forty-eight hours, etc.) died in spite of advanced peritonitis. Stress was then laid on adequate resuscitation and conservative surgery.

It appeared that there would have been better results if the cases had been treated more conservatively. This is illustrated by an actual case observed in Italy. Nearly three days had elapsed since the wound, and a loop of terminal ileum and a small part of the caecum were in the wound. The patient's general condition was surprisingly good and there was little abdominal distension. There were wounds of the extruded bowel. At operation a paramedian incision was made to explore the abdomen, and the small bowel was sutured and returned to the abdomen, both wounds sutured, and a drain left in the pelvis, where some purulent fluid was found. The patient subsequently died. The after-thought naturally arose as to whether any other treatment in such an unusual case was possible. Perhaps removal of the extruded loop with the ends left open as a double-barrelled ileostomy and partial closure to close over the portion of caecum could have been carried out rapidly with no trauma, and the peritoneum left to care for itself, with subsequent drainage of the pelvic collection, if necessary. He might have had a better chance with the simpler, though not perfect, procedure; and in bad cases a risk of leaving something undone must be taken.

The type of treatment of the late appendix could reasonably be followed in the abdominal wounds of war, and exploration restricted to the drainage of any abscess which developed. Cases have struggled to recovery in that way, and it must not be forgotten that abdominal cases did recover without operation during the South African and other previous wars. The utilisation of penicillin and the sulphonamides, gastric suction, and intravenous blood serum, and fluids give us a better chance today.

OPERATION

Theatre Technique

The operating theatre technique depended to a great extent on the supplies available and on the possibility of washing and sterilising under the prevailing conditions. The elaborate arrangements of a civil hospital were naturally impossible in a tent in the desert. It was impracticable to use large numbers of sterile gowns and guards, and generally impossible to wash them properly. This led to the minimal use of linen gowns and guards for operation. At times, when conditions rendered it possible, sterilised gowns, guards, and dressings were sent up to the forward areas from the base hospitals in Egypt. However, for the abdominal cases gowns and guards were used whenever possible, but sparingly. Caps and masks were used, and care taken that the masks were impervious. Ordinary soap and water allowed satisfactory cleansing of the hands, and methylated spirits gave some added safety. Gloves were used generally for all cases, and always for abdominal cases.

Sutures and ligatures were freely available, but catgut was sparingly used. Cotton and linen thread were utilised instead. Ordinary cotton was found quite suitable for ligatures and caused less trouble than catgut. Catgut was utilised for deep stitches in the abdominal wall where sepsis might ensue. Linen thread was used for sutures both for the intestine and for the skin.

Instruments and Appliances

Abdominal sets of instruments were often prepared in readiness for instant use. The instruments generally available were ample, but a good pedicle clamp, simple flexible abdominal retractors, and a strong rib spreader were useful additions. An efficient suction apparatus was considered essential, as was electric lighting. Independent electric lighting sets for FSUs were eagerly sought after, and the Italians had an excellent model. An angle-poise lamp was found of use in abdominal cases.

Preparation

1. Skin Preparation: Soap and water was mainly relied upon for pre-operative cleansing of the operation area and shaving was carried out as required. Antiseptics (such as iodine, dettol, mercurichrome), however, were commonly applied afterwards.
2. Catheterisation was regularly performed before operation.
3. Morphia had normally already been given to these patients, and further dosage was administered as required with or without atropine.

Anaesthesia

The type of anaesthetic used depended a good deal on the anaesthetist. Our teams generally used pentothal for induction followed by ether. When the Macintosh's apparatus became available it proved of great value in the forward areas in the desert. Later much use was made by experienced anaesthetists of anaesthesia machines and sometimes of cyclopropane. Intratracheal anaesthesia was also used, especially for thoraco-abdominal cases.

Other Wounds

Wounds elsewhere in the body complicated the operative procedure. The determination of the sequence of operative attack called for experience and judgment in the surgeon. The patients were as a rule very ill, and only urgently necessary procedures in regard to other than abdominal injuries were normally carried out. Any urgent wound treatment that necessitated other than a recumbent position was done first so as not to move the patient after laparotomy. If bleeding was taking place from a limb injury it was attended to first. A traumatic amputation was also dealt with so as to facilitate the rapid resuscitation of the patient. Other injuries which could be dealt with readily in the recumbent position were left until after laparotomy, so that should the patient collapse they could be left alone. It was often of great value to have two surgeons working at the same time on different lesions in order to cut down the operating time. The association of head injuries created a difficulty, but if the patient could not be safely evacuated to a head unit for combined operation, then abdominal operation was carried out and the head wound dealt with as deemed necessary at the time, and according to the experience of the surgeon in head surgery.

The Abdominal Incision

Careful excision of the gunshot wound was carried out so as to ensure an aseptic healing following suture. Exploration of the abdomen was carried out either through the enlarged original gunshot wound or through a separate incision. The original wound was utilised frequently at the beginning of the war, especially for approach to the flanks. It was then realised that healing of these wounds was often unsatisfactory and other more normal exploratory incisions were used. There was no standardisation of these incisions, surgeons often using the one they were accustomed to in civil practice. Some used a paramedian, some a rectus split, and others a mid-line incision for a general approach, and transverse or oblique incisions in the flanks, sometimes extending forwards to the mid-line. The original wound was still used occasionally for injuries localised to one flank The wound of entry was sometimes preferred when the damage to the abdominal wall was extensive and a wide excision of it seemed the easiest method of approach. Considerable difficulty was often experienced in closing such incisions.

One of our surgeons used the following incisions in a series of abdominal cases: mid-line, 18; paramedian, 66; transverse, 21; oblique, 9; thoracic or thoraco-abdominal, 10.

There seemed to be less trouble following the central abdominal incision, and more herniation following rectus split and transverse rectus incisions. (All incisions were sutured with, at times, temporary drainage in the original wounds.) Separate incisions were generally made for colostomy or abdominal or retro-peritoneal drainage.

The Exploration of the Abdomen

Every forward surgeon recognised the need to carry out a thorough and orderly examination of the abdominal contents. The probability of injury to any organ or viscus was evaluated from the position of the wounds and the probable course of the missile, but, especially in the case of the mobile small intestine, it was difficult to be certain that no injury had taken place. The surgeons worked on an orderly plan. First came suction and mopping up of blood, which was generally present in some degree, and, in about half the cases, to a marked degree. Large abdominal cloths were used and gentle tilting of the body often allowed blood to run out. Then at the earliest moment any actual bleeding vessel was caught up with forceps and tied off with fine thread. The mesentery or omentum was the common site of serious continued bleeding. The small intestine was then examined loop by loop from one end to the other, generally starting at the caecum, forceps being applied to each lesion as it was found, and repair carried out at the end of the examination of the small bowel. Multiplicity of wounds in the small intestine was so common that examination of the whole of the small bowel was essential except in exceptional circumstances. Then the stomach and the large bowel were examined, and finally the liver, spleen, kidney, and bladder, as indicated by the wound and the other injuries.

In examining the colon, freeing of the fixed colon was often necessary when the bowel was injured or when injury to the retro-peritoneal aspect was considered possible, the liberation of the bowel facilitating both the examination and the treatment, generally by exteriorisation, of any lesion present. One of our forward surgeons stated that the fixed colon should almost always be mobilised as suture would be difficult unless this were done, and there was, in any case, usually a through-and-through wound of the colon. Another of our surgeons stated:' In wounds of the fixed colon the damaged section should ideally be mobilised and exteriorised. But, if any great difficulty arises in doing this, a local repair plus free drainage and a proximal colostomy should be done. Better a live patient with a proximal colostomy and a faecal fistula than a dead one with exteriorised damaged bowel'. Unfortunately, the efficiency of this method was offset by the extra shock produced, especially in the severe cases. Major Estcourt, RAMC, who reported in 1945 a series of operations on wounds of the colon with the low mortality of 36·5 per cent, stressed the severity of the extensive mobilisation necessary to exteriorise the fixed portion of the colon, and described it as a shocking procedure which the war abdomens would not stand. The stomach could be adequately examined by an approach through the gastro-colic omentum.

Treatment of Bleeding in the Mesentery

Sometimes severe and continued bleeding was encountered from a mesenteric vessel, and bleeding into the mesentery itself made treatment difficult. Brigadier Ogilvie, RAMC, pointed out the danger to the circulation of the bowel of using sutures in this situation. He strongly advised the picking up of the bleeding vessels by small forceps and ligature by fine thread, including the minimum of tissue. His advice was followed by us.

Treatment of Wounds of the Small Intestine

The holes in the small intestine marked by the forceps were then dealt with in turn, generally by a single layer of stitches. The stitches were either continuous or single according to the nature of the lesion, and were of fine thread and sometimes of catgut. Resection was employed only when the mesenteric blood supply was interfered with or when portion of the intestine was hopelessly damaged, it being recognised that resection was followed by a high mortality. Simple end-to-end suture was employed in resection cases, generally using only one row of stitches.

Illustrative Case of Multiple Injuries, including Resection of Small Intestine: Soldier wounded by shrapnel in sacral region 20 April 1943. Laparotomy ten hours after wounding disclosed, (a) six ragged tears of lower ileum for which eight inches of gut were resected with end-to-end anastomosis; (b) small hole at pelvi-rectal junction of colon, which was oversewn and inguinal colostomy performed; (c) perforation of intra-peritoneal wall of bladder, which was closed and a suprapubic cystostomy established.

A drain was placed to the pelvis. The foreign body was not found. Patient was given six pints of blood altogether. He was evacuated on 12th day, and eventually reached 3 NZ General Hospital at Tripoli on 16th day. Just over a month later the suprapubic incision had healed, and the colostomy was working well, and he was evacuated to Egypt.

This case illustrates the sound technique utilised by the forward surgeons at that period.

Treatment of Wounds of the Colon

It was in treatment of wounds of the colon that the greatest interest was shown during the war. This was a natural sequence to the advancement in operative procedures in civil surgery, and especially the recognition of the dangers of infection following operations on the colon. This had led to the adoption of conservative types of operation such as the Paul-Mikulicz in preference to direct excision and suture. Devine had used a proximal colos-tomy to divert the intestinal contents and so render subsequent excision of the colon much safer. The repair of the thin and fat-laden wall of the colon was difficult and the danger of leakage and infection ever present. In gunshot wounds there was extra bruising and devitalisation of the bowel. Ogilvie early in the war made a vehement appeal for the exteriorisation of the colon, saying that' no surgeon might repair and suture a colon injury and return it to the abdominal cavity.' This appeal had a marked effect on surgeons in the MEF and they adopted the method, thus bringing about a marked lowering in the mortality of these cases as compared with the First World War. Great improvement in his results was reported by Major Giblin, AAMC, who first utilised suture and later adopted exteriorisation. Major S. L. Wilson, NZMC, carried out exteriorisation from the beginning, and this was the regular routine of all our later forward surgeons. Wilson stated that' the decompression produced by the combined use of colostomy and gastric suction in large bowel injuries produces as completely as possible the ideal of complete physiological rest of the whole intestinal tract and contaminated cavity'. The colon was at times brought out through the original wound, but this was found unsatisfactory and a small separate incision was then always used for the colostomy, no suturing being required. A double-barrelled colostomy was made if at all possible, and a definite spur was formed. Serious bruising of the colon without actual perforation was also dealt with by exteriorisation as subsequent sloughing and perforation was not uncommon. A proximal colostomy was opened at the original operation, but exteriorised damaged bowel was not generally opened until twenty-four to forty-eight hours later. Exteriorisation remained throughout the war as the standard form of treatment for colonic injuries, and especially for lesions of the left side of the colon.

As time went on, however, and difficult cases arose, many surgeons were not satisfied with the rigid rule, and in the case of the wounds of the right colon began to suggest that closure might be both justified and beneficial. Many considered the right colon should be treated like the small intestine, except in major injuries. Suture began to be tried in the lesser cases, and marsupialisation combined with tube or

Paul tube drainage in all but the severest cases. The copious and irritating discharge of fluid contents from the caecum caused much trouble, infected the parietes, and many cases died. A case was observed at the battle of Mareth of a severe injury to the caecum in which a large mass of caecum and ascending colon was exteriorised with the ileo-caecal valve protruding in the wound. Marked loss of fluid occurred, with irritation of the skin and infection of the wound extending into the loin. Partial closure was attempted a few days later, but without success. The case made a deep impression on all who saw the distressful condition present. Radical excision of the right colon as for the treatment of cancer of the bowel was often undertaken, but this was a severe operation and the cases needing such treatment often could not stand it. Short-circuiting of the terminal ileum into the transverse colon was often used with success, but the damaged colon had still to be dealt with. When suture was adopted drainage of the abdomen, and also of the retro-peritoneal tissues if involved, was deemed essential by most surgeons. Suture was also undertaken by some surgeons in the lesser lesions of other parts of the colon, being more cautious with choice of cases on the left side. It is recorded that cases of tearing of the walls of the transverse colon without injury to the mucous membrane healed successfully after suture of the external coats. Proximal colostomy associated with suture was performed by some, especially in the splenic flexure cases, and as a routine in the lower pelvic colon and rectal cases. When exteriorisation was carried out, as in the majority of cases, and in all the severe cases, sufficient bowel was brought out to allow of the formation of a satisfactory spur. Care was taken to approximate the limbs, so that the mesenteric attachment would not be afterwards caught in the clamps when the spur was crushed. When drainage was instituted in wounds of the caecum early closure was carried out, generally on the fourth day, to prevent the continued discharge of fluid and the soiling of the wound as the Paul's tube became loosened.

Wounds of the Rectum

The serious nature of wounds of the rectum was recognised early, as was their frequent association with wounds of the buttock and pelvis. Severe infection, especially in the retro-peritoneal tissues, was usual in these injuries. Suture of any injury to the intra-peritoneal part of the rectum and the lower sigmoid was carried out and a proximal colostomy formed, through a small separate stab wound, generally in the left iliac region, no stitching in the wound being necessary or desirable. Drainage was instituted to the pelvis. In extra-peritoneal injuries a colostomy was formed and free drainage instituted in the mid-line of the perineum with removal of the coccyx to give adequate room. In Crete Major Christie reported that the rectum was usually opened in severe wounds of the sacral and coccygeal regions. These cases developed severe toxaemia, and probably also peritoneal infection, and none survived in spite of a transverse colostomy being performed on one case.

In the earlier periods of the war a colostomy was sometimes performed to ensure non-soiling and better healing of large buttock wounds, and this seemed justified in seriously ill patients, though adding another risk and burden to the patient. The introduction of penicillin rendered this operation unnecessary, and many large buttock wounds were dealt with successfully either by primary or delayed primary suture, combined with local and parenteral penicillin.

Injuries of the Stomach and Duodenum

Stomach wounds lent themselves to satisfactory suture, and normally did well if not, as was common, complicated by other serious intra-abdominal injuries.

Duodenal injuries were dealt with by suture which frequently presented great difficulty. Drainage was provided as leakage was common. The mortality was high.

Illustrative Case of Stomach and Duodenal Injury: GSW wound operated on within eight hours. Entrance wound in left flank. Lower pole of the spleen was torn, splenectomy performed. Two holes in stomach sutured. A perforation of the transverse colon necessitated exteriorisation. Multiple holes in the jejunum were closed. A perforation of the peritoneal aspect of the second part of the duodenum was closed by a double layer of sutures. The patient had a smooth convalescence and was evacuated from the CCS on the fifteenth day after operation.

Injuries of the Bladder

These were dealt with by suture of the wounds of the bladder and drainage provided suprapubically and, if necessary, extra-vesically, and in the cave of Retzius.

Some of our cases had to have both a colostomy and a suprapubic cystostomy performed for multiple injuries of the colon and bladder.

Injuries of the Liver

The treatment of liver injuries was the cause of some anxiety in the early period, and special needles were provided for possible suture. It was recognised that in severe lesions there was considerable bleeding and that in these cases there was a heavy mortality. Suturing, however, proved difficult and unsatisfactory, and fortunately was only very rarely necessary.

Captain A. Douglas, of 1 NZ General Hospital surgical team, stated that of 56 abdominal operations during the advance from Alamein to Tunis only one liver injury needed treatment, and in that a pack was inserted. Suturing over a muscle graft was sometimes carried out with success. Packing with gauze, protected by omentum, was resorted to in the few cases with active bleeding. The large majority of the cases had small lesions and bleeding had ceased.

A case illustrating the severity of some of the liver injuries had a thoraco-abdominal injury, and laparotomy disclosed that the peritoneum was full of blood from a damaged liver. Four mattress stitches were inserted and a foreign body removed from the dome of the liver. The patient did not pick up and died within twenty-four hours.

A large number of liver injuries were associated with penetrating wounds through the chest wall and not involving any other abdominal organ. They were treated, if necessary, in conjunction with the chest wound, by a thoracic approach. Drainage was at first instituted through the chest wound, but this was generally found to be unsatisfactory, often leading to infection of the pleura. Better results were obtained, when drainage was deemed necessary, by retro-peritoneal drainage through the loin and below the diaphragm. Operation for liver injuries alone was found to be seldom necessary as bleeding had practically always ceased before exploration and, except in the very severe fatal cases, was seldom of any consequence. Major Rob, RAMC, operated on only one of a series of 33 liver injuries.

Injuries of the Gall Bladder and Ducts

These were of more importance. Drainage was always carried out after repair of the ducts. The damaged gall bladder was either removed or drained.

Injury to the Spleen

These injuries were not associated with the severe bleeding present in the crush injuries seen in civil life. In many cases the damage to the spleen was slight and little bleeding had taken place, and in some cases suture of a small tear was carried out and the spleen left without any treatment. In the majority of the cases, however, splenectomy was performed, often through a thoracic approach, which was easier and was associated with a lower mortality. In none of our cases was bleeding from the spleen the main cause of death. One of our surgeons reported 17 injuries of the spleen, of which 13 cases were treated by splenectomy. In the other four cases there were perforations or portions split off a pole or edge. In no case was the decision to leave the spleen regretted.

Injury to the Kidney

This was often recognised in the course of exploration of an abdominal or loin wound or by the presence of haematuria as disclosed by catheterisation. In rare cases very profuse bleeding took place from a damaged renal vessel, but in the majority of cases the damage was not severe. Exploration was generally carried out through the loin, though the anterior-abdominal approach was utilised at times when there were other injuries present. Nephrec-tomy was performed when there was serious damage to the kidney. One surgeon carried out nephrectomy in 7 of 13 cases actually explored for kidney injury.

In lesser injuries the kidney was repaired and drainage instituted. When, however, there was an associated injury of the adjoining colon, nephrectomy was carried out. Experience had shown that there was a very real risk of serious infection of the kidney arising from the colon, and there were several deaths from this cause. Just as in civil practice, a conservative attitude was adopted for all the less severe injuries.

Retro-peritoneal Injuries

Injuries to the retro-peritoneal tissues were comparatively common, and marked bleeding was frequently present. Cases of fatal haemorrhage from main vessels were reported, and marked bruising of the perirenal areas was common, sometimes associated with some damage to the colon or kidney. Infection was very prone to arise in the bruised tissues, and free drainage was found to be essential.

Use of Sulphonamides

The introduction of 10 grammes of sulphadiazine in 10 per cent gelatine suspension into the abdomen at the completion of the operation was carried out by forward surgeons in the pre- Alamein period, and at first more was injected through a tube after twenty-four hours. This was done in an attempt to prevent peritoneal infection, and the generally satisfactory progress made by the abdominal cases at that time seemed to point to some benefit from this treatment. There was no evidence of any serious deleterious effect, though, on the other hand, no positive evidence of any marked benefit. In two cases that Major T. Harrison, NZMC, re-operated on, he found sulphonamide caked between the leaves of the mesentery, apparently in its original quantity.

It continued to be used by some surgeons throughout the war. Parenteral sulphadiazine was also given, some surgeons giving a three days' course intravenously.

Penicillin

This was given locally to the wound and into the abdomen when it became available in Italy and largely replaced the sulphonamides. When supplies allowed, it was given parenterally for several days after wounding. It was believed that penicillin greatly reduced chest complications, and it certainly led to a marked reduction in abdominal sepsis, no case dying of infection at the New Zealand base hospitals during the last eight months of the war.

Drainage

This was a question on which surgeons differed greatly both in civil practice and, not unnaturally, in military practice. Drainage of the abdomen had been proved to be efficient only for a very limited period unless there was a definite collection or abscess cavity to drain. Thus in civil practice many surgeons did not drain the abdomen except when an abscess cavity was present. In war injuries there came into play special factors, particularly the presence of bruised and damaged tissues.

Ogilvie early in the war recommended drainage for twenty-four hours in doubtful cases, and up to ten days in septic cases. Our forward surgeons had no fixed routine, but were inclined to use drainage only in the presence of definite contamination and to rely on the peritoneum to deal with infection in the ordinary case. One of our surgeons drained in one half (59) of the cases recorded by him. In certain conditions, however, drainage was insisted upon. These included soiling from large bowel injuries, large liver wounds, especially if involving the bile passages, pancreatic and duodenal injuries, rectal injuries, and injuries involving the retro-peritoneal regions.

Thoraco-abdominal Wounds

The definition of a thoraco-abdominal wound is not easy. Almost every liver wound, for instance, is a thoraco-abdominal wound, but very many of these were never explored and were not enumerated as thoraco-abdominal injuries. Many upper left abdominal wounds with injuries in the region of the tenth or eleventh ribs were not classified as thoraco-abdominal wounds though the pleural cavity may have been penetrated.

Thoraco-abdominal injuries were relatively common with the foreign body traversing the thorax then penetrating the diaphragm to injure liver, kidney, spleen, mesentery, or hollow viscus. Herni-atipn of abdominal contents into the thorax sometimes occurred.

The early approach, to the treatment of these cases was to use an abdominal approach and treat the chest wound by simple local excision, aspirating the chest if necessary. It was realised that these wounds carried a rather high mortality, and that a combined thoraco-abdominal approach was very severe, but fortunately hardly ever necessary. In large sucking wounds of the chest, however, it was found that lesions of the stomach and spleen could be dealt with by the chest approach and the diaphragm readily sutured, and that the cases did well. There was also the added consideration that forward surgeons developed a facility in operating on the chest that was not possessed by the ordinary civil surgeon who did not specialise in this field. The review of our New Zealand cases in Italy showed that the majority of patients with a thoraco-abdominal wound, for which a laparotomy had been performed, died, whereas in those dealt with solely through a chest approach the large majority survived. Though the series was small and there was a run of very severe cases, yet the opinions of others supported this preference for a chest approach.

By an intercostal incision or the excision of a rib free access was obtained and the wound of the diaphragm could be enlarged if necessary. Wounds of the spleen and stomach could be satisfactorily dealt with, and at times wounds of the intestine were sutured, though where the intestine was involved laparotomy was found to be preferable and generally essential. The diaphragm could be readily sutured through a chest approach. The chest was closed without drainage, penicillin instillation and tapping being relied on to prevent chest infection; a temporary intercostal sealed drain was utilised when infection was specially to be feared in the case of visceral injury.

For injuries of the right side, where the liver was normally involved, excision of the entry wound and the wound in the diaphragm was carried out with suture of the diaphragm to the parietal pleura, leaving a drain to the liver. However, there was trouble with sepsis, bile pleurisy, and empyema in these cases. This led to closure of the diaphragm and pleura and the substitution of drainage below the diaphragm from the loin in many cases.

The abdominal incisions utilised were either a mid-line or a subcostal incision. The abdominal approach was utilised when the chest injury was of minor degree requiring no operative treatment in itself, and also was necessary when a bowel lesion, apart from an easily dealt with lesion of the stomach, was present. The nature of the chest wound generally determined the approach. If a combined approach was necessary, the continuation of thoracic incision across the costal margin into the left upper quadrant of the abdomen and splitting the diaphragm proved satisfactory. In chest cases an excess of blood or saline transfusion was undesirable.

Cases Illustrating Thoraco-abdominal Wounds

Exploration of the Chest only: Wound of the right side of chest; two large holes were present in the diaphragm associated with tears in the liver. Portion of the sixth rib was removed and a bleeding internal mammary artery tied. The haemothorax was sucked out, no foreign body was found, the diaphragm was sutured, a drain inserted to the liver, and the chest closed with a superficial drain. An intercostal nerve block was carried out. (There was in addition severe infected fractures of the foot.) An infected haemothorax developed, and this was first aspirated and then treated by intercostal tube drainage. A fortnight later four inches of the eighth rib was excised and stinking clot and a large foreign body removed from the lower lobe of the lung. Drainage was instituted and penicillin instilled regularly. The chest cleared well. The foot had to be amputated.

Exploration of the Chest and Abdomen: A sucking wound of the right side of the chest was excised, clot removed and the wound sutured. An upper muscle split abdominal incision disclosed a small hole in the diaphragm with wounds of the liver, of the gall bladder (for which a cholecystostomy was performed), and of the stomach which was sutured and covered with omentum. The foreign body was removed. A drain was inserted to Morrison's pouch. The patient developed some signs of nephritis but cleared up well.

Late Abdominal Operation: Wound of the right side of the chest associated with emphysema. X-ray disclosed a foreign body in the region of the 9th intercostal space on the right side of the chest. Aspiration was carried out several times. Later in the advanced base hospital he developed severe abdominal pain with collapse, and laparotomy disclosed a large collection of blood in the abdominal cavity with clot in the pelvis and also under the liver. Drainage was instituted and the abdominal condition subsided, though the patient still remained ill. He then coughed up profuse blood and bile-stained very offensive material. Pus and albumen appeared in the urine and oedema became marked. Finally he struggled to health after a desperate illness. It was thought that the lesion was probably a subdiaphragmatic haemorrhage of liver origin which burst first into the peritoneal cavity and then into a bronchus. X-ray films supported this interpretation.

POST-OPERATIVE TREATMENT

Nursing

The post-operative nursing of the abdominal cases was recognised throughout the war to be of the utmost importance, and it was realised how difficult it was to give adequate treatment under the conditions of the mobile warfare experienced in the desert campaigns. At first in the Field Ambulances, where the abdominal surgery had to be carried out, no beds were available and the cases were nursed on stretchers. This made the retention of Fowler's position very difficult. Just before the Battle of Alamein beds were provided for these cases, both for the Field Ambulances and for the Field Surgical Units, with marked improvement in the comfort of the patient.

At first when the abdomens were operated on in the Field Ambulances the personnel of those units were called upon to undertake the responsibility of nursing these very serious cases after operation. They nobly rose to the occasion and did very good work. Our units, however, had no trained nursing orderlies similar to those in the RAMC regular force.

Later, during the second Libyan campaign in 1941, orderlies with some nursing experience at the base hospitals were available in our Mobile Surgical Unit. In the pre- Alamein period nursing orderlies, as part of the light section from the CCS, were attached to the Field Ambulances, and this often happened afterwards when the Field Ambulances were called upon to deal with the abdomens. At the CCS sisters were always available for nursing the serious cases and they were also able to train the orderlies in this work. The presence of nursing sisters made it desirable, if conditions were at all favourable, to carry out the abdominal surgery at the CCS.

This is illustrated by the following report:

The NZ Field Surgical Unit functioned for the first time in Italy at the Sangro river with entirely new theatre personnel and new orderlies, and was attached to 4 MDS, who had no orderlies trained in nursing abdominals. The team operated on 32 abdominal cases in'twenty days. The nursing situation in a small inadequate Italian building in mid-winter rapidly became unmanageable and a nightmare to the surgeon. Two nursing sisters were sent up from 1 NZ CCS, and in the space of a few hours entirely transformed the situation and the appearance and comfort of the patients.

Position

Fowler's position was utilised following operation up till the last year of the war. It was then suggested that the horizontal position was preferable. It had been observed that abdominal patients, nearly always very shocked following operation, had collapsed, and those who died often did so shortly after their return to the ward, presumably from circulatory failure. It seemed better to treat the patients for shock by laying them flat till the circulation had improved. They were also prone to develop chest complications, and Fowler's position was thought to contribute to this. Forward surgeons readily discarded the Fowler's position and were of the opinion that the horizontal position was definitely preferable and also made nursing easier.

Blood and Plasma

It was noted by the Canadian research unit that the mortality following operation was much higher than that occurring pre-operatively in the resuscitation ward. Lieutenant-Colonel Grant. of the British shock research unit, vividly pointed out the occurrence of shock following operation and the anxiety which must remain for at least twenty-four hours. He considered the patient required just as careful handling and resuscitation at this period as he did before operation. This corresponded to our experience that the majority of deaths occurred in the first forty-eight hours following operation.

Unfortunately the majority of the deaths were probably inevitable because of the severity of the original trauma, and when the operative trauma was added to this the man stood a very small chance of recovery. We learnt that further blood and plasma was essential at this stage in most cases, and in the later stages of the war blood and plasma were given much more freely. In addition to the immediate post-operative resuscitation, a pint of plasma or serum daily was given to the serious cases to counteract any protein deficiency.

Less than a week following operation there was commonly a secondary anaemia, so that further blood transfusions of from 1 to 2 pints was of the greatest benefit. The graphs of deaths showed that there was a small peak at the sixth day, and this was in keeping with clinical observation. In the severe cases a crisis was always expected about that time, and it was at that time that blood transfusion was of great value in increasing the resistance of the patient to infection.

Intravenous Fluids

The administration of intravenous fluids after operation was a routine in the abdominal cases from the beginning of the war. Solutions available were normal saline, 5 per cent glucose solution, and a glucose saline containing 3 per cent saline in the 5 per cent glucose.

It was recognised that an excess of chlorides was undesirable and that the bulk of the fluid should be given in the form of isotonic glucose. The total fluid given in the course of twenty-four hours was from 8 to 10 pints. The quantity of saline given was at first variable, but later became stabilised at 2 pints daily, plus replacement of the quantity of fluid removed by gastric suction by an equal quantity of saline. An output of 50 oz. of urine daily was aimed at. The presence of chloride in the urine was tested for when there was doubt as to the quantity of saline to be given.

Gastric Suction

Gastric suction was instituted early in the war and remained a regular routine. The tube was introduced through the nose at, or soon after, operation. Kyle's tubes were used at first, but as the supply was inadequate the larger tubing of the blood transfusion apparatus was utilised and found to be superior. The gastric fluid was drawn off regularly by means of a continuous suction through a bottle. It was continued till signs of peristalsis were present as shown by the stethoscope or by the passage of flatus. The average period was about four days.

Fluid by the Mouth

At first no fluid was given by the mouth till the gastric tube was removed, though the mouth was frequently rinsed and cleansed. Later it was realised that water by the mouth in the presence of the gastric tube could hardly be deleterious and would help the gastric lavage. The swallowing of the fluid gave great comfort to the patient. It was then found that water given by the mouth was partly retained without any deleterious effect, and helped in the necessary supply of fluid. This encouraged surgeons to give more fluid and gradually to introduce fluid nourishment, if the progress of the patient warranted this, even before the gastric tube was removed. Nourishment was given in the form of sugar, sweets, diluted milk, then Benger's Food, egg flips, etc., from forty-eight hours after operation. On the removal of the tube, fluid was given freely in small quantities and nourishment given and stepped up with the progress of the patient. The earlier administration of food led to the more rapid recovery of the patient, and the diminution of post-operative debility and vitamin deficiency.

Morphia was given without question when necessary.

Purgatives were not normally given. One of our surgeons gave small doses of liquid paraffin following the removal of the gastric tube and the re-establishment of peristalsis.

Enemata were given if necessary after peristalsis was present, generally after the fourth or fifth day. The lower bowel was very liable to become loaded with a mass of hard faeces. This was distressing to the patient and interfered with his recovery. Sometimes oil enemata were needed, and even manual removal was occasionally necessary.

POST-OPERATIVE PROGRESS IN THE FORWARD AREAS

This was influenced markedly, as one would expect, by the general conditions of the campaign and also by the conditions under which the surgical treatment, resuscitation, and nursing could be carried out. Thus, in the first Libyan campaign lack of mobility of the CCS militated against prompt treatment of abdominal casualties. In Greece and Crete battle conditions made it very difficult to provide efficient treatment. Both Lieutenant-Colonel Debenham, RAMC, and Major Christie, NZMC, reported that the abdominal cases in Crete did badly and generally ended fatally if the bowel was perforated, and all rectal cases died. In the desert campaigns evacuation over the rough terrain had serious effects on abdominal cases, as did early evacuation by air. In Sicily the continuous and exhausting fighting led to a marked increase in mortality. In Italy at the Sangro battle there were severe weather conditions as well as difficulties of evacuation. During the worst period at Castelfrentano 9 cases died out of 12 abdominal operations. Later in Italy the conditions improved, and with our marked air predominance medical treatment was largely unhampered, giving the abdominal cases a better chance of survival.

It was realised from the beginning of the war that the majority of the deaths occurred soon after wounding or soon after operation, generally within the first forty-eight hours. It was also realised that gross trauma and serious haemorrhage were the main causes of these deaths, and that infection with peritonitis was a secondary or later danger. There were certain lesions with a bad prognosis, and the common association of serious injury elsewhere in the body added markedly to the mortality. Multiple abdominal lesions were naturally more fatal. Large bowel lesions, especially rectal injuries, were more serious than lesions of the small intestine, but resection of the small intestine had a high mortality. Duodenal lesions were generally fatal, as were massive injuries of the liver. Thoraco-abdominal injuries involving a hollowr viscus also had a high mortality. Deaths from ileus were largely prevented by the adoption of continuous gastric suction and intravenous fluid administration, and the giving of blood and plasma, both following operation and about a week later, did much to improve the chances of survival. The use of the sulphonamides and penicillin also contributed, but probably to a much lesser degree.

The commonest cause of death from the second to the tenth day in the forward areas was anuria. Lung complications also occurred. These could be prevented by adopting the normal lying position following operation, and also by the prevention and removal of bronchial mucus and the encouragement of deep breathing and, if necessary, coughing. Peritonitis was noted generally in the late cases.

Anuria developed in the seriously shocked cases which responded slowly to resuscitation.

Eight of the twelve deaths from anuria in our New Zealand series in Italy took place between the fourth and seventh days following operation, and the last two cases were on the tenth day. Conditions noted in these cases were that four patients were extremely shocked; four had a very large quantity of blood in the abdomen; three had faeces and also a fairly large quantity of blood in the abdomen; only one case had been given an extra large transfusion of blood; two had injuries to the main blood vessels of the lower limbs; one had amputation of the thigh; two had large buttock wounds; two were injured by blast, which in itself causes a high mortality; three had multiple abdominal injuries; three had injuries to both the small and large intestines; one had injury to the pancreas, one to the duodenum, and one to the liver and gall bladder.

It is quite evident that in our cases anuria was associated with very severe injury, and anoxia of the kidney following the shunting off of the renal circulation would seem a rational explanation of the damage to the renal tubules which takes place, and which is often associated with casts and albuminuria. To prevent the onset of anuria full resuscitation, both pre- and post-operative, was essential, and the giving of intravenous fluid at the same time to attempt to keep the urinary function active seemed a logical plan. Treatment proved largely unavailing. Various methods were tried to stimulate the kidneys to function, such as 10 per cent glucose or sodium sulphate intravenously, pressor substances, renal lavage and sympathetic block, without result.

There was often noted to be a dangerous weakening about the seventh day, possibly toxaemic in origin. Later septic manifestations showed themselves, and proved the main problem, at the base hospitals.

EVACUATION FROM THE FORWARD OPERATING CENTRES

The conditions experienced during the first two Libyan campaigns rendered evacuation of abdominal cases very difficult. It has already been pointed out that the immobility of the CCS made it necessary to perform abdominal surgery in the Field Ambulances. This still left unsolved the question of evacuation after operation from a unit which was essentially mobile and whose main function was the collection and evacuation of casualties. The terrain added to the difficulties as there was only one good road available and the distances were often great. Evacuation across the roadless desert was very rough and extremely trying for the seriously wounded man. The abdominal cases had to be shifted back shortly after operation to the CCS and then to the base hospitals, and it is not surprising that they did badly. The forward surgeons had at first no accurate knowledge of the progress of these cases after evacuation. It was gradually realised, however, that early evacuation after operation was deleterious, and efforts were made by the forward surgeons to hold the cases for some days. There were difficulties in doing this as no hospital beds and no trained nursing personnel were available in the Field Ambulances. During the second Libyan campaign our Mobile Surgical Unit was able to provide more skilled nursing but, unfortunately, could not function normally.

During the pre- Alamein period conditions had improved markedly and the lines of evacuation were short, but there were difficulties in retaining and nursing the cases in the Field Ambulances. Air evacuation, however, became available for special cases, including the abdomens, and this appeared at first a satisfactory solution of the problem of post-operative management.

It was soon realised, however, that the abdominal cases were dying shortly after arrival in Cairo in spite of the smooth travelling by plane. Major-General Monro, Consultant Surgeon MEF, drew attention to this, and in consequence a conference of senior British and New Zealand medical officers was held at a New Zealand Field Ambulance to discuss the matter.

The decision was reached to hold the abdominal cases at the Forward Operating Centre normally for a period of ten days following operation, and to provide hospital beds and nursing orderlies for the Field Ambulances to enable the cases to be adequately looked after during that period. This decision was immediately implemented and beds and nursing orderlies were sent up with the NZ CCS surgical team to our active MDS. These were the first beds used in the Field Ambulances in the Western Desert. There was an immediate improvement in the results, and whenever possible thereafter abdominal cases were always held at the site of operation if conditions allowed of it. Evacuation by air later was still arranged and ambulance car evacuation utilised as little as possible, especially in the desert.

During the Tunisian campaign the NZ CCS was commonly working alongside British CCSs as part of a Forward Operating Centre. Shortly after the battle of the Wadi Akarit the NZ CCS had orders to go forward, handing over their patients to a British CCS nearby. This necessitated only a very short trip by ambulance car to beds already prepared for the cases, amongst which were several abdomens normally expected to recover. The cases, however, did very badly, some dying a short time after moving, and this so impressed us that an immediate decision was made never to transfer our abdominal cases to any other unit, but to leave behind a section of our CCS to hold and nurse them for the normal period before evacuation.' Patients can be moved miles before operation, but afterwards any movement should be measured in feet.' The British consultants were immediately informed of the unfortunate result of shifting the patients and took steps to prevent a repetition.

During the advance to Tripoli two or more operating units travelled with the New Zealand Division and took it in turns to set up and operate. When they moved off to rejoin the Division, they left a company of a Field Ambulance with trained nursing orderlies to nurse the cases till they were fit to be evacuated. Cases evacuated in the first few days rarely did well and usually developed septic wounds. Captain Douglas noted that in static conditions, with skilled nursing and mental and physical peace and quiet for the patient the mortality was at its lowest. His figures were: cases operated on while the surgical teams were stationary, 23, with 6 deaths; cases operated on while the teams were ambulant, 11, with 5 deaths.

It was recognised also that the cases differed as regards their suitability for evacuation and that the more serious and toxic cases should be kept longer. The general tendency was to lengthen the period in the forward unit.

In Italy attention was drawn by Lieutenant-Colonel Rodgers, RAMC, who carried out an investigation of cases at the base hospitals, to the association of wound sepsis and burst abdominal wounds with intra-peritoneal infection. This led to the retention of cases in the forward areas if any signs of wound infection were present, partly for the prevention of bursting of the wound, but also for the general treatment of abdominal infection.

All surgeons in forward areas, and those at the Base handling the patients after evacuation, were in agreement that the patient who did not run a straightforward course should not be evacuated till any doubt as to his future had been cleared up. Patients dying at the Base all died of sepsis. It was agreed that peritoneal infection was accentuated by movement, and experience at the Base showed this all too clearly. The infected patient had a difficult uphill fight and often just pulled through. Shift him and he died. The number of patients of this type was quite insufficient to clog the Casualty Clearing Station, so there was no real reason to shift them. It was clearly shown that, unless one was perfectly happy about a patient with an abdominal wound, then that patient should be held, even against administrative urging. It was finally determined to retain all abdominal cases in the forward areas till their condition was satisfactory in every way, throwing the full responsibility for recovery on the forward surgeon. Undoubtedly this led to a lowering of mortality at the Base and did not lead to any corresponding increase in the forward areas.

PROBLEMS AT THE BASE HOSPITALS

In a survey of battle casualties at an advanced base hospital (2 NZ General Hospital) in Italy abdominal cases totalled 2·7 per cent of all casualties admitted, the same proportion as major amputations and just more than chest wounds. The abdominal cases, however, accounted for 10 out of a total of 16 deaths in the hospital among battle casualties.

As already stated, the main complications arising in the abdominal cases at the Base were due to infection in one form or another.

Secondary haemorrhage sometimes occurred, mainly associated tvith colostomy wounds. Rarely was it seen in the abdomen, but cases of bleeding from the mesentery were recorded. In one case, at the CCS, fatal haemorrhage took place from a repaired wound of the jejunum. The bleeding came from a very small raw area in the invaginated suture line close to, but not at, the mesenteric border, and seemed to be the result of a small false aneurysm. The patient's condition following other extensive abdominal injuries did not allow of exploration, and blood transfusion did not save him.

In all there were seven recorded cases of secondary haemorrhage, with five deaths, all of which, except the jejunal case, were associated with marked sepsis.

Intestinal obstruction: This was usually a sequel of peritonitis. One case, however, was noted with the development of a volvulus following haemoperitoneum without visceral injury. This pointed to the necessity of evacuating blood from the abdomen during operation. A case was reported of obstruction due to herniation of the small bowel lateral to a left iliac colostomy. There were 9 cases in 2 NZEF in Italy, with 6 deaths. Two of the deaths followed resection of the small intestine.

Case Illustrating Late Obstruction at the Base Soldier wounded 23 October 1942, Battle of Alamein. Operated on at MDS six hours later. Three small holes in descending colon and a large hole in transverse colon found. Splenic flexure mobilised and transverse colon sutured to pelvic colon, and the whole splenic flexure brought out as a colostomy. Drain to pelvis; 10 grammes sulphadiazine introduced; 5 pints of blood during operation. Eight days later passed through 1 NZ CCS, and twenty-six days after wounding admitted to 2 NZ General Hospital with a history of having had a secondary haemorrhage on the tenth day, for which he was given 3 pints of blood. When admitted to 2 NZ General Hospital he was very pale and ill, but the abdominal wound and drain wound had healed; the colostomy was healthy, but there was a pocket of pus lateral to the colostomy. Eleven days after admission to 2 NZ General Hospital he was operated on for acute obstruction, and a loop of small intestine was found to have prolapsed through a foramen formed by the lower limb of the colostomy and the lateral abdominal wall. This was reduced, but his condition did not allow of closure of the foramen. Patient recovered, and later the pus pocket was opened up and a bullet removed from the region of the spine.

Burst Wound: This was always associated with infection, both of the wound and of the peritoneum. It carried a high mortality- 8 deaths in 11 noted cases and 6 of a series of 16 deaths at our base hospitals. Retention of cases in the forward areas and penicillin given parenterally from the beginning appreciably lowered its incidence. Half of the deaths at Base had serious infection of the abdominal wound, associated with peritoneal and generalised infection.

Wound Sepsis: This was found to be much more common if the gunshot wound was utilised for abdominal exploration or for the exteriorisation of the colon. Lieutenant-Colonel J. M. Clarke, NZMC, reported that half the incisions which involved the original wound had severe sepsis afterwards. Abdominal wall abscesses were serious and were often silent. Lieutenant-Colonel L. A. Bennett, NZMC, reported that no case which had a colostomy brought through a separate incision, or in which the retro-peritoneal tissue had been well drained, developed an abscess.

Incisional Hernia: This was relatively frequent and was referred to by many observers. Transverse rectus incisions were found by Colonel Brebner, South African Consultant, to be especially prone to hernia, but so also were rectus split incisions and to some extent also paramedian incisions. The mid-line incision seemed to give less trouble and was utilised much more towards the end of the war.

Peritonitis: This was the commonest cause of death in the base hospitals, as shown in Major Stead's figures, in Lieutenant-Colonel Clarke's report, and in Colonel Stout's review.

In Italy peritonitis accounted for 14 deaths in the 2 NZEF, 9 of them at the Base. It was recorded in Lieutenant-Colonel Clarke's report that all 3 cases of resection of the small bowel died of peritonitis in the base hospital. It was also recorded that out of 11 cases of peritonitis 7 died, and in no case had a drain been used at the original operation. Only eight of 57 cases had been drained. This was a very significant observation and was in keeping with Ogilvie's opinion as to the advisability of drainage.

Recorded Case: Patient with ten holes in small intestine, foreign body removed from the pelvis. Developed haematoma of the wound which became septic and burst. A faecal fistula developed, followed by localised peritoneal abscesses. Death took place on the twentieth day, the patient having been evacuated at a comparatively early stage from the CCS. At the post-mortem gangrenous peritonitis was found.

Gangrene of the Bowel: Two deaths occurred from gangrene following vascular damage. In one case the last six inches of the ileum and two-thirds of the ascending colon were affected, and in the other a portion of the stomach.

Subphrenic abscess, which led to three deaths, caused great difficulty both in diagnosis and treatment. Adequate drainage was established posteriorly and from below by an approach through the bed of, or below, the last rib.

Recorded Case: Operation in twelve hours, extensive blood in the abdomen associated with injury to the liver, no drainage. Developed subphrenic abscess and empyema for which drainage was instituted. Patient died suddenly, probably from cardiac failure associated with the toxaemia. Lack of primary drainage is noted.

Retro-peritoneal abscess: Infection in this region was relatively common, but was generally warded off by free drainage of retro-peritoneal injuries.

Abscess Elsewhere: These were not common but demanded careful handling. Abscesses were opened when the location and access were both quite definite and nothing but simple opening and drainage instituted. Searching and dissection for obscure abscesses in the abdomen was an unsatisfactory and dangerous procedure. Constant alertness had, however, to be exercised in elucidating the explanation of continued illness and pyrexia in all wounded patients, especially with lesion of the abdomen or chest. Ten cases were recorded with four deaths, all associated with very severe injuries.

Recorded Case: Moderate bleeding in the peritoneal cavity; small intestine injury and one large tear in the extra-peritoneal portion of the rectum, which was sutured and drainage instituted through the buttock wound. Abscess of the abdominal wound developed on the tenth day. The patient was evacuated on the eleventh day. He also had a fracture of the femur. Sepsis developed in the buttock wound and in the femur, and he developed a cerebellar abscess, meningitis and broncho-pneumonia. The femur wound was responsible for his evacuation from the CCS on the tenth day so that definitive treatment could be carried out at the base hospital, which was quite close and easily reached over a good road. Even if he had been retained at the CCS recovery could hardly have been hoped for. Patient died in hospital.

Kidney Infection: Serious infection sometimes developed in a damaged kidney, especially when there was an associated wound of the colon. The kidney infection produced rapid deterioration of the patient's condition, often rendering secondary nephrectomy impossible, and it was associated with a high mortality. Primary nephrectomy was therefore generally carried out when there was injury of both kidney and colon.

A man was wounded in the right loin with involvement of the hepatic flexure and the right kidney. Colostomy was performed and the kidney drained. Six weeks later he died from pyelo-nephritis. Primary nephrectomy would have saved him.

Colon Injuries at a Base Hospital

In a series of 39 cases of injury to the colon treated at 3 NZ General Hospital in Italy there were 2 deaths, a mortality of 5 per cent. One of the deaths was an associated injury of the colon and kidney without nephrectomy, and the other a severe injury to the right colon with prolapse of the ileo-caecal valve and an intermuscular abscess.

Anaemia: Secondary anaemia was common in abdominal cases and was frequently associated with sepsis. A marked deterioration often set in about the seventh day, and extra blood and plasma transfusion at that period proved very valuable. At a later period, especially in the infected cases, extra blood was again required. Fresh blood, carefully cross-typed, was necessary at that stage, as severe reactions were not uncommon.

Nutritional Deficiencies: These were quite common following abdominal injuries, no doubt due to the semi-starvation and also to the toxaemia present. Improvement followed the early administration of light nourishment during the latter part of the war. Blood and plasma infusion were also of assistance, as well as a high protein diet and vitamin products. A great deal of importance was placed on these matters at the end of the war. The rapid healing of the wounds was also held to be dependent on proper general nutrition.

Chest Complications: These were relatively uncommon. Nine deaths were recorded. Apart from the obvious septic conditions, lung complications were of little importance, and some cases of oedema of the lung were probably due to anuria. Three cases of pneumonia were recorded.

Repair of Colostomy: In the first half of the war little attempt was made to close the colostomy wounds overseas, and the patients were evacuated to New Zealand to have the repair carried out there.

In the latter part of the war, however, every effort was made to repair the colostomy in Italy before evacuation to New Zealand. This was carried out by pressure clamp on the spur, by operative repair, or by a combination of the two. The repair was carried out in the colon cases as soon as definite stability had been reached. Rectal cases needed a much longer interval to enable the perineal wound to heal. In caecal injuries with drainage by Paul's tube repair was carried out by purse-string suture on the day the tube came out.

Disposal of Cases at the Base Hospitals

The large majority of the abdominal cases were evacuated to New Zealand as no longer fit for active service, and only two out of 57 men at one base hospital were returned to full duty. Our opinion was that it was in general undesirable to retain such men in the forces. Even if they made a satisfactory recovery, a long period of convalescence was desirable, and this was better carried out in New Zealand.

final results

(As reported from the Pensions Department in New Zealand)

It has been ascertained that abdominal injuries generally cause no permanent disability and that comparatively few pensions have been granted for them. There have been very few reports also of serious complications.

STATISTICAL SURVEYS

It was stated by Major Stead, RAMC, in his Italian survey that abdominal operations represented 4·6 per cent of all opefations performed on battle casualties in the forward units, but that half the deaths occurred in the abdominal group.

The results obtained in the treatment of abdominal injuries during the war were undoubtedly satisfactory in comparison with those achieved in previous wars. It was most important, however, to realise the pitfalls of statistics. The results quoted were nearly always the percentage of recovery in cases operated on. It was obvious that this depended on the operation rejection rate and also on the number of cases reaching the operation centre. If operation was carried out at the Field Ambulance, cases were dealt with which would possibly not have survived to reach the CCS. The cases dying before operation or not operated on were not generally included in the figures. The follow-up of cases evacuated from the forward areas was always difficult, and it was probable that some deaths were missed at that stage. It was also necessary to cover a long period and a large number of cases as freak results were sometimes obtained in a small series. There were several surveys made during the war, and results are set out in the following table:

mortality rates following operation reported in surveys. north africa and italy

Period	Reported by	Number of Cases	Percentage Mortality	Remarks
abdominal—				
End 1941	Surg Conf MEF	25	60	
	SurgConfMEF	33	65	
Late 1942	Giblin, AAMC	90	58	Before exteriorisation.
Late 1942	Giblin, AAMC	90	38	After exteriorisation.
1942–43	Harrison, NZMC	36	36	No rejected cases.
Mid 1943	Ogilvie, RAMC	628	39.2	
1942–43	NZ cases in Ogilvie series	96	29	
Late 1943	Lowdon, RAMC	64	44	

1943–44	Douglas, NZMC	125	36	
Early 1944	Button, NZMC	50	22	
1944–45	Stout, NZMC	227	35.7	
1944–45	Stead, RAMC	560	45.4	
thoraco-abdominal—				
1944	From Normandy	292	51	
1944–45	Blackburn, RAMC	126	36.5	
1944–45	Stead, RAMC	78	60	Laparotomy,79percent; thoracotomy, 35 percent.
1944–45	Stout, NZMC	54	42.6	

Major A. W. Douglas, NZMC, who was a forward surgeon with the Field Surgical Unit, has reported a series of 125 abdominal cases operated on from February 1943 to August 1944 in North Africa and Italy. The after-history was assiduously followed up except in a few prisoner-of-war, South African, and Canadian casualties. Every case operated on has been included, and every death, no matter what the cause, one case dying from a head injury. Three or four of the cases were laparotomies without intra-peritoneal injuries and one of these cases died. From the records it was not possible to separate abdomino-thoracic from purely abdominal injuries. There were more injuries of the large than the small intestine, and also a lower mortality in the colon cases. Douglas remarks,' The better figures for North Africa are probably partly the luck of the game and partly due to passing on good risks to the CCS when working with the MDS in Italy'. The mortality in the series is 36 per cent, which is the same as the mortality in the survey of New Zealand abdominal casualties in Italy.

	Tunisia	Italy	Total
Number of cases	28	97	125
Survived	21	59	80
Died	7	38	45
Mortality (per cent)	25 per cent	39 per cent	36 per cent

A complete survey of abdominal injuries in 2 NZEF in Italy was carried out at the end of the war. There was a total of 364 abdominal casualties, of which 73 (20 per cent) were thoraco-abdominal—44 of the 73 were included in a survey of chest cases with available details less complete. Altogether there were 183 recoveries (50·3 per cent). There were 281 operations performed with 177 recoveries (63 per cent).

In the abdominal cases there were 227 operations with 146 recoveries (64·3 per cent). In the thoraco-abdominal cases there were 54 operations with 31 recoveries (57·4 per cent).

Of the total of the two groups 59 died without operation before reaching the CCS, including 34 casualties brought in dead to medical units. Only 11 cases reaching the CCS alive died without operation (3·6 per cent), and seven of the cases were not admitted to our own CCS. A further 10 cases were not operated on at the CCS but recovered.

Results in the Main Group

There were 317 cases with a death rate of 50 per cent, covering cases brought in dead to field units and cases dying in the field units but not operated on. Of patients admitted alive to a CCS 96·3 per cent were operated on, and of those admitted alive to any unit, including the ADS, 89·6 per cent were operated on. The mortality in cases operated on was 39 per cent, which included all deaths at the Base. The marked fluctuation in results in small series is shown by a mortality of 15 per cent in one month and 41 per cent in another.

The percentage of deaths in all cases recorded at different stages and the gradings of those surviving is shown in the following chart:

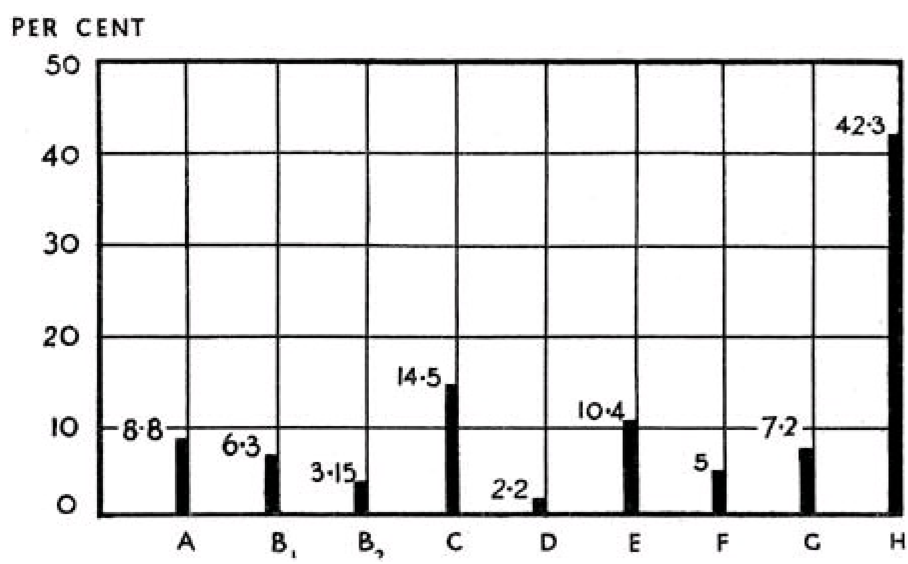

Chart I: Record of cases showing percentage of deaths at different stages and gradings of those who survived

A = dead (BID); B1 = died in field ambulance (no operation); B2 = died in casualty clearing station (no operation); C = died in twenty-four hours; D = died in forty-eight hours; E = died later in forward areas; F = died at Base; G = alive, graded A–D; H = alive, graded E (evacuated to NZ).

There were in all 28 casualties brought in dead to medical units. Of the 20 deaths in field units of wounded who had had no operation performed, one occurred at the RAP, nine at an ADS, and ten at MDSs.

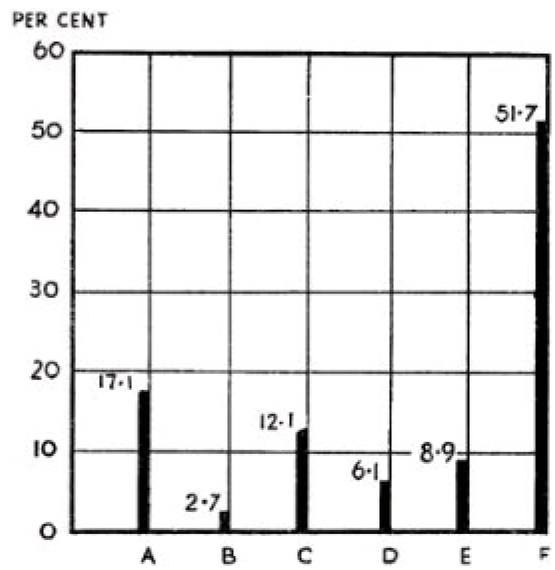

Chart II: All cases in which operation was performed. Showing percentage of patients dying at different stages and grading of those alive

A = died in twenty-four hours; B = died in forty-eight hours; C = died later in forward areas; D = died at Base; E = alive, graded A–D; F = alive, graded E.

Nearly half of the post-operative deaths (46 out of 102) occurred in the first twenty-four hours, with a further 7 deaths in the next twenty-four hours. These deaths, it will be agreed, were due to the severity of the trauma, first from the wound and then from the operation. Of the 33 deaths which occurred later in the forward areas, anuria was the most common cause, accounting for one-third. Chest complications, peritonitis, and obstruction accounted for 11 deaths. Infection in some form was responsible for half the deaths.

At the Base all the 16 deaths were due to some form of infection. There were no deaths at Base during the last eight months of the period. This might be attributed to the early parenteral administration of penicillin and to the holding of serious cases longer in the forward areas. The surviving patients generally remained in hospital in Italy for some months pending evacuation by hospital ship to New Zealand. The only patients requiring further treatment in New Zealand were a few who still had an open colostomy. Only 8 surviving patients were not subjected to an abdominal exploration, either direct or through the chest, the majority having liver injuries with retained foreign bodies

[In Major Stead's review the causes of death were given as:

(a) Within twenty-four hours (55 per cent)—shock and haemorrhage.
(b) From two to ten days (33 per cent)—renal insufficiency then lung conditions and peritonitis,
(c) Later (12 per cent)—commonest condition was peritonitis, and all deaths were due to some type of sepsis.

Ileus was reported to be rare.]

The time after operation when death occurred is shown in Chart III.

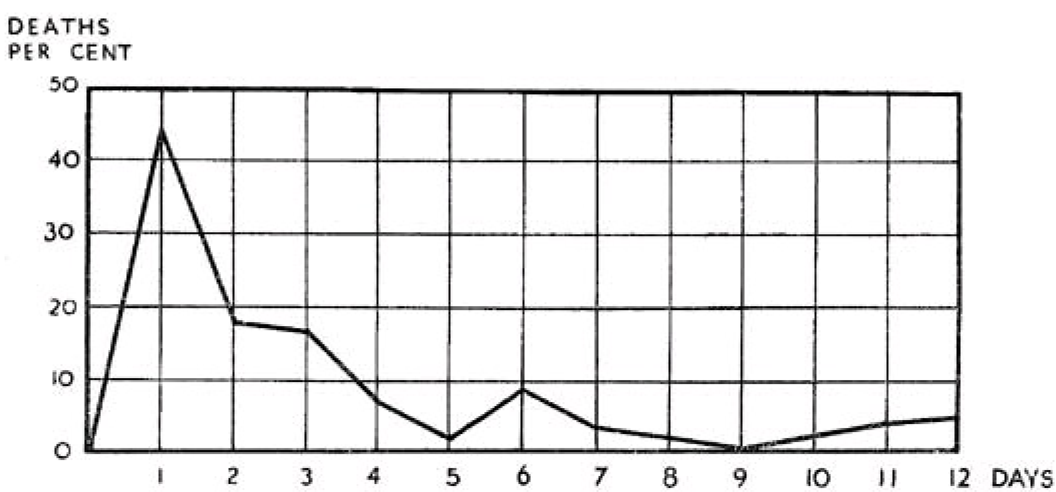

Chart III: Showing period between operation and death

The association of other injuries was of great importance. It was reported by one surgeon' that no recovery of an abdominal wound had been seen in the presence of a fracture of the femur or a traumatic amputation. Cases of survival are, however, reported in our series. Multiple abdominal injuries also were associated with a high mortality. Severe general injuries included in the series were 9 fractured femurs, 9 amputations, 7 severe head injuries, and 9 severe spinal injuries. At least 9 of this list died without operation.

Thirty of the cases remained in a very bad condition at every stage, and possibly all these cases could have been left without operation and this would have improved the operative mortality considerably; but, as already mentioned, our routine was to operate on every case fit to be put on the table, and occasionally our faith was justified, but the figures naturally were not improved. The deletion of these 30 cases from operation would have improved the operative mortality from 39 per cent to 311·4 per cent. It was noted that 28 patients at no time showed the least signs of recovery following operation, 5 dying on the table and 2 as soon as they reached the ward. It might be inferred that operative trauma was responsible for the failure in these cases. This was disproved, however, by an evaluation of the severity of the original trauma in the cases that died, checked in the great majority of the cases by postmortem examination. It was ascertained from the case records in which the data were available that the original injury sustained in the cases that died was hopeless in 23 cases, very severe in 21, severe in 23, and there are only 2 other cases. What this does signify is that the large majority of these cases are inevitable deaths, and that in these very severe cases operation must entail the minimal trauma. This is of special significance when one considers such procedures as the freeing of the fixed colon and the type of operation to be undertaken in the late cases. A third of the deaths were associated with severe injuries to other parts of the body.

The average time lapse before operation was worked out in regard to the ultimate results. When death occurred within twenty-four hours of operation this time interval was 6·4 hours, and when death occurred later in the forward areas it was 7·25 hours. Of those who recovered but were invalided to New Zealand, the interval was 6·0 hours, while with those who recovered but did not require invaliding the period was 6·5 hours. It would appear that the average time it took to evacuate abdominal injuries to the operating centre during the Italian campaign was six and a half hours. The interval between the receipt of the wound and the actual surgical operation was 10·4 hours, both in the group of cases that died and in the group that recovered.

SPECIAL FACTORS

Blood in the Abdomen: In the series of 102 patients who died following operation, 33 had a large quantity of blood in the abdomen and 18 had a moderate quantity. The amount in all cases was sufficient for special mention to be made of it in the notes. The total percentage was 50, so that half the deaths were associated with at least a moderate amount of blood in the abdomen. The records of these cases demonstrated clearly that the prognosis is bad when there is much blood in the abdomen. (This is associated with severe injuries to kidney, liver, and, less commonly, spleen, as well as with damage to the large vessels and especially to the mesenteric arteries.)

Of the 123 patients who survived, only 7 had a record of excessive blood and 16 of moderate bleeding.

Faeces: The presence of faeces was noted in 10 cases, and all the patients died.

Bile: The presence of bile was noted in 4 cases, and all the patients died. The bile was associated with severe damage to liver or ducts.

thoraco-abdominals

The mortality in these cases was noted by most observers to be high, but with the utilisation of the thoracic approach there followed a great improvement.

Major Stead reported an overall mortality of 68 per cent. Of 19 cases with sucking wounds 17 had laparotomy and only 2 survived, a mortality of 79 per cent. Of seven cases treated solely by thora-cotomy the mortality was only 35 per cent. Major Blackburn reported a mortality of 36·5 per cent in a series at the end of the war.

In the New Zealand series in Italy (which included a further 44 cases not recorded in the main abdominal survey, and in which there were 21 deaths and 23 recoveries) the mortality was 49·4 per cent. This covers all cases admitted alive or dead to a medical unit, including the Field Ambulances. Of the total of 73 cases, 54 were operated on, and of these 31 (57·4 per cent) recovered.

Operations	Number of Cases	Recoveries	Per Cent
Thoracotomy	23	19	82.6
Laparotomy	22	9	41
Thoracotomy and laparotomy	9	3	33
No operation	19	6	31.6
	73	37	50.6

Of the 13 cases which died from thoraco-abdominal injuries without operation, 11 died in the first twenty-four hours, and about half these were brought in dead to the Field Ambulances. The 73 thoraco-abdominal injuries represented 20 per cent of the total of 364 abdominal casualties.

The heavy mortality in the thoraco-abdominal cases is partly explained by the severity of the injuries, which were recorded as follows: severe abdominal injuries (unspecified), 4; severe liver injuries, 10; lesser liver injuries, 9 (6 lived); kidney injury with nephrectomy, 2; splenectomy, 11 (7 lived); suture of spleen, 1 (lived); small intestine injury, 4 (all lived); colon injury, 7 (5 lived); stomach injury, 3 (2 lived); gall bladder, 1 (lived).

Other associated injuries recorded were: fracture of femur, 2; brain injury with hemiplegia, 1; severe retro-peritoneal bleeding, 2; severe mutilating face injury causing death, 1.

RESULTS OF TREATMENT

RESULTS OF TREATMENT

The results of treatment of different abdominal organs in the New Zealand series of 364 cases in Italy have been analysed. The multiplicity of the lesions in the abdomen and also the association of wounds elsewhere in the body make it very difficult to classify the cases and evaluate the results. It is impossible to do more than give the main features of the lesions. These are shown in the accompanying tables:

Table I: Frequency of Injury to Separate Organs, Either Single or Combined with other Injuries

Organ	Number of Cases	Number of Deaths	Percentage Mortality
Small intestine	106	50	47.1
Large intestine	98	48	48.9
Liver	65	30	46.1
Kidney	26	16	611.4
Stomach	24	12	50
Spleen	23	10	43.5
Rectum	13	6	46.1
Bladder	12	6	50
Gall-bladder	3	1	33.3
Pancreas	4	4	100
Duodenum	5	3	60
Mesentery	17	10	58.8

The following results recorded by Major Douglas, NZMC, in his series of 125 abdominal cases are very similar except for the lower mortality in the colon cases:

Organ Involved	Cases	Died	Mortality Percentage
Spleen	18	8	44
Liver	26	10	38
Kidney	13	8	61
Stomach	15	9	60
Small intestine	49	23	47

Large intestine	51	21	41
Bladder	4	1	25

Table II: Injuries of Single Organs With or Without Extra-abdominal Injuries

Organ	Number of Cases	Number of Deaths	Percentage Mortality
Small intestine	36	10	28
Large intestine	27	8	29.6
Liver	23	11	48
Spleen	8	2	25
Kidney	7	2	28.5
Rectum	4	1	25
Stomach	4	0	0

Table III: Injuries of More than One Abdominal Organ

Organ	Number of Cases	Number of Deaths	Percentage Mortality
Small intestine and colon	34	15	44.1
Small intestine and rectum	3	1	33.3
Small intestine and bladder	3	2	66.6
Small intestine and liver	3	1	33.3
Small intestine, liver and kidney	1	1	100
Colon and kidney	2	2	100
Colon and liver	3	3	100
Colon and spleen	1	0	0
Stomach and liver	2	0	0
Stomach and colon	2	0	0
Stomach and spleen	1	1	100
Liver and kidney	4	3	75
Rectum and bladder	1	1	100
Duodenum and pancreas	1	1	100
Duodenum and small intestine	1	1	100
Rectum and prostate	1	1	100
More than two organs	11	5	45.4

Table IV: Injuries not Involving a Viscus1 [1]

Type of Injury	Number of Cases	Number of Deaths	Percentage Mortality

No viscus injury but some pathology	12	0	0
Liver injury with retained foreign body but no laparotomy	7	0	0
No intra-abdominal injury	8	1	11
Total	27	1	3.7

In the one case death was due to severe multiple injuries, including a compound fracture of the tibia and fibula, for which an amputation at the thigh was performed, and compound fracture of the radius and ulna, penetrating wounds of leg, arms, neck, and penis were also present. The patient was badly shocked and died of uraemia and anuria on the sixth day.

It is satisfactory that none other of the 27 patients died, especially as figures quoted at the Rome conference gave a much more gloomy picture (28·8 per cent mortality). It is also satisfactory to note that in only 9 cases was no intra-peritoneal lesion of any kind found, in spite of the fact that only 3 per cent of patients with abdominal injuries were not operated on at the Casualty Clearing Station level, and all but 3 patients in our New Zealand units were operated on.

Foreign Bodies in the Peritoneal Cavity: In 42 of the cases the foreign body was removed at the primary operation, and of these cases 10 died. Foreign bodies were removed in 2 subsequent operations.

Type of Missile Causing Abdominal Injury

In the New Zealand patients in Italy the number wounded by the different missiles and the mortality rates were as follows:

1. Bullets caused 63 casualties with mortality of 36 per cent.
2. Shell and mortar caused 215 casualties with mortality of 37 per cent.
3. Mines, grenades, and booby trap and bomb wounds caused 29 casualties,

    Mortality in mine wounds was 71 per cent.

    Mortality in grenade wounds was 57 per cent.

    Mortality in bomb wounds was 43 per cent.

    One booby trap casualty died.

4. Bayonet wound, 1 casualty and no death.

In the Western Desert our figures were:

1. Shell wounds, 59 casualties; mortality, 22 per cent.
2. Bomb and bullet wounds, 18 casualties; mortality, 33 per cent.
3. Mine wounds, 16 casualties; mortality, 44 per cent.

Mine wounds are shown to be extremely serious cases, and there was little difference between the mortality rates from shell and bullet wounds.

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[1] Including cases with liver injuries with retained foreign bodies, and cases of retro-peritoneal haemorrhage, and also of blood in the peritoneal cavity.

ABDOMINAL WOUNDS 3 NZ DIVISION, SOLOMON ISLANDS

ABDOMINAL WOUNDS 3 NZ DIVISION, SOLOMON ISLANDS

The close nature of the jungle warfare and the predominance of rifle bullet and grenade wounds resulted in very few abdominal casualties surviving to reach the Field Ambulance dressing station. The forward units recorded only 5 abdominal cases, 2 of them being Japanese prisoners, and all but one dying at the MDS. Only 2 of the cases were definitely recorded as New Zealand casualties. There were only some three hundred New Zealanders killed and wounded in the campaign. Treatment of the abdominal cases followed the lines adopted in the Middle East.

PENSIONS SURVEY

In December 1952 Dr D. Macdonald "Wilson in a review found that only 170 ex-servicemen in whom the peritoneal cavity had been entered by a missile had applied for a war pension. The files of 150 of these cases were examined. The cases had not been a great source of invalidity since their return to New Zealand. Only three men had not returned to full work, but these suffered from multiple wounds among which the abdominal condition was not the chief source of invalidity. The men were occupied in various trades, professions, clerical and heavy manual work.

After return to New Zealand several men underwent repair operations for ventral herniae, but in only two cases had adhesions with obstruction caused major disabilities requiring operative interference. One case resulted from an accidental bomb wound in New Zealand and was associated with a torn gall-bladder and subsequent subphrenic abscess.

A number had no pensionable disability, but most had been granted pensions for a 20 per cent to 30 per cent disability, while a few were assessed at a higher rate for symptoms and associated ventral herniae. The main disabilities were flatulent dyspepsias with constipation or alternate constipation and diarrhoea

SUMMARY OF IMPORTANT ASPECTS OF THE TREATMENT OF ABDOMINAL INJURIES — STATISTICS (NEW ZEALAND FIGURES IN ITALY)

SUMMARY OF IMPORTANT ASPECTS OF THE TREATMENT OF ABDOMINAL INJURIES

1. Necessity for rapid evacuation, with minimal stops, to the Forward Operating Centre.
2. Resuscitation, if necessary, at the ADS, continued as an in-ambulance drip transfusion, but full resuscitation only just before operation.
3. Operation preferably carried out at the CCS level.
4. Operate without delay but only when optimum resuscitation by blood, plasma, and serum has been achieved.
5. Urgent operation without full resuscitation is called for in continued intra-abdominal haemorrhage, traumatic amputation, and severe muscle injuries.
6. Utilisation of an experienced senior surgeon for the diagnosis and listing of cases.
7. Auscultation of the abdomen to eliminate possibility of intestinal injury and so save laparotomy.
8. Use of the X-ray especially to localise foreign bodies in cases of diaphragmatic and retro-peritoneal injury, with a view to saving laparotomy.
9. Routine catheterisation for diagnosis of urological injuries.
10. Careful investigation with rectal examination for possible abdominal injury in wounds of the pelvis and buttocks.
11. Provision of a suction apparatus.
12. Provision of electric lighting-generally by mobile plants.
13. Operation undertaken when the systolic B.P. reached 100 mm. Hg. and is rising. (80 mm. is the minimum level of operatability.)
14. The necessity for highly trained anaesthetists and best available apparatus for these cases.
15. The ample provision of young, well-trained surgeons in Mobile Field Surgical Units for attachment to forward operating units.
16. Laparotomy preferably by a mid-line incision. Loin incisions for localised and renal injuries.
17. Orderly examination of the abdominal organs.
18. Simple, generally one layer, suture, of small intestine injuries. Resection avoided

if at all possible.

19. Exteriorisation of all severe lesions of the colon through a separate small incision.
20. Suture of small simple wounds of the right colon. Drainage by Paul's tube, with early secondary closure, of more severe lesions.
21. Proximal colostomy for lower sigmoid and all rectal injuries.
22. Free perineal drainage for lower rectal wounds.
23. Formation of spur for colostomy with care to prevent injury to the mesentery by the clamp during later closure.
24. Conservative treatment of lesser liver and kidney injuries, the large majority of the cases.
25. Nephrectomy when a wound of the colon complicates an open renal injury.
26. Conservative treatment of the late abdomen.
27. Drainage instituted when in doubt, and definitely for wounds of the colon, pancreas, duodenum, biliary passages, bladder, and retro-peritoneal injuries.
28. Thoraco-abdominal exploration, unless the intestine is involved, preferably through the chest.
29. Resuscitation just as necessary after operation as before operation.
30. Gastric suction instituted till peristalsis definitely reestablished.
31. Intravenous fluid given freely, 8 to 10 pints daily, after operation to combat dehydration and prevent the onset of anuria.
32. Water given by mouth early and light nourishment, when possible, after forty-eight hours.
33. Patient nursed in horizontal position following operation.
34. Post-operative administration of plasma and later of high protein and vitamin diet.
35. Administration of penicillin parenterally in all cases and also local application to the peritoneum and the wound.
36. Evacuation from the forward operating centre to be delayed (especially in cases of wound sepsis) till full stability has been reached. Responsibility of survival placed on the forward surgeon.
37. Closure of colostomy wounds as soon as possible.
38. Conservative treatment of late sepsis with drainage of established abscesses.
39. Burst wound always associated with infection of the wound and also of the peritoneum.
40. Provision of body armour to protect the abdomen and chest is recommended.

Statistics (New Zealand figures in Italy)

1. The mortality covering all cases was 50 per cent.
2. The mortality covering abdominal cases operated on was 36 per cent.
3. The mortality covering thoraco-abdominal cases operated on was 42·6 per cent.
4. Cases operated on at CCS level, 96 per cent.

Abdominal Injuries
Battle Casualties Invalided to NZ
from 2 NZEF Total cases 196

injury to—	
Small intestine	56
Colon	62
Stomach	12
Duodenum	3
Rectum	10
Bladder	10
Liver	39
Kidney	5
Anal canal	1
Urethra	2
Spleen	16
Gall bladder	3
Bowel	3
Other	4
Penetrating abdomen	16
Penetrating abdominal wall	11
Two hollow visci	31
Thoraco-abdominals	33
Hollow and solid visci	11
Two solid visci	4
More than two organs	12
Colostomy	52
Colostomy (probable)	14
Colostomy and cystostomy	3
Colostomy, double	1
Cystostomy, suprapubic	1
Cystostomy, suprapubic (prob)	5
	76

complications—	
Burst abdomen	2
Nephrectomy	2
Haematoma, extra-peritoneal	2
Ventral hernia	1
Faecal fistula	1
Abscess, intra-peritoneal	1
Abscess, retro-peritoneal	2
Abscess, retro-pleural	1
Abscess, subphrenic	1
accidental injuries invalided to nz—	
Laceration liver	1
Rupture spleen	1
Stricture rectum	1
Rupture bladder	2

Admissions to 2 NZEF Hospitals, July 1941—July 1945	
Penetrating abdomen	282
Penetrating abdomen with lesion of—	
Liver	57
Spleen	21
Kidney	28
Bowel	85
Bladder	14
Colon	69
Stomach	39
Perforating abdomen	73
Abdominal wall	133
Contusions, etc., of abdomen	41

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CHAPTER 12 — FRACTURES

Contents

FIRST WORLD WAR

THE treatment of fractures during the First World War underwent considerable development as regards both wound treatment and splintage. The development of wound treatment of fractures is naturally just part of general wound treatment, which has been already described in another chapter.

The only special aspect is the treatment of the actual bone itself. It was the custom to remove any loose portion of bone, which would naturally be without blood supply, and in the presence of infection would become a sequestrum. Sequestration was common, and till the dead bone was satisfactorily removed final healing could not take place. In the treatment of chronic bone infection, and after the removal of sequestrae, BIPP paste was often used. The removal of all loose bone, often too rigorously carried out, led to many severe cases of non-union. Secondary suture of wounds complicated by fractures was not often undertaken, but it was done in cases of late removal of sequestrae.

The association of joint injury and subsequent infection led to serious toxaemia, and amputation was often found necessary. Dependent spreading abscesses in the back of the thigh were frequently encountered, and drainage was resorted to freely in these cases and for any gross infection. Long-continued infection was common in the first part of the war, but during the last year of the war the picture became much more cheerful, and in the majority of cases sepsis was well controlled by the Carrel-Dakin treatment, toxaemia was uncommon, and the wounds healed much more quickly.

At the beginning of the First World War splinting was so unsatisfactory that the majority of men with fracture of the femur died. The splints used were archaic and provided no proper stability to the limb. Long Liston splints were generally applied to fractures of the femur. When the Thomas splint was introduced the whole picture changed, and the mortality in cases of fracture of the femur fell dramatically from 70 to 30 per cent. The splint was thereafter used as a routine for all fractures of the long bones of the lower limb, and also for all injuries of the knee joint. Attachments were made, such as the iron foot-piece, to allow suspension of the foot and support for the splint, and an extra movable leg-piece to permit movement at the knee joint. Special wooden foot-pieces for glueing to the soles of the feet were used as a means of extension and accurate fixation of the position of the foot. Extension was obtained by glue bandage, by strapping to the limb, or else by the foot-piece described. Rubber slings were made out of the inner tubes of tires and fixed by strong bulldog clips to the sides of the splint.

The Thomas splints were suspended by cord to Balkan beams, and special fracture wards had framework put up to fulfil the same function. Fixed extension was usual, the foot of the bed being raised, but weight extension was also used.

Fractures of the leg were treated in the same way, the glued foot-piece being more often used for extension. Injuries of the knee joint were also treated in the Thomas splint with some extension. Hip-joint cases were treated in Balkan frames.

In the upper limb the straight-arm Thomas was used for severe cases, with extension to the end of the splints, also slung up by cords. A Jones splint, bent at a right angle at the elbow, was used for fractures of the lower part of the humerus, the elbow, and the forearm. Abduction splints were utilised as an ambulatory splint for fractures of the shoulder and humerus, as well as for muscular and nerve injuries.

The Carrel-Dakin treatment, with the constantly soaked dressings and frequent changes required, was facilitated by the use of the Thomas splint with its narrow iron bars. The utilisation of cords and pulleys enabled the patient to move in bed, and made nursing much less onerous. The results obtained towards the end of the war were generally excellent as regards length and alignment of the limbs and healing of the wounds.

There remained the question of sequestration and chronic osteomyelitis and the stiffness and wasting of the limb. Stiffness in the joints of the limbs after prolonged treatment and fixation was frequently seen, especially in the earlier years of the war. Much attention was directed to the functional rehabilitation of the limb in the later stages of the war, and physiotherapeutic treatment was assiduously applied, as was re-education of muscular and joint movements. Sir Robert Jones made a great contribution to the treatment of these injuries, and Sinclair, in France in his special unit, made important contributions to the treatment of leg fractures, and demonstrated what excellent results could be obtained. It was Sinclair who introduced the method of extension by glue and the wooden foot-piece.

The French surgeons utilised free drainage of fracture and joint injuries by means of rubber tubes, and carried out rigid plaster immobilisation for long periods.

The improvements carried out in the war persisted into the peace, and army methods were used in civilian work. For the treatment of chronic osteomyelitis the Winnett Orr technique began to be used with success.

Winnett Orr described his treatment as embodying early reduction, rigid immobilisation, drainage, rest, and absence of dressings. His technique consisted of reduction of the fracture on a traction table; débridement, followed by swabbing the wound with iodine in alcohol; packing of the wound with vaselined gauze from the depths to the periphery, with dry dressings on top; putting the limb in a plaster cast incorporating a traction pin; no dressings for four to eight weeks; and changing the plaster on the operating table with full aseptic precautions when the odour became unbearable.

He maintained that no plaster cast caused constriction if properly applied, and that frequent dressings caused infection. With adequate surgery, complete rest, and no dressings the patient's own defences were usually adequate. He reported a series of 268 compound fractures, of which 259 had healed. There were three deaths but 90 per cent good results. The technique depended on a fracture table being available. The good results can be ascribed to the complete rest and to the prevention of cross infection.

SPANISH WAR

Spanish War

During the Spanish War the Winnett Orr treatment was applied to recent war injuries and was attended with such success that it became the standard form of treatment for all fractures as well as for all large gunshot wounds. Trueta described the technique and gave very optimistic reports of its success. He carried out debridement of the wound, left the wound freely open, applied vaselined gauze, and then enclosed the limb, including the joints above and below the site of the fracture, in a closed plaster. The plaster was changed only for cleanliness, for altering the position of the fracture, or when complications arose. There was marked saving in dressings and nursing attention. In the majority of cases no serious infection or toxaemia arose, and the wounds slowly healed under the plaster.

SECOND WORLD WAR

In the early part of the war the Trueta closed plaster method was used for fractures of the arm and leg, and the Thomas splint for fracture of the thigh. During the first Libyan campaign great difficulties arose with regard to the forward treatment, and especially the evacuation of fracture casualties. Transport in ambulances across the roadless desert caused great suffering to the fractured femur cases, and extension and fixation in the Thomas splint was not satisfactory. Colonel Monro, Consultant Surgeon MEF, suggested the utilisation of plaster in conjunction with the Thomas splint and this was done by the Australian and British units at Tobruk, whence long evacuation by road and desert was at first necessary. They applied an enclosed plaster splint from the toes to the groin and then over the plaster applied a Thomas splint to the limb, the original Tobruk splint. This splint, either in its original or else in modified form, soon became established as a routine for the forward treatment of fractured femurs and remained so throughout the war. The use of extension produced difficulty during transportation till it was realised that only sufficient extension should be applied to fix the limb, and that anything more was neither desirable nor practicable, and merely produced overriding of the ring over the tuber ischii.

The arm fractures were splinted in the forward areas with Kramer splinting and, after operation, with closed plaster splints. Abduction plasters were generally unsuitable in the forward areas. Difficulty arose during transport unless the patient could travel in a sitting position, and this led to the utilisation of plaster bandages to fix the splinted arm to the chest, which gave greater but not perfect comfort.

Unpadded plasters, especially for leg fractures, were found to endanger the circulation of the limbs owing to swelling during evacuation. Padded plasters were then used, and they were also split before the patient was evacuated to another unit.

The closed plaster treatment was continued at the Base, except when treatment of infection delayed healing and called for the utilisation of the Thomas or other splints. Abduction splints were used for shoulder cases. The femur cases were treated in a Thomas, or sometimes a Braun splint, with extension by means of Steinmann pins through the crest of the tibia. Weight extension was usually employed, and regulated by measurement and X-rays.

Plates and screws were used in British orthopaedic centres in Italy, but these proved unsatisfactory in compound fractures, though of use in certain types of simple fracture, especially of the radius and tibia. Stress was laid on the restoration of the functional activity of the limb more and more as the war continued. The usefulness of the hand was held to be the main aim of treatment in any injury to the arm, and the preservation of movement at the knee, and in the foot and ankle, was also of great importance in the lower limb.

Patients with fractures of the femur, hip, and pelvis were held in the base hospitals overseas until union had taken place, but all other fractures were evacuated to New Zealand whenever a hospital ship was available. The retention of these cases followed serious trouble resulting from the too early evacuation by hospital ship of patients wounded during the second Libyan campaign. Some of the patients in plaster spicas or Thomas splints were badly upset by the journey from Cairo to Suez, and others developed plaster sores. No further patients of this type were evacuated to New Zealand till their condition had become quite stabilised and infection had subsided. There was no further difficulty of this kind throughout the war.

WOUND TREATMENT

Wound Treatment

The treatment of gunshot wounds associated with fractures of the long bones consisted essentially in the treatment of the wound, followed by the application of splints to ensure union of the bone in as near perfect length and alignment as possible. In the treatment of the wound the aim was the promotion of rapid healing without infection. This treatment depended on the character of the wound. If the wound consisted of a small puncture of the skin or two small punctures of a perforating wound, and there was no marked swelling of the limb, no operative treatment was required unless some complication was present or a large foreign body was definitely located. These cases, especially in the Desert period, generally healed without any difficulty. When there was any marked swelling, however, exploration was undertaken and the wound dealt with in the same way as an open wound. In the case of the open wound, operation was essential and wound excision undertaken so as to remove all devitalised tissue, especially muscle, as was done in the ordinary flesh wound. In dealing with fractures, very free exposure was essential to open up all nooks and crannies in the depth of the wound and also to relieve all possible tension. For this purpose transverse incision of the deep fascia was often carried out in addition to the usual longitudinal incisions. In perforating wounds the excision had to be carried out in respect of both wounds. In large wounds in the early period of the war extra incisions for dependent drainage were frequently made.

The main bone ends and fragments were generally moulded into satisfactory position. Foreign bodies were removed when found during the wound treatment or sometimes sought for when localised by prior X-ray examination.

The general treatment of the wound was similar to that of the ordinary flesh wound. The closed plaster treatment with local and parenteral sulphonamide, the latter given as a course of six grammes daily for six or seven days, was, at first carried out, and was undoubtedly of value, providing rest and preventing cross infection. Signs and symptoms of infection necessitated inspection of the wound, with change of plaster and dressing. From the end of 1943 penicillin gradually replaced the sulphonamides, both locally and parenterally. Unsuccessful attempts at primary suture were followed by the performance of delayed primary suture in suitable cases, with large doses of parenteral pencillin both before and after suture. Three-hourly injections were given for five days (a total of 500,000 units) for fractures of the upper extremity and a seven to ten-day course of 700,000–1,000,000 units for those of the lower limb.

In Italy in 1944 delayed primary suture of fractures of the femur, with a gap left for drainage, was tried at 3 NZ General Hospital shortly after the patient's admission, and dressings were left unchanged for three weeks. Parenteral penicillin was given following suture. Finally, in 1945, complete suture, if possible, was carried out twenty-four hours after arrival at the Base, parenteral penicillin having been given regularly in the forward areas, and a full course given afterwards. In a considerable proportion of cases tension prevented complete suture, and partial suture alone was possible, but closure of the deeper part of the wound was aimed at. In other cases when infection was present drainage was necessary, parenteral penicillin being given as a routine in all cases.

Delayed primary suture of arm fractures was carried out even before penicillin became available. During the Cassino battle period one of the New Zealand padres was admitted to 2 NZ General Hospital at Caserta with a severe comminuted fracture of the humerus. The wound was healthy, and it was decided to carry out suture shortly after arrival. Complete success was obtained and, as a result, closure of all similar cases was undertaken, at first without penicillin, utilising sulphathiazole-proflavine locally in some cases.

During the last year of the war in Italy delayed primary suture of all suitable fracture cases was carried out as a routine except when contra-indications such as established sepsis were present, penicillin being given in full dosage.

Secondary repair of wounds by suture or by skin grafting was carried out as soon as practicable, to prevent cross infection and to allow of rapid restoration of function. The closure of the deep part of the wound, ensuring cover for any exposed bone, was infinitely more important than the closure of the skin.

In the latter stages of the war flaps were often fashioned and fixed over any exposed part of bone to preserve the vitality of the bone, the surface of which would otherwise flake off as a sequestrum. A change was made in the dressings used later in the war, and plain gauze was substituted for vaseline gauze. The surgeons were of the opinion that this led to a healthier wound when exposed to delayed primary suture, and also facilitated drainage.

TREATMENT OF INFECTION

Treatment of Infection

When infection developed, the treatment in the early period consisted in the provision of adequate dependent and other drainage, and at first the parenteral administration of sulphonamides. The sulphonamides in general were not successful in the treatment of gross infection but were of use in streptococcal cases. Local injection of the wound with antiseptics of different kinds was then utilised and the Carrel-Dakin treatment reintroduced, using electrolytic hypochlorite and new antiseptics such as 5 Ammo-Acridine-HCL.

The difficulty of controlling infection at that period is illustrated by a visit to a British hospital in July 1943, when a ward full of late cases of fracture of the femur was inspected. The hospital had a very efficient and active staff, and the condition of the patient was not due to any neglect of treatment, but to the inability of treatment at that time to cope adequately with infection in many cases. The condition of these patients created an unforgettable impression. They were usually thin and very anaemic. The wounds were very septic, and the smell of pus pervaded the ward. There were many cases of non-union. Various methods were being utilised in these cases to clear up the infection, including the use of electrolytic hypochlorites given by the Carrel-Dakin method. Fixation in plaster with free drainage was also used, combined with local applications to the wound through a window cut in the plaster.

The introduction of penicillin brought about great improvement, especially in the treatment of established gram-positive infection. Local treatment by injection was utilised, but parenteral administration was of more value and in particular brought about a marked improvement in the general condition of the patient. There was a marked lessening in the incidence of toxic symptoms following its use. The penicillin-resistant gram-negative organisms, though often producing marked local signs of infection, produced little general reaction and generally interfered little with wound healing. Pyocyaneus infection, which was common and often persistent, was treated by the local application of 2 per cent acetic acid.

Blood transfusion was of great value in the later stages when anaemia was always well marked. A high protein diet with vitamins was also given.

BONE FRAGMENTS

Bone Fragments

In the First World War any unattached piece of bone was removed as it was held that this would inevitably die and form a sequestrum and act as a focus of infection till it was removed. As already mentioned, the removal of larger fragments undoubtedly led to many cases of non-union, especially in the humerus and tibia. The removal of loose bone was recommended at the beginning of the Second World War until it was realised that there was grave danger of non-union resulting. The improvement in wound healing brought about by skilful surgery and the use of sulphonamides, and later of penicillin, made it possible that separated bone fragments might have a chance of survival. When delayed primary suture became a routine procedure and the wounds remained free from infection, the preservation of the bony fragments became the usual, and finally the regular, procedure. At that time bone chips were being utilised for the treatment of non-union, and it seemed anomalous to remove loose bone in fractures if bone chips could be introduced later and live. The success which attended the preservation of the loose fragments must as a rule have ensured solid union of the fractures. The preservation of bone fragments at the shoulder and at the elbow was strongly advocated, as stability in those positions was held to be preferable to the flail condition that might arise from removal of bone. The only bone then often requiring removal was the fractured or dislocated head of the radius:

NON-UNION

Non-union

The occurrence of non-union in war fractures was not uncommon, as could be expected both from the frequent loss of bone and from the often long-continued osteomyelitis. Non-union became less common with the better treatment and more rapid healing of fracture wounds.

With the introduction of penicillin and its damping effect on infection, operative treatment for non-union could be attempted with success at an earlier period, and before the bone at the site of non-union had become sclerosed and its ability to regenerate lessened. The utilisation of cancellous bone chips in the repair of non-union of the jaw led to the use of similar methods in the long bones, but as stability was of great importance during the repair, a combination of a long fixing graft and cancellous bone chips was generally used. The great advantage of using cancellous bone was realised, the denser bone acting almost solely as a temporary splint. Screws were commonly used for fixation of the main graft, though sometimes wedging was employed. The cancellous bone was generally taken from the crest of the ilium. It was recognised that the taking of a large graft from the tibia was prone to weaken the bone seriously, and subsequent fracture was not uncommon in these cases.

Non-union commonly occurred in the humerus, the radius, the ulna, and the tibia. The war has given us fresh knowledge and better means of dealing with the condition.

LATE OPERATIONS

Late Operations

It was noted that there was an excess of scar and fibrous tissue present in cases treated by the Trueta plaster method early in the war in comparison with cases treated in the latter part of the war by penicillin and delayed primary suture. It was more difficult to carry out reconstructive operations in cases treated by the Trueta method.

TREATMENT OF INDIVIDUAL FRACTURES

Fracture of the Humerus

Plaster was generally used for the splinting of fractures of the humerus in the forward areas, and at the Base. Kramer wire was frequently used in the forward areas as a temporary splint till operation was performed. The most common method of application of plaster, the U splint, was by means of a slab starting on top of the shoulder and carried down on the outer aspect of the arm to the elbow, then round to the inner aspect of the arm to the lower border of the axilla. This was moulded to the arm and then fixed by circular plaster bandages. A pad was placed in the axilla and then the arm was fixed to the chest by circular plaster bandages around the arm and the body, also supporting the forearm but leaving the hand free. At first there was no plaster round the body and the forearm was held up by a sling. This did not give enough stability during evacuation, and the fixation to the chest materially improved the comfort of the patient. Better fixation was obtained by an abduction arm spica, but this was impossible to apply properly at the original operation, and, if markedly abducted, created difficulties during transit in an ambulance. If the abduction plaster was applied the day after operation, with the patient sitting up, a satisfactory plaster could be put on. Abduction was, however, only of particular value in fractures at or near the shoulder joint, especially when joint fixation was feared, and the simple U plaster, slightly abducted, was generally more practicable. For fractures at the lower end of the humerus a slab was usually carried along the forearm to the wrist, the elbow being fixed at a right angle, with the forearm in mid position. At the Base, plaster was generally continued and abduction plasters were more commonly employed. With the development of delayed primary suture, these fractures gave very little trouble.

In England there were two schools in regard to treatment, the one utilising plaster splint and fixation till union took place, the other using only the simplest form of splinting with a sling and encouraging free and early movement. It was held that movement encouraged union and preserved and encouraged function. Both schools agreed that early and free movement of the wrist and hand was to be encouraged.

Fractures of the Radius and Ulna

These were treated in plaster splints in the mid position of pronation and supination, the arm being in a sling and the hand free for movement. In simple fracture early excision of a dislocated head of the radius was practised if replacement was not possible. Plating of simple fracture of the radius was also carried out frequently at the end of the war.

Fracture at the Hip

The treatment of these fractures was very difficult under war conditions, especially when there were extensive wounds in the buttock region, a not uncommon complication. A plaster spica was the only method of obtaining fixation and stability, but there were many difficulties associated with it.

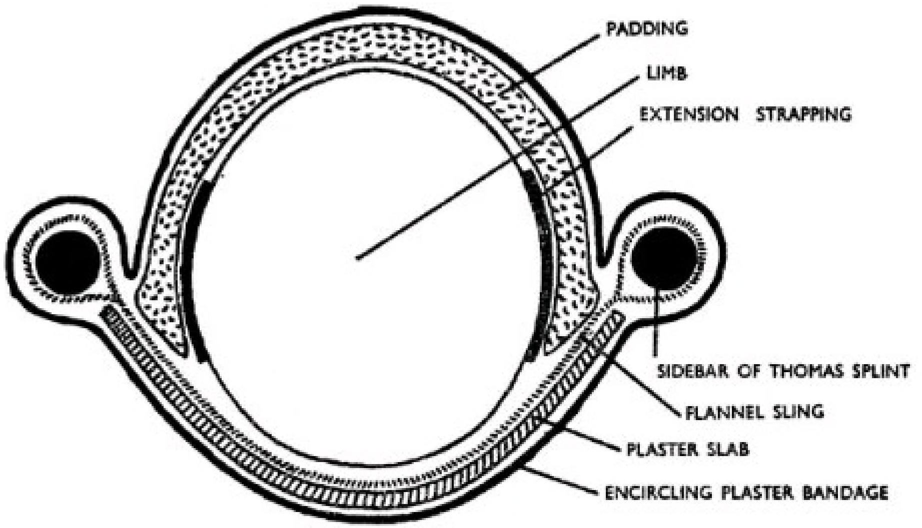
In the forward areas it was difficult to apply without the help of a special orthopaedic table. An unsatisfactory spica contributed to the discomfort often experienced during transportation, and to the common development of plaster sores. Careful padding and the use of felt round the pelvis helped a good deal, but the presence of wounds under the plaster added to the difficulties. These cases were shifted as little as possible, and the New Zealand cases were retained overseas till full stability was reached. Sepsis was a very serious complication, and involvement of the hip joint always meant a dangerous illness. Penicillin was given to these patients from the beginning, as soon as supplies permitted, and continued till the fear of sepsis was over. It was also of great value in the treatment of established infection. Good drainage of the hip joint was established by chiselling the great trochanter from the femur.

Fracture of the Femur

At the beginning of the war the Thomas splint was used with the usual slings and extension. In the field the limb was often placed in the splint without removal of clothes or boots, and extension applied by a clove hitch over the boot or by a clip into the heel of the boot.

If any marked extension was applied this was found to cause sores across the dorsum of the foot. This was relieved by loosening the laces and placing a pad under the tongue of the boot, but it was soon realised that at that level all that was required was sufficient extension to steady the limb in the splint and then no injury would be caused. If time and conditions allowed, the boot was removed and elastoplast extension applied to the leg after it had been shaved.

At the forward operating centre careful wound excision was carried out, with free incision to relieve tension and transverse division of the fascia if necessary, and the usual application of sulphanilamide and dressings with vaseline gauze inserted in the wound to keep the wound open. Then the Thomas splint was applied with elastoplast extension to the limb and the ring well padded at the outer aspect to fit the limb, as normally the Thomas splint had rings much too large for proper fixation. The usual foot-piece and stretcher bars were adjusted and the 1914–18 technique completed. The desert, however, provided special difficulties, and evacuation over its rough surfaces was a trying ordeal for the patient in the ordinary Thomas splint. Plaster was then suggested as an addition to provide more stability, and this led to the development of what was called the Tobruk splint. The original Tobruk splint consisted of the application of a plaster splint for the limb from the upper part of the thigh to the toes, extension having been applied to the limb beforehand. The limb in plaster was then put into a Thomas splint. The extension was fixed to the end of the splint, and then circular plaster bandages were used round the splint and limb to fix the plastered limb securely in the splint and a pad put on the outer aspect of the ring. By this means there was very adequate stability and the patients travelled with greatly increased comfort over the desert. Instead of the complete plaster splint round the limb, which necessitated some disturbance and time, simpler methods were tried. At first the limb was fixed in a Thomas splint in the usual manner and then circular plaster bandages passed round the splint and limb as extra fixation. These bandages were apt to cut into the thigh above the knee, and the leg below the knee, and if the extension became loose there was little fixation.



CROSS-SECTION OF LIMB IN TOBRUK SPLINT, NEW ZEALAND PATTERN

CROSS-SECTION OF LIMB IN TOBRUK SPLINT, NEW ZEALAND PATTERN

Then a posterior slab was used beneath the slings from the ring to the ankle, and then circular plaster applied after padding firmly between the limb and the splint, all along the front of the limb, with thick padding of wool or gamgee, also placing rings of felt round the ankle and a pad inside the ring. After the circular plaster bandages were applied the full length of the limb to the ankle, the plaster was moulded round the bars of the splint and between the limb and splint so as to provide adequate fixation. Care was taken to apply only sufficient extension to stabilise the limb in satisfactory position. Real extension caused the ring to ride over the tuber ischii during transit, with the occasional production of sores. The Thomas splint was slightly bent at the knee and the usual foot-pieces attached. This was the method used by our New Zealand forward surgeons throughout the war, and it proved very satisfactory as well as being easily and rapidly applied. [1]

At the Base the Thomas splint was still utilised for treatment, with slight flexion at the knee. Weight extension was generally used, but fixed extension was also employed. The extension was obtained by Steinmann pins and sometimes by Kirschner wire inserted into the upper end of the tibia. The weight employed was calculated at two to two and a half pounds per stone body weight for four to six weeks, but generally the weight was adjusted according to the measured length of the limb and the X-ray. A weight of 15 lb. was generally satisfactory after the initial stage.

The Braun splint was also used by some surgeons, especially for supracondylar fractures, but the great majority of surgeons preferred the Thomas splint for all cases, bending it more when treating supracondylar cases.

Fractures of both femora were treated by two Thomas splints, sometimes joined together at the rings. Treatment by a double plaster spica for fractures below the level of the trochanter had the serious disadvantage of allowing the development of both angulation and shortening.

Fractures of the Patella

Fractures of the patella were of special importance because of the danger of infection in the knee joint and of the stiffness that was apt to develop in the joint following the prolonged fixation that was necessary for the healing of the fracture. If the fracture were simple in nature the danger was slight, but if severe comminution was present the danger was real. Forward surgeons treated the fractures of the patella conservatively at first but later excised the patella in any severe fracture, bringing the capsule together laterally. This facilitated early movement and resulted in surprisingly little disturbance to the knee.

Fractures of the Leg

The closed plaster treatment was employed from the beginning of the war, the plaster extending well up the thigh and enclosing the foot except the toes. The plaster was extended beyond the toes along the sole as a protection, but on the dorsum the toes were left quite free so that toe movements were permitted, and these were strongly encouraged.

With wound excision and vaseline gauze dressings there was normally no replacement of dressings till called for by the softening or serious fouling of the plaster or by complications such as serious infection. At first non-padded plasters were used, but it was found that this often led to danger of interference with the circulation of the limb. Transport caused increase of swelling and in the change of medical units detection was necessarily difficult. Padded plasters were then used and also split as an extra safeguard before the patient was evacuated. The splitting was facilitated by the introduction of a long vaselined rubber tube along the front of the leg, outside the padding, before the application of the plaster. The tube was then removed, leaving a raised arch along which the plaster could be rapidly cut up later. This remained the routine treatment throughout the war. At the Base, at first, healing was allowed to take place under the plaster. In many cases, however, it was found that the wound became unhealthy and healing was sluggish. Packing under the plaster had been noticed to dam up secretion. Windows were then left in the plasters and local applications of antiseptics made, or Thomas and Braun splints used, to allow of more satisfactory local treatment. Skin grafting was often undertaken when the wound became healthy. Closed plaster treatment was still used for the majority of the cases of fracture of the leg unassociated with definite infection, and in these cases gave satisfactory results. When penicillin became freely available, delayed primary suture was carried out when possible and parenteral penicillin utilised. There was difficulty, however, in suturing the leg wounds because of tension and frequently the skin could not be approximated. Bristow pointed out that a foot fixed in varus was a disaster and that the ankle must be splinted at a right angle.

Fracture of the Os Calcis

Severe injuries to the foot were very commonly seen as the result of mine injuries, either sustained in a vehicle or on the ground. These injuries were often so severe that amputation was inevitable, but lesser injuries were present, often not associated with an open wound. Fracture of the os calcis was common, the heel being split off and drawn up by the tendo Achilles, or else the bone split and spread out laterally. The first step in the treatment of these injuries was manipulation to bring the heel down, or moulding the fractured bone together laterally. Kirschner wires and pins were inserted into the heel to pull it down into position, and plaster was utilised to fix it in the improved position. It was found very difficult to get much improvement, and the fixation in plaster tended to delay the return of functional activity. As regards fixation, this occurred to excess in any case. So frequent were the disappointments resulting from attempts to get improved position that primary correction alone was attempted, and no splint used. Free movement was encouraged so as to preserve the functional activity of the foot and ankle, but weight bearing was delayed till stability was obtained. Much improved results were then obtained and surprisingly good function eventually was obtained in seriously damaged feet. Astragalectomy was sometimes carried out at the earlier period in an attempt to get better position, but this was later given up and condemned by the senior orthopaedic surgeons. The good functional results obtained, often in spite of misshapen feet, justified the preservation of the foot in the forward areas in many of the severe mine injuries. The conservative attitude triumphed in this as in many other directions.

Fracture of the Carpal Scaphoid

Fractures of the carpal scaphoid frequently occurred during the war and gave rise to considerable difficulty, both as regards treatment and disposal. Pre-enlistment fractures often led to disability during service; their treatment was unsatisfactory and the patients were generally graded down for work at the Base or sent back to New Zealand. Arrangements were made quite early in the war for the treatment and control of all these cases to be put under the charge of the orthopaedic surgeons, both whilst in hospital and also as out-patients.

The fracture was caused by falling on the hand, most commonly at football, and by backfiring when starting up motor engines. The early symptoms were generally not severe, and often the possibility of fracture was quite overlooked and the diagnosis made of slight sprain. Local tenderness could be located over the scaphoid.

Immediate X-ray very often disclosed no sign of fracture, which would only show up three or more weeks later. It was therefore imperative that any patient suspected of having a fracture should be treated by immobilisation for three weeks on suspicion till a further X-ray was taken. A true sprain of the wrist rarely occurred, and this made the investigation of possible fracture all the more necessary.

It was found essential to apply plaster splints as soon as the diagnosis of a recent fracture was made, and to continue the splint for a minimum period of three months, and frequently longer. It was necessary to rigidly control the wrist joint and the metacarpo-phalangeal joints by extending the plaster half-way along the first phalanx. The period of immobilisation was determined by X-ray examination.

In cases diagnosed and treated shortly after the original injury the results of immobilisation were satisfactory, though many cases required very prolonged fixation. In later cases the results were not as good, though immobilisation was persisted in for long periods. The treatment of pre-war long-standing cases was still more difficult, though immobilisation following the possible further injury on service was sometimes successful if active bone was present. In some cases treatment involved drilling of the bone, in others bone grafting, and, in some cases, removal of the proximal fragment or the whole of the scaphoid. The results were not satisfactory in the large majority of the cases. Ankylosis of the wrist was at times done when serious arthritis was present, associated with marked pain.

From the army standpoint operation was not justified by the results, and grading or discharge from the army was preferred. Conservative treatment; owing to its prolonged nature, also led to marked interference with military service and led to down-grading for varying periods. It was very difficult to evaluate the degree of disability in these cases. Many cases were seen with long-standing non-union but with function unimpaired even when the man had been employed in hard manual work. In only about a third of the cases was the diagnosis made within a month of injury. Arthritis was present in a proportion of the cases, but serious arthritic changes were uncommon. It was difficult to exclude the psychological element, and difficult to ignore symptoms if X-rays disclosed an un-united fracture; but there could be little doubt that in a very large number of the cases the disability was very slight, and was either not present or ignored by many men with well-marked fracture. The results of later treatment were given by Dr D. Macdonald Wilson in a survey of Pensions cases in 1949. He considered that the best results were undoubtedly obtained when union had occurred. In 56 cases with union 41 had no disability, and only 2 had as much as 25 per cent. In 73 cases with nonunion and no further treatment, only 11 had no disability, the majority having a disability of 20 to 25 per cent and 9 of 30 per cent or more. There were 15 cases which had had excision of proximal fragments, the average disability being 20 per cent and 2 with no disability. Seventeen cases had had total excision and in 7 there was no disability and in 5, 25 per cent. Four cases with arthrodesis had a 30 per cent disability.

These results give a more optimistic outlook on the cases operated on than was formed during the war, especially in the cases of total excision of the scaphoid. The cases associated with arthritis had no higher degree of disability than those without arthritis, which seems to show that in the greater number of these cases the degree of arthritis is slight, and maybe depends largely on radiological appearances of little moment functionally.

Early and prolonged treatment of recent fracture was established as the best treatment, and grading down or discharge from the army proved necessary in the great majority of the cases, either of old or recent fractures.

Organisation

In the 2 NZEF arrangements were made from the beginning to attach a qualified orthopaedic surgeon to each of the three base hospitals. These were available to take charge of the treatment of the more serious and important fractures, to advise general surgeons on orthopaedic problems, and to run an out-patients department for orthopaedic cases when conditions made this desirable. The supply of orthopaedic surgeons from New Zealand was, however, not sufficient to allow of replacements for those evacuated to New Zealand because of sickness, or for those promoted to executive positions in medical units, and in Italy orthopaedic surgeons were not available for each of the hospitals.

There were no full orthopaedic units or centres such as were set up by the RAMC, but there were all the essentials in the matter of staff and equipment, including physiotherapeutists, vocational training staff, and nursing sisters trained in the work.

In the forward areas all the fracture work was carried out by general surgeons-some with experience of orthopaedic work. There was no rigid classification of the cases to be placed under the control of the orthopaedic surgeons, but in effect all cases necessitating specialised treatment, such as fractured femurs, came under their charge. As regards civil cases, the semilunar cartilage operations were all undertaken by the orthopaedic surgeons. The segregation of the orthopaedic cases by the RAMC into orthopaedic centres attached to a few of the base hospitals worked efficiently, and allowed large numbers of patients to be treated with the minimum of specialised staff. It meant more administrative planning in the evacuation of patients and more difficulty in the treatment of the orthopaedic cases still remaining in those base hospitals without an orthopaedic surgeon on the staff.

A surgeon with some orthopaedic experience was attached to the staff of the HS

Maunganuz. (In New Zealand the fracture cases were sent to the four main hospitals where orthopaedic surgeons and departments were available.)

Summary

By the end of the war in Europe there was a wonderful improvement in the treatment of war fractures compared with the treatment given at the beginning of the Second World War. There was only 4′6 per cent mortality in 2364 cases of fracture of the femur in the North-West European campaign.

This improvement can be ascribed to the increasing knowledge and experience of the war surgeons, as the surgical treatment of these cases remained the cardinal factor and, if we read surgical history aright, will always do so. The adequate surgical cleansing of the wound with removal of all devitalised tissue, the prevention of wound contamination, and the complete suturing of the wound by delayed primary suture about the fourth day, proved remarkably successful. The provision of adequate fixation and rest by means of the application of splints, plaster or otherwise, was a valuable aid.

With regard to splintage, plaster retained its place as a comfortable and efficient means of primary splinting and for transport. Its incorporation with the Thomas splint made an excellent method of transporting fractured femurs. The splinting of hip-joint cases remained a great difficulty and the plaster spica, although in many ways undesirable, remained the most satisfactory method both for transport and for hospital treatment.

With regard to the arm fractures, what we may call the partly abducted arm plaster was generally employed for fracture of the shoulder and humerus.

For transport the binding of the splinted arm to the trunk by means of plaster bandaging was the best technique devised but was still not quite satisfactory. At the Base treatment varied from the ordinary abduction plaster to much more simple splinting combined with free movement.

For the forearm simple plaster splints were generally used.

The Thomas splint remained superior in the treatment of fracture of the femur and for knee-joint injuries. Braun splints were sometimes used for supracondylar fractures. The Steinmann pin continued to be the popular method of extension, which was carried out either by weight or fixed extension. Padded plaster splints, split before transportation, remained the routine treatment of fractures of the leg, and proved very suitable when delayed primary suture was carried out. In septic cases the Thomas splint was often employed as in the First World War. The cardinal end-result desired in the upper limbs was functional use of the hand, and every effort was concentrated on that. As far as the lower limb was concerned stability was all-important, the limb's primary function being to support the body both at rest and in locomotion.

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[1] A full description is given in the appendix to this chapter.

Appendix

APPLICATION OF TOBRUK SPLINT

Technique for application of Tobruk splint (New Zealand pattern) for transportation of fractured femurs and gunshot wounds of knee:

1. When the operation is completed shave the leg, apply a felt or gamgee collar round the malleoli and the heel, and traction elastoplast up to as near the wound as possible.
2. Apply a Thomas splint, bent 10 degrees at the knee, with 4–inch flannel slings to support the limb, a firm pad of appropriate size inside the outer part of the ring, and ample gamgee and wool in front of and at the sides of the limb.
3. Fix the extension to the end of the splint and insert a rod of wood or other material to act as a windlass.
4. Apply a plaster slab from the back of the ring behind the slings to three inches above the ankle. Then encircle the splint and limb with plaster bandages covering the same area and incorporating the ring pad. Then squeeze the plaster bandage round the bars to provide a grip.
5. The foot is supported in mid position by a foot-piece, padded both on the dorsum and the sole, and fixed with plaster bandage at right angles. The plaster is carried on the flat forward beyond the toes on the sole, but the dorsum is left free for toe movement.
6. The lower end of the Thomas splint is firmly fixed to the suspension bar and the bar to the stretcher.
7. In fractures of the upper third of the femur a second suspension bar at the level of the ring, to which the ring should be fixed, is advisable.

STATISTICS OF CASES INVALIDED TO NEW ZEALAND

It has been possible to analyse the records of patients invalided to New Zealand from 2 NZEF MEF and CMF, and to produce statistics showing the type and location of fractures, the associated injuries, the complications, the date of medical boarding, and the missile responsible for the wound.

Type and Location of Fractures in Battle Casualties: The involvement of the contiguous joints is seen to be common, 20 per cent of the fractured femur cases having involvement of the knee joint, but only 4 per cent having involvement of the hip. In fractures of the tibia 12 per cent had knee-joint involvement, while in fractures of the humerus 26 per cent had elbow-joint involvement.

Associated Injuries: Injuries to the main nerves are seen to be common and are of particular importance in regard to the eventual function of the limb. They are more common in arm injuries, the musculo-spiral nerve being affected in 20 per cent of fractured humerus cases, and the sciatic nerve in 8 per cent of the fractured femur cases. Vascular injuries were not so frequent but were of considerable importance.

Complications: These were fortunately relatively uncommon, only three cases of purulent arthritis of the knee being recorded in the group of fractured femur cases, 61 of which had involvement of the knee joint. Serious after-effects such as malunion and non-union were sometimes seen in returned prisoners of war.

Date of Boarding: This gives a good idea of the severity and number of casualties sustained in the different years of the war. They show the largest numbers in 1944. The figures for 1941 do not show the prisoners of war, many of whom were not boarded until their release in 1945.

Missile causing Injury: The figures show clearly the marked predominance of shell injuries in all the groups. Rifle and machine-gun bullets caused many wounds of the femur, humerus, and forearm. Mine wounds caused a large proportion of the fractures of the legs and feet. A high incidence of accidental injuries is shown, especially in the latter part of the war.

Admission to Hospitals: The figures show clearly, as one would expect, that practically all the men sustaining major fractures were invalided back to New Zealand.

Fractured Femurs Invalided FROM 2 NZEF

	Group A (BCs)	Goup B (BCs)	Group C (AIs) Compound	Simple	Totals
Shaft	142	52	9	13	216
Involving hip	12			1	13
Involving knee	61		4	1	66

Incomplete	21	7			28
Simple	2				2
Both femora			1		1
	236	61	29		326

Particulars Referring TO THE 236 Cases In Group A

associated injuries same leg—

Fracture tibia involving knee	4
Fracture tibia	2
Fracture fibula	1
Fracture patella	2
Fracture tibia, fibula, and patella	3
Fracture tibia and fibula	1
Fracture tibia and patella	1
Injury ext popliteal nerve	7
Injury femoral vein	1
Injury post-tibial artery	1
Arterial haematoma	1
Arterio-venous aneurysm femoral	1
Arterio-venous aneurysm popliteal	2
Injury sciatic nerve	12

complications-

Purulent arthritis hip	3
Purulent arthritis knee	3
Secondary haemorrhage	1
Osteomyelitis (PW)	1
Osteitis	1
Anuria (transfusion)	1
Fibrous ankylosis knee (PW)	1
Shortening (PW)	1
Deformity	1

date of boarding—

	Group A.	Group C
PW	12	
1941	8 (PW)	
1942	60	7

1943	45	3
1944	79	10
1945	40	9
?PW	5	

missiles causing—

Shell	99
Gunshot	47
Mortar	23
Machine-gun	21
Mine	14
Bomb	14
Rifle	7
Other	6

Fractured Tibias and Fibulas Invalided from 2 NZEF

	Group A (BCs)	Group B (BCs)	Compound	Group C (AIs) Simple	Undefined	Totals
tibia and fibula—						
Shaft	72	24	38	41	18	193
Both legs	2			13	3	6
Simple	7	4				11
Involving knee	6	4		2		12
Involving ankle	10	2	1	1		14
	97	34	105			236
tibia—						
Shaft	90	48	8	18	4	168
Both legs	3					3
Incomplete	10					10
Simple	8	2				10
Involving knee	25		3	10		38
Involving ankle	18		2	4		24
	154	50	49			253
fibula—						
Shaft	56	26	7	12		101
Incomplete	1					1

Involving ankle	5				5
Simple		2			2
Fibula and os calcis				1	1
	62	28	20		110
Totals	313	112	174		599

associated injuries—	Group A (313)	Group C (174)
Ant tibial artery and vein	3	
Ant tibial artery	4	
Post tibial vessels	8	1
Popliteal artery and vein	2	
Gas gangrene		1
Post tibial nerve	11	1
Ant tibial nerve	1	
Peroneal nerve	13	2
Musculo cutaneous nerve	1	
Fracture tarsus	8	
Fracture patella	2	3
Fracture ankle	1	
complications—		
Amputation (late), below knee	1	
Suppurative arthritis, ankle	1	
Arthritis, ankle	1	
Bony ankylosis, ankle	1	
Mai-union (PW)	1	
missiles causing—		
Shell	138	
Mine	49	
Gunshot	31	
Mortar	27	
Machine-gun	16	
Grenade	3	
Other	12	

date of medical boarding—	Group A	Group C
PW	16	

1941 (PW)	9	
1942	82	16
1943	54	18
1944	120	49
1945	40	55
1946		5
?PW	7	

Admissions to Hospital, 19411–45

	Compound	Simple
Fract tibia and fibula	166	20
Fract tibia	220	23
Fract fibula	115	8

Fractured Humeri Invalided from 2 NZEF

	Group A.(BCs)	Group B(BCs)	Group C(AIs)	Totals
Shaft	101	66	25	192
Involving shoulder	44			44
Involving elbow	64	15		79
Both humeri	2		1	3
Simple fracture	5			5
	216	81	26	323

Particulars referring to Group A (216 cases)

ASSOCIATED FRACTURES SAME ARM-	
Scapula	16
Clavicle and scapula	2
Radius and ulna	14
Radius	7
Ulna	11
Simple radius and ulna	1
Disorganisation shoulder	3
ASSOCIATED NERVE INJURIES—	
Musculo-spiral	43
Musculo-spiral and ulnar	1
Musculo-spiral and ulnar and median	2
Musculo-spiral and median	2
Posterior interosseous	3

Median and ulnar	2
Median	7
Circumflex	1
Brachial plexus	1
Ulnar	14
Ligature brachial artery	1
Ligature brachial artery and vein	1
Ligature axillary artery	1
COMPLICATIONS-	
Purulent arthritis shoulder	2
Causalgia median	1
Ankylosis elbow (PW)	3
Ankylosis shoulder (PW)	1
Osteomyelitishumerus(PW)	1
MISSILES CAUSING-	
Shell	109
Gunshot	43
Machine-gun	19
Bomb	1
Mortar	10
Mine	7
Grenade	3
Rifle	3
Other	7
DATE OF MEDICAL BOARDING-	
PW	8
1941	5
1942	62
1943	27
1944	92
1945	23
? PW	3

Admissions to Hospital, 1941–45	
Comp fract humerus	282
Simp fract humerus	18

Fractured Forearms Invalided from 2 NZEF

Group A	Group B	Group C

	(BCs) Compound	Simple	(BCs) Compound	Simple	(AIs) Compound	Simple	Totals
Radius	61	2	26	2		11	102
Ulna	65	1	53	1		7	127
Radius and ulna	38	1	16	1	4	20	80
Involving elbow	18		5		2	3	28
Involving dislocation	1					1	2
	187		104		48		339

	Group A
associated injuries—	(187 cases)
Involving wrist	18
Ulnar nerve	22
Median nerve	11
Musculo-spiral nerve	12
Post-interosseous nerve	9
Median and ulnar nerves	3
Ulnar and radial nerves	1
Radial artery	3
Ulnar artery	2
Brachial artery	1
complications—	
Excision head radius	1
Osteomyelitis radius	1
Non-union ulna (PW)	3
Non-union radius (PW)	1
Osteomyelitis ulna (PW)	1
Bony ankylosis elbow (PW)	1
missiles causing—	
Shell	72
Gunshot	31
Gunshot mult.	5
Machine-gun	19
Mortar	16
Rifle	5
Bomb	4
Mine	4

Grenade	3
Other	3

date of medical boarding—

	Group A	Group C
PW	14	
1941 (PW)	6	
1942	39	10
1943	22	11
1944	63	21
1945	27	39
1946		2
? PW	8	

Admissions to Hospital, 1941–45

Comp fracture radius and ulna	310
Simp fracture radius and ulna	17

Fractured Feet Invalided from 2 NZEF

	Group A (BCs) Compound	Simple	Group B (BCs) Compound	Simple
Tarsus	38	2	24	
Tarsus and metatarsals	11			
Metatarsus	63	1	11	
Both tarsi	1	1		
Os caicis	13	11	11	
Os caicis double	3			
Involving ankle	8			
	152		46	

missiles causing—	Group A
Shell	47
Gunshot	23
Mine	29
Machine-gun	12
Bomb	13
Mortar	8
Grenade	3
Other	4

date of medical boarding—	
1942	42
1943	35
1944	45
1945	11

Admissions to Hospital, 1941–45

	Compound	Simple
Fracture os caicis	61	21
Fracture tarsus	83	8
Fracture metatarsus	135	14

Fractured Jaws Invalided from 2 NZEF

	Group A (BCs)		Group C (BCs)		Group C (AIs)	
	Compound	Simple	Compound	Simple	Compound	Simple
Mandible	35	1	19		8	5
Maxilla	12	1	8		5	1
	49		27		19	

missiles causing—	Group A
Shell	16
Gunshot	13
Mine	5
Mortar	5
Rifle	3
Other	5
date of medical boarding—	
PW	4
1941	5
1942	8
1943	13
1944	11
1945	7

Admissions to Hospital, 1941–45

Fracture mandible	73
Fracture maxilla	46
Fracture malar	15

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CHAPTER 13 — AMPUTATIONS

Contents

WAR SURGERY AND MEDICINE

[SECTION]

IN war surgery amputations have always been an important feature. In past centuries the performance of amputations was a relatively easy and crude surgical procedure which could be carried out rapidly and with few instruments. In the absence of anaesthesia speed was essential, and it is on record that famous surgeons in the past prided themselves on the extreme rapidity of their work. The large amputation knives were designed to cut straight through all the tissues to the bone irrespective of anatomy, and with a large saw the limb was soon lopped off. The tourniquet would also deaden the pain as well as stop bleeding. Circular methods of amputation were naturally suitable for this type of procedure, and they became standardised. The indications for the removal of the limb were many and were mainly preventive in character, and no doubt many lives were saved, at the expense of the limb, by the removal of dead and severely traumatised tissue, and by the prevention of severe infection.

FIRST WORLD WAR

First World War

It can be realised how important amputation must have been in the past when at the beginning of the First World War practically all patients with fracture of the femur died. It must have seemed reasonable at that time to amputate many of these cases. The frequency of gas gangrene in France made it necessary to carry out rigorous and ruthless excision of muscle and also led to the performance of many amputations, especially of the lower limbs.

Free drainage was essential following operation, and with the introduction of the Carrel-Dakin treatment continuous irrigation of the stumps was carried out.

The simplest form of amputation that would preserve the maximum amount of healthy limb was undertaken, and the circular type of amputation, with the wound left wide open, was therefore done. The nerves were generally pulled "down and cut very short and at the same time crushed and tied, and often alcohol was injected into the end of the nerve. This was done to prevent the development of neuromata in the stump. The fibula was cut across one inch higher than the tibia, and the crest of the tibia rounded off. At first the muscles were often sutured over the ends of the bone, but this was later given up as it tended to make the stumps clumsy, and in any case the muscle atrophied later.

Often in traumatic amputations the limb was simply cut across and the bone trimmed. This led to the term' guillotine amputations', a most unfortunate term, as it has ever since led to misunderstanding. The ordinary amputation undertaken in the 1914–18 War was not a guillotine amputation, but a circular amputation with the muscle and bone cut across at progressively higher levels. If no traction was applied to the skin, there would be inevitable retraction of the soft tissues and the end of the bone would protrude beyond them. A ring sequestrum would then form at the end of the bone, and there would be slow healing by granulation and scar, with the end of the scar fixed to the bone. This sequence has led to the extreme unpopularity of circular amputation in a wide circle of surgeons, and the name guillotine is just as popular with them as it was with the Royalists at the French Revolution.

The circular amputation, however, as normally carried out, and with efficient skin extension from the beginning, did function very satisfactorily in the treatment of infected cases. Drainage was free, the minimum of tissues was traumatised and opened up, and the end-results in the stump were generally good, the bone being well covered. A cut-down Thomas splint with a ringed broad end was used for the extension in the lower limbs, and a straight-arm Thomas for the upper limbs. Secondary suture of the stump was also commonly carried out in the latter part of the war, thereby shortening the period of healing considerably. The type of amputation performed varied considerably. Commonly, a maximum length of bone was left, there being no attempt to lay down sites of election. In the arm the circular type of amputation was most common, though flaps were sometimes formed, and the amount and position of skin available for covering the stump often dictated the position of the flaps. In the thigh the transcondylar or Stokes-Gritti amputations were usually performed if conditions admitted. The circular amputation was most often carried out in the leg, but again depending on the skin available. Syme amputations were performed if possible, and partial amputations of the foot were also carried out. Amputations were carried out through the knee joint, but were not found to be very satisfactory, except as a temporary life-saving measure in severely ill cases.

Considerable attention to the stumps was needed not only because of infection, but also because of the length of the stumps and the presence of bulky or scarred ends. Refashioning to get smooth snug stumps, without adherent and weak scars, was commonly carried out. Many of the stumps had to be shortened because of poor circulation, often associated with eczema and even ulceration of the skin.

It was found that about seven inches was the ideal length for below-knee stumps and that two inches was about the minimum which would allow of fitting a below-knee limb with knee movements. Limbs were fitted to through-knee amputations, but with considerable difficulty because of the bulkiness of the stump and the altered level of the joint, and re-amputations were generally carried out. End-bearing stumps were not popular. Neuromata gave trouble and were frequently removed, but often with recurrent symptoms. The phantom limb disturbance persisted often for a long time, but generally finally passed away. Removal of neuromata and more radical measures did little, if any, good. With the weight taken in below-knee amputations by the tuberosity of the tibia, there was frequently a development of pressure sores or sebaceous formations in the skin in this area. Gradually the weight was transferred to the ischial area of the thigh either in whole or in part.

In New Zealand the artificial arms proved to be of little use and were worn by fewer than 5 per cent of the amputees. It would seem that the only useful kind of arm is one that is definitely indispensable for a man's work and livelihood, and that this must be fitted and used for its special work as soon as possible after the limb is lost. Otherwise it is a waste of money to fit an artificial arm, and the money could be better used for extra pension or other benefit.

The lower limb is quite a different matter. Locomotion is essential to living, quite apart from working. And the most efficient artificial leg is worth everything to the amputee, and he must also have a spare limb in case of emergency and when repairs are necessary.

Fortunately very good limbs were made available for the First World War men, both in Britain and also in New Zealand, where a limb factory under private management was set up in Wellington. As far as the lower limb was concerned, our New Zealand factory utilised the British limbs; but, for the arms, the McKay arm invented by one of our own amputees proved quite as satisfactory as the British types. The four main hospitals also developed splint workshops which were able to carry out the minor repairs. The First War amputees were well looked after by this means.

It was found that lower limb amputees were liable to circulatory disturbance with blood pressure and cardiac changes, and provision had to be made for war disability and old age pensions at an earlier age than is usual in many cases.

SECOND WORLD WAR

Second World War

At the beginning of the Second World War the experience in Britain had led to an evaluation of the different types and sites of amputation stumps and to the development of artificial limbs to fit them. At Roehampton, the heart of the British administration, there were surgeons with great experience in this matter, and also limb-fitting surgeons who had concentrated on the actual fitting of the artificial limb and did no surgery. The limbs themselves were made by private firms with factories clustered round the hospital, which was itself under the control of the Ministry of Pensions. Roehampton completely dominated the amputation and limb-fitting activities in Britain and accumulated a mass of experience, and we owe practically all our advances in knowledge to the men working there. They had found the long stump, particularly in the leg, very unsatisfactory. Circulatory changes were marked in the legs with frequent ulceration. Syme amputation had not stood the test of time and the large majority had had to be re-amputated. End-bearing stumps generally had also not stood up to the work.

The surgeons at Roehampton had laid down sites of election for all the different amputations as a definite guide to all surgeons at the beginning of the war. The below-knee site was five and a half inches below the joint line, and in the thigh it was from ten to twelve inches below the top of the great trochanter. In the forearm the site was seven inches below the tip of the olecranon and in the upper arm eight inches below the acromion process. These sites were well known to surgeons and had been freely accepted. It will be seen that the below-knee stump was shorter than it had been during the First World War, and that the thigh stump was now well above the knee, instead of being either an end-bearing Stokes Gritti, or transcondylar, as was common during the First War. The arm amputations were placed well above the joints so as to give room for the joint movement of the artificial limb.

A memorandum was issued by the Medical Research Council War Wounds Committee on Emergency Amputations in 1941, and this gives the general opinion at that time. It pointed out that the main indication for an emergency amputation was the irreparable interference with the blood supply. Occasionally when the injuries were grave, and the results of reconstructive surgery could not be better than those of amputation, and the patient possibly had to risk grave illness from infection, amputation might be justified; but, in general, the only justification was the imminence of gangrene from the destruction of the main vessels.

The memorandum pointed out that the surgeon who performed an amputation for severe local injury alone assumed a grave responsibility, and recommended that in these cases a second opinion should be sought. This is a clear and admirable presentation of the case.

The technique recommended was to complete a traumatic amputation by severing the remaining strands and excising portions of badly lacerated muscle. In less severe cases a guillotine amputation was advised, at the site of injury, preserving the maximum amount of bone. A secondary formal amputation was envisaged later.

In the ordinary case, especially in the first six to eight hours after injury, 'the safe period', a formal amputation at the site of election, with the skin flaps sutured in the normal manner and with drainage when necessary for twenty-four hours, was advised. It was recommended that the nerves should be simply cut as they lay in the wound, as the more elaborate treatment had proved unsatisfactory and useless.

If the wound was well below the site of election, a site-of-election flap operation with immediate suture might be safe, even with a greater time lag than six to eight hours, but that the risk of infection increased with every hour's delay, and primary suture might be dangerous particularly in the event of early evacuation. If the time lag was somewhat longer, a flap amputation was recommended with delayed skin suture, the sutures being inserted but not tied for two to ten days.

For later amputation the indications given were gangrene due to vascular thrombosis, massive gas gangrene, and danger to life from spreading infection or severe secondary haemorrhage. Warning was given that in these cases infection was almost inevitable and flap amputation with primary skin suture was unsafe and might be disastrous. The technique advised in cases where amputation could be done well below the site of election was either a guillotine or circular flapless amputation, or a flap amputation with flaps left wide open. (The Committee preferred the guillotine or circular amputation.) In cases where the amputations had to be at, or close to, the site of election either flap amputation with traction and secondary suture of skin flaps was recommended, or, if there was no viable skin below the level, a guillotine amputation with continued skin traction till the wound was healed. A strict guillotine was seldom necessary, and generally some sort of flaps could be cut.

Guillotine Amputations

It was pointed out that experienced surgeons did not perform true guillotine amputations but cut the tissues at different levels. The object of this type of operation was to save life in severe infections by rapid operation, leaving ample drainage and conserving lengths of stumps. A definitive amputation would be planned later. Warning was given against a guillotine operation at the site of election as it involved the sacrifice of too much skin and gave no room for re-amputation. Attention was drawn to the absolute necessity for skin traction within twenty-four to forty-eight hours of operation. Infrequent dressings were recommended and re-amputation was best deferred till all risk of sepsis was over and all oedema had disappeared. If treated by continued skin traction, a guillotine amputation gave a satisfactory stump, as proved by twenty years of experience at Roehampton. The Committee suggested that guillotine amputations might be used in desperate cases; in crush injuries; for severe infection or gangrene as a temporary measure; at the site of election to preserve the maximum of skin. However, flap amputations were preferred at or above the site of election when skin was available.

In summary, the Committee said that a second opinion should be sought before amputation of a limb was performed for the treatment of war wounds; and the type of amputation suited to a particular case depended upon (a) the time which has elapsed since injury; (b) the level at which amputation was indicated; (c) the general condition of the patient.

The memorandum was of great importance as it gave the lead, with great authority, to war surgeons in the early part of the war. In spite of the fact that the members of the sub-committee were largely men of very considerable experience in the First World War, the recommendations were largely influenced by the experience of civil surgery between the wars. Advice was given to perform site-of-election amputations with suture up to eight hours, and with delayed primary suture up to twenty-four hours.

2 NZEF Experience: Greece and Crete

Our own New Zealand experiences of amputations in the Second World War commenced in Greece and Crete, but our experience was limited and the majority of the cases did not reach Egypt. In Crete Major Christie recounts having performed several amputations of arm and leg. The usual indication was gross destruction of the bone and joint below the site of amputation. In some doubtful cases of vascular injury operation was delayed in the hope of a collateral circulation developing. No guillotine amputations were done, short anterior and posterior flaps being used. The site of election was used and, whilst the ends of the wound were sutured, the central part was left open for drainage. No tubes were used. Main vessels were double-ligated, nerves were neither cut short, pulled upon, crushed, ligated, nor injected. A tourniquet was used in the lower limbs, but digital compression in the upper. It will be seen that Major Christie, an orthopaedic surgeon, was using the site of election but not sewing up the wound completely.

Libya, 1941

During the second Libyan campaign many amputations were performed, both in the forward areas and at the Base. They were demanded by the severity of the injury and also by severe sepsis, and in some cases by severe secondary haemorrhage. Gangrene following vascular injury also necessitated amputation in several cases at the Base. Unfortunately in some patients the arm had had to be sacrificed in the treatment of secondary haemorrhage, and this caused much concern. Site-of-election amputations with primary suture were carried out and these all proved unsatisfactory. In very many cases the bone was protruding markedly through a septic wound. Skin traction had been largely neglected. Stumps with skin flaps stitched back had generally remained healthy. It seemed clear at that time that amputation should be carried out as low as possible and the wound left open as sepsis was to be expected.

Surgical Conference, Cairo, 1942

The results gave much concern, and a discussion on amputations was made a feature of the surgical conference held in Cairo in February 1942, when the New Zealand consultant surgeon was asked to read a paper on the subject. He reviewed the cases admitted to the New Zealand base hospitals, a total of 47, 27 being immediate amputations in the forward areas and 20 secondary at the Base. All the immediate amputations were done for gross damage to the limbs and a conservative attitude had been adopted, as was shown by amputation at the Base of seriously injured limbs given a chance of survival in the forward areas.

Of the 20 secondary amputations alone, 7 were through the upper arm, 1 was through the forearm, 6 were through the thigh, 2 were through the knee, 4 were through the leg.

The indications for secondary amputation were seen to be:

1. Damage to main vessels causing gangrene of the limb.
2. Infection: (a) gas gangrene, (b) life-endangering infection, especially that involving the knee joint.
3. Hopelessness of outlook for function of the limb, especially infected tarsal injuries.
4. Secondary haemorrhage, especially combined with severe sepsis.

Amputation for cases of gangrene was inevitable, but in dry gangrene operation was best delayed as long as possible unless sepsis intervened or the patient was in distress from pain or absorption. It was considered that greater risks in cases of infection should be taken in arm cases as the arm was incomparably more precious and absorption much less marked than in the lower limb, so that every means short of amputation had to be taken to combat sepsis.

Infection of the knee joint, especially if associated with bone injury, had necessitated amputations. Serious injuries to the foot involving skin and tarsus, with a hopeless outlook as regards eventual function and a probability of prolonged illness, were considered to warrant amputation. The performance of amputation for secondary haemorrhage was deprecated, especially in relation to the arm, and a plea made for closer observation and earlier operation in these cases with ligature of the bleeding vessel in the wound in preference to proximal ligation.

A circular type of amputation was suggested for temporary amputations, planned so as to save the maximum length of limb, especially in the leg and also in cases where in short stumps there was insufficient skin available to form flaps, and where skin traction would be required. When ample skin was available, flaps were recommended, especially if at the site of election. Nerves were simply cut across in the wound and the wound left open. In cases wherein sepsis was unlikely to arise, stitches could be inserted ready for suture in a week to ten days. Strapping extension was advised in all circular amputations after twenty-four hours. The maximum length available was recommended for primary amputation, especially in the lower limb. Amputation through the knee joint had been of value as a temporary measure in severely shocked cases. Stress was laid on the inadvisability of performing site-of-election amputation in the lower limb and preservation of the maximum length, the site-of-election amputation to be reserved for a secondary operation.

The certainty of infection under war conditions was stressed, as well as the disaster which had followed when infection had occurred. In late amputations for gangrene or infection it was still more important not to do site-of-election operations. Nine out of fifteen below-knee amputations required re-amputation, some following flap amputations.

An illustrative case was quoted. He had an amputation of both legs. His first amputation was performed the day after his wounding and was at the site of election. The flaps were completely sutured. Later the stump became grossly infected, the sutures were removed, free pus discharging. Then the end of the tibia protruded through the skin to the extent of an inch and re-amputation was required later. His amputation of the other leg, necessitated by severe sepsis in a badly shattered tarsus, was performed by guillotine operation three inches above the ankle, definitely as a temporary procedure to safeguard an aseptic amputation higher up at a later period.

In the after treatment skin traction was all-important, and its neglect had led to the pathetic sight of stumps with retracted skin and protruding bone. Spread of infection, especially posterior-ally in thigh amputations, had occurred, necessitating drainage. Secondary haemorrhage had been fairly frequent.

It was recommended:

Never remove a viable limb unless you are certain that a functioning limb will not result even in the distant future. Prefer loss of limb to loss of life. Amputate as low as possible, expecting sepsis to occur, and forget about the site of election except as a guide to the necessity of preserving at all costs the limb down to that level.

Remember that even under the best treatment and care re-amputation may be necessary and your site of election thereby hopelessly destroyed. Closing the wound is an invitation to infection which invariably occurs. If you spare the extension you spoil the stump. (Failure to recognise an infected knee joint may lose joint or limb.) In secondary haemorrhage if you neglect the warning stain of blood you may lose the limb. Go in early and tie the bleeding vessel before collapse makes amputation the easiest way out. Re-amputate only when the infection is quite forgotten and the patient's general condition completely recovered. No possible necessity for hurry exists and a further septic stump would be a disaster for which the surgeon is necessarily responsible.

'I need not refer to the disability that so often arises in healed septic stumps, and to the frequent remodelling necessary, to stress the advantage of carefully planned deliberate secondary amputations.'

This paper provoked, as was intended, spirited discussion. The forward surgeons, especially the able surgeons attached to 62 General Hospital in Tobruk, strongly combated the criticism of performing site-of-election amputations in the forward areas, and claimed that their results were very good and fully justified the procedure. An appeal was made to the large audience, which contained representatives of probably all the base hospitals, to testify that the cases had done and were doing well. This appeal brought forth not a single supporter, but surgeon followed surgeon describing the serious condition of the stumps, the constant presence of sepsis, broken-down wounds, and protruding bone.

The discussion revealed a general consensus of opinion on matters of most importance, with some differences in details. There was agreement that nearly all stumps were septic on arrival at the Base and many showed protruding bone. It was agreed that the maximum skin and bone should be preserved and no site-of-election operations performed. Flaps were generally preferred, either stitched back or with stitches inserted for tying later. Greater risks were advised in infected cases in the preservation of the arm. Skin traction was agreed upon. In secondary haemorrhage ligature in the wound was preferred, but proximal ligature was held to be often necessary and amputation called for in desperate cases with severe local injury.

As a direct result of this discussion Army directions were issued to the effect that site-of-election amputations were not to be performed either as emergency or secondary operations. The fashioning of flaps was generally recommended. Traction was strongly advised, especially to circular amputations. The tying of the vessel at the bleeding site was also recommended whenever possible in secondary haemorrhage, and amputation was deprecated, especially in arm cases.

Alamein, 1942

In the pre- Alamein fighting the New Zealand Division suffered many casualties, and amputations, some for gas gangrene, were fairly numerous. The wounds generally were clean and traction more satisfactorily applied. Light suturing over vaseline or tulle gras rolls had become the common type of dressing and, provided the tissues were healthy, gave good results. In incompletely excised traumatic amputations, however, the results were poor. Secondary sutures at about the tenth day were being carried out at the Base with success.

After the Alamein battle, 23 October to 3 November 1942, it was observed that the forward units had been conservative as regards amputation, and especially so in the badly damaged feet resulting from mine injuries which were very common at that time. (Many of the feet had to be amputated at the base hospitals.) The maximum of healthy tissue was retained and skin flaps were usually employed, loosely stitched over a vaseline pad. The necessity for thorough excision, or higher amputation, of the traumatic amputation stumps was being realised. Serious sepsis had so often developed if this had not been done. The traumatic amputation was ever afterwards regarded as a dangerous injury both as regards infection and toxaemia.

North African Review

In July 1943 it was reported by Colonel Fouche, consultant orthopaedic surgeon from South Africa, that all patients with septic compound fractures of the os calcis and tarsus transferred from the Middle East to South Africa had had to hive amputation performed. In the majority of infected fractures of the lower third of the tibia, amputation had also been carried out because of the chronicity of the bone infection and the involvement of the ankle joint. He stated that' once osteomyelitis, always osteomyelitis'. The question was discussed at a surgical conference held in Cairo at that time, and there was general agreement that amputation was generally advisable for septic injuries of the tarsus. Otherwise many of these patients with very prolonged and severe sepsis suffered, as a result, serious damage to general vitality, and probable shortening of life. Often their lives were endangered for a limb that was ultimately severely disabled. Lives had been lost in the vain endeavour to save a questionable limb.

With regard to amputations for septic fractures of the lower third of the tibia there was not the same agreement, though it was recognised that amputations might often be necessary in these cases.

The presentation of the South African view was very valuable and it produced much discussion afterwards. The considered view of our New Zealand surgeons was that many more of the mine injuries of the foot should be amputated in the forward areas, but that, we did not agree with the pessimistic attitude towards fractures of the leg or towards osteomyelitis, and that we should still continue to treat all the cases conservatively and only do secondary amputations when the life of the individual was endangered. Subsequent experience fortunately proved that our view at that time was correct. The South Africans saw only the bad cases (the others had by that time healed or become stabilised), and naturally they were struck by the depressing group of septic cases. As will be stated later, the view expressed by surgeons in Britain, surveying the final end-results of all cases, was that the majority of the cases treated conservatively had ended up with a functional limb vastly superior to any artificial limb.

Italy

During the Sangro battle, November 1943 to January 1944, conservative amputations were carried out, especially in the arm and hand. It was considered, however, that it was useless to preserve fingers with compound fractures of phalanges and damage to tendons, though any remnant of thumb was of great value. Cases had been observed with amputation through the knee joint in the presence of fracture of the lower end of the femur, when amputation through the fracture would have been preferable.

Penicillin was being utilised at that time, and delayed primary as well as secondary suture was carried out in all amputations with excellent results. In March 1944 the treatment had become stabilised and flaps were cut and later sutured about the fourth day at the Base. At that time it was observed that 'if with the progress of wound treatment by penicillin and other substances the wounds continue to show less and less infection a reconsideration of our present plan of saving all possible length of limb may be modified so as to approximate the length of limb more to the ideal lengths desired by the artificial limb maker. Judgment would of necessity be required in choosing the cases for more radical removal of tissue.'

In October 1944 stress was again laid on the treatment of the traumatic amputation cases, and it was stated that amputation must be done through healthy tissue above the devitalised area as soon as possible to prevent toxic absorption and subsequent sepsis. The application of a tourniquet at the lowest possible level, as a first-aid measure to prevent bleeding and toxic absorption, was sometimes carried out. At this time, and all through the Italian campaign, the amputation of lower limbs, frequently both legs, was common. This was due to the wooden Schu mine which was used so liberally by the enemy during his retreat.

Penicillin was proving of value in preventing sepsis in the badly injured feet and so saving some cases from amputation. Stitching the flaps together in the forward areas was still deprecated.

From the experience of conditions in Italy it was obvious that amputation could now be carried out with a certainty of satisfactory healing and of absence of infection, following delayed primary suture. In that case it seemed wrong to subject a patient to a primary amputation that would make a secondary amputation inevitable. Complaints were also received from New Zealand from amputees who had the impression that they had not been properly operated on overseas and thereby had to go through with what should have been an unnecessary operation. The New Zealand surgeons also would not be able to appreciate the necessity for preserving all possible tissue when the cases were arriving back without any sepsis. Nevertheless it was still obvious that the original forward amputation should not be at the site of election as far as the leg was concerned, as, if any severe infection did occur, it would still be disastrous.

It was possible, however, to amputate high enough up the leg to make the wearing of an artificial limb satisfactory, and still conserve ample length in case of complications. Three inches are required by the limb maker for proper play of an artificial ankle joint, so it was decided that primary amputations in future should be three inches up from a joint.

The Consultant Surgeon 2 NZEF discussed the matter in England with Brigadier Bristow, orthopaedic consultant to the British Army, and strongly urged that Army Instructions should be altered to give effect to these recommendations. Bristow promptly agreed, and as a result the following was issued from the'War Office:

It is now advised that the leg should be amputated 3′′ above the ankle joint, below the bulge of the calf, not 1′′ to 2′′ above the ankle. This is advised because the limb fitters require at least 3′′ clearance above the ankle joint in order to fit the most suitable prosthesis, one which includes a useful ankle-joint mechanism. If the stump heals, which it often does, such a prosthesis can be fitted, if not, there is ample room above for re-amputation. This operation of election will provide the ideal 5½′′-below-knee stump.

Admittedly the stump which is too long may also heal, but unless the patient agrees to an early re-amputation he will be deprived of the advantages of the better type of artificial limb. Once his stump is healed, a patient not unnaturally tends to object to the second amputation, often in spite of advice and argument. Any long stumps may, of course, require amputation in any case, some years later, should the circulation fail.

This then remained as the policy till the end of the war and resulted in extremely satisfactory results both from the surgical and the patient's point of view.

With the utilisation of penicillin and the regular use of delayed primary suture, amputation stumps ceased to give any trouble. Thus the war ended with an Army routine which included adequate wound excision, conservative approach to the site of amputation, delayed primary suture of the stump, and resulted in an almost complete absence of sepsis and in healing in 90 per cent of the cases.

It is of interest to relate that at an orthopaedic congress in London in January 1945 the question of amputations was discussed. The opening speaker was a young surgeon in a base hospital in England, and he was followed by a leading Russian orthopaedic surgeon. The British surgeon gave an account of late repair of stumps, emphasizing the importance of suturing the fascia over the end of the bone.

The Russian gave an account of the Russian experience in the war and their technique. It was difficult to realise we were living in the same age. The Russian conditions were such as one might have expected a century ago with sepsis, secondary haemorrhage, and re-amputation as the common experience. British war surgery was undoubtedly supreme, and we were pleased that we had added our quota to the result.

The Amputee in New Zealand

With regard to the fitting of the artificial limbs, New Zealand had at the outset of the war a long-established central limb factory in Wellington, and splint workshops in the four main hospitals where repairs could be carried out. The limb factory was taken over by the Disabled Servicemen's League early in the war. There had always been close association with Roehampton, the main amputee centre in Britain, and New Zealand utilised the British limbs, though we made use of the McKay arm, invented and produced by one of our own amputees.

In August 1944 Lieutenant-Colonel J. K. Elliott was appointed adviser to the New Zealand Government with regard to the rehabilitation of amputees, including the provision of artificial limbs. After visiting the United States of America and England, and spending some time at Roehampton hospital obtaining full details of the surgical and limb fitting procedures adopted there, he returned to New Zealand and co-ordinated the treatment and limb fitting of the amputees.

His observations in America led him to the conclusion that the open-flap type of operation with skin traction was much superior to the guillotine amputation as practised by the Americans. There were very few Syme stumps, and the performance of this operation for most war injuries was impracticable. The Stokes Gritti stumps were satisfactory. Rehabilitation with active stump exercises and pressure bandaging was carried out in a similar manner to that adopted at Roehampton. The Americans fitted a temporary limb, which Lieutenant-Colonel Elliott considered unnecessary.

In his report on Roehampton Elliott pointed out that, after the surgical treatment was finalised, special limb fitting surgeons undertook the preparation of the stump for limb fitting and prescribed the appropriate type of limb and superintended the amputee and his limb for the rest of his life. He did not recommend this arrangement for New Zealand, but suggested that the orthopaedic surgeon and the limb-fitter together were all that was necessary.

Elliott set out his opinions in a report, among them being the following: The primary amputation stump should not be more than nine inches for the leg and three inches up from the joint elsewhere. Plaster pylons were of use in above-knee amputations to allow time for shrinkage. There was need for a proper technique for stump bandaging, and also for exercises and the prevention of contractions. Investigations showed that 60 per cent of the below-knee legs were fitted with willow sockets, the leather sockets being used mainly for the short stumps. Full tibial bearing was obsolete and full ischial bearing was irksome, so Roehampton was compromising by providing a long, blocked, leather corset with roll strap and buckle.

Above-knee stumps were fitted with metal sockets and metal limb and internal coil knee springs instead of the usual pick-up. Tilting table limbs were being fitted satisfactorily. Remarkably little surgery was necessary in the First War cases, but full ischial bearing became necessary in many of the older cases. With regard to the arms, a new improved arm had been brought out at Roehampton. A proper psychological approach to the amputee was necessary, with full explanation of the future and the use of the artificial limbs, and with no extravagant predictions.

The difference in the opinions held by the British and the Americans with regard to the value, and especially the lasting qualities, of the different amputation stumps is of considerable importance to our outlook in New Zealand. It had been suggested that climatic conditions are of considerable importance, and it may be that there is some important difference in the New Zealand climate.

Lieutenant-Colonel Elliott was of the opinion that the Roehampton opinion of the Syme and the Stokes Gritti and transcondylar thigh amputations could not be supported by our experience of the results of those amputations in New Zealand. Under New Zealand conditions there were many men from the First World War who had carried on satisfactorily with these stumps, and it had not been found necessary to re-amputate or to substitute remote-bearing for end-bearing in the limb.

He also considered that, in the very short leg stumps, removal of the head of the fibula had been of definite advantage. This opinion seemed to suggest that our New Zealand conditions were such that we could steer a course between the two extremes and under certain conditions still do the Syme amputation, and possibly also the Stokes Gritti and transcondylar. It would be, however, only on the rarest occasion that a Syme amputation would be able to be performed during war with any chance of success, and the same applied to the Stokes Gritti. With the control of infection by the bacteriostatics the conditions might possibly be modified in the future.

In the treatment of long-standing painful neuromata in the leg stumps, division of the external popliteal nerve in the popliteal space had been found to be the most effective measure.

Recommendations for the Future

In war surgery at the primary operation the indications for amputation are:

(1) A non-viable limb due to destruction of the blood supply.
(2) A limb so badly damaged that it is certain it will be less functionally useful than an artificial limb and may be the cause of severe illness to the patient. The gross destruction of the main nerves will be of importance in this respect.

It roust be understood that any part of a hand is better than any artificial limb, and that generally artificial arms are useless.

In carrying out a primary amputation it is essential to preserve the maximum length which can be fitted satisfactorily with an artificial limb. This means that amputation should be three inches above the joints, thus allowing for artificial joint action. Anterior posterior flaps should be cut, the muscles and nerves cut at the same level as the bone. In suturing, only the fascia and skin should be sutured over the bone. The wound should be left open and delayed primary suture undertaken about four days later, penicillin having been administered to combat infection. Adequate excision of the wound is essential, especially in traumatic amputations.

When there is any deficiency of skin, traction should be applied immediately after the operation.

When secondary amputations are performed later, the indications are:

(1) Gangrene following destruction of the main blood supply.
(2) Massive gas gangrene.
(3) Severe and life-endangering infection.
(4) Severely damaged and infected feet for which there is no hope of eventual satisfactory function.

The sites of amputation will be similar to those of primary amputation, and whether primary suture is possible will depend on the complete absence of any infection.

After-treatment, when healing has taken place, consists in early, continuous, and accurate bandaging, to get shrinkage of the stump, and early and full exercises to preserve joint movement and prevent contractions. The application of an artificial limb should be made at the earliest possible moment, that is, as soon as the stump is well healed and well shrunk and consolidated. This applies particularly to arm stumps when manual work is to be carried out. If the fitting of the limb is delayed there is grave danger that the remaining arm will adapt itself to carry out all the necessary functions. Unless the man is trained early for particular work and has the artificial arm fitted up to be useful at that work, the arm will be useless and will not be worn. In the lower limb, wooden buckets are better for the leg, metal for the thigh. Pylons are of use in thigh stumps.

Bearing should be taken partly on the tuberosity of the tibia and upper end of the fibula and partly on the ischium, some of the weight being taken by the thigh by means of a lace-up cuirass. Cineplastic stumps have proved unsatisfactory.

APPENDIX — PRESENTATION OF ROEHAMPTON IDEAS AT THE END OF THE WAR

A ppendix
PRESENTATION OF ROEHAMPTON IDEAS AT THE END OF THE WAR

The surgeons at the Ministry of Pensions Hospital, Roehampton, formulated the following conclusions as a result of their experience of limb fitting after many thousands of amputations:

1. End-bearing stumps did not last. The majority of the pensioners of the First World War with Syme and transcondylar amputations had required re-amputation at a higher level.
2. The shorter the stump, the less risk there was of circulatory dis-turbances and ulceration. The end of a long stump was cold and blue in winter, suffered from chilblains, and frequently ulcerated.
3. The stump must be long enough to remain within the socket during movement when the joint was bent to a right angle, and to contain the insertion of the controlling muscles.
4. A conical stump was desirable.

Mr G. Perkins stressed that unless a surgeon could guarantee a primary stump that would satisfy the requirements of the limb fitting surgeon he should plan to perform two amputations, a preliminary or provisional amputation followed at a later date by a definitive or final amputation. The provisional amputation would be preferred in the presence of infection and should be performed as low as possible. In recent infections, and especially in battle casualties, no sutures should be inserted.

The final amputation was not performed until the risk of infection was minimal. This meant waiting till the oedema and tenderness of the stump had disappeared and until there was a healing edge all round the ulcer.

There were four sites of election, two in the leg and two in the arm:

Below Knee: A five-and-a-half-inch stump, measured from the level of the knee joint. The shortest stump that could be fitted with a below-knee prosthesis was about two inches.

Above Knee: An eleven-inch stump, measured from the top of the trochanter. A stump shorter than nine inches was deficient in adductor power, and the artificial limb could not be allowed free abduction-adduction movement at the hip; this was a serious drawback, because the amputee could not walk without a limp unless he was able to balance his trunk over the artificial limb by unrestricted movement at the hip.

When the stump was too short for an above-knee limb (i.e., less than six inches long) a tilting table would be necessary; even then it was better to leave a four-inch stump if -possible, around which the socket of the limb could be moulded.

Below Elbow: The ideal stump was seven inches long, measured from the tip of the olecranon. Amputations through the wrist joint were not satisfactory, as it was impossible to fit a socket which would allow rotation of the arm. With a shorter stump the appliances could be brought nearer the elbow and better controlled. The stump, however, must be long enough to get a good purchase on the socket of the limb, and for this reason it should not be less than four inches in length.

Above Elbow. The ideal stump was eight inches long, measured from the tip of the acromion process. This ensured that the bone was sectioned through the narrow part of the shaft and gave a conical stump. A length of at least six inches was needed to retain the stump in the socket.

The operative technique was almost the same for all four recommended amputations. The flaps should be antero-posterior, of equal length and semicircular in shape. This gave a terminal transverse scar, which was not subjected to pressure, and which would not be pulled upwards between the two bones in below-knee and in below-elbow amputations. The semicircular flaps gave the stump a conical shape, which was essential when fitting the modern limb. The skin and deep fascia were reflected together to prevent the skin from becoming adherent to the deeper tissues. The muscles were cut transversely, half an inch below the site of the proposed bone section. The muscles must on no account be sutured over the bone, as this left a bulky mass of soft tissue which was difficult to fit into the conical socket. The nerves should be cut at the same level as the muscles, and afterwards left undisturbed. The bone was sawed through flush with the retracted muscles, except in below-knee amputations, where the sharp anterior angle of the tibia should be levelled and the fibula cut one inch shorter than the tibia. Haemostasis must be as complete as possible, for a haemotoma was the most frequent cause of sepsis. The deep fascia should be sutured carefully, and the skin edges finally brought together, care being taken that there was no tension on the suture line.

After Treatment

The stump must be converted into a conical shape. This was achieved by firm bandaging by crepe bandages applied several times a day, the greatest pressure being applied to the end of the stump. The muscles controlling the stump must be strengthened by exercising them against a weight and pulley. This applied particularly to the adductor and extensor muscles of the hip in above-knee amputations. Early movement of the stump should be encouraged, special care being taken to avoid flexion deformity of the knee and a flexion-abduction deformity of the hip. Massage was deprecated.

Finally, the patient must be instructed to use the stump, in order to restore co-ordination movement. The simplest method was to make the patient play with a large, soft, indiarubber ball which he could propel with his stump, whatever the level of the amputation.

When the prosthesis had been supplied, the patient must be taught to walk, or, in the upper limb, the correct use of the scapular muscles. The proper training of the amputee in the use of his artificial limb was still too frequently neglected.

It was usually possible to fit an artificial leg in three months from the healing of the wound, and an artificial arm in six weeks. Shrinkage might not be complete at this time, but it was better to obtain a new socket when full shrinkage had occurred than to delay the fitting of the limb.

The views of the Roehampton limb-fitting surgeons as expressed by Dr Kelham agreed with those of Mr Perkins. In addition, he stated that weight bearing in the lower limbs was taken:

Above Knee: On Tuber Ischii.

Below Knee:

(a) (i) Inner head of tibia.
(ii) Shaft tibia beneath anterior tibial tubercle.
(iii) Shaft of fibula beneath the head.

(b) Tuber Ischii (with or without stump bearing).

Upper Limbs: It was claimed that, if the artificial limbs were applied early, with adequate training and early commencement of suitable occupation by the amputee the limbs were quite satisfactory.

Pylons were held to be unnecessary, the same results being most easily obtained by crepe bandaging.

Other Amputations

Syme: Not approved, though the stumps were sometimes satisfactory. Combined end and tioial bearing could be provided.

Foot Amputation: Could be fitted with limbs, but were generally unsatisfactory.

Care of Stumps

1. Careful washing daily, with good soda-free soap. Scar not rubbed. Spirit applied, followed by talc powder on the scar.
2. Stump socks and crepe bandages washed regularly. A clean sock worn every day, next to the skin.
3. Leave off limb when stump was bruised, cut, or septic.
4. Neuromata were best left alone.
5. Bursae occasionally needed excision.
6. Chronic ulcers might call for excision or re-amputation.
7. Chronically infected skin areas might sometimes require excision.
8. Adjustment of buckets was often necessary before the stump had become stabilised.

Experience in USA and Canada at the End of the War

A conference was held at the end of the war in Canada at which representatives of both the United States and Canada were present, as well as British surgeons from Roehampton. A very marked difference of opinion was shown. The Americans and Canadians were in favour of guillotine operations for primary amputations in the field and of end-bearing stumps such as the Syme and the Stokes Gritti as the final amputation. Some observations made by Mr Perkins, the senior Roehampton surgeon, were as follows:

1. Provisional amputations should save as much as possible of the limb. British surgeons prefer to fashion flaps and leave them open for secondary suture. The Americans favour the guillotine amputation with early skin traction.
2. Final amputations should be done only by surgeons experienced in such work.
3. Many, but not all, of the Canadians and Americans favour endbearing stumps-Syme and Stokes Gritti or supracondylar amputations. The British prefer the five-and-a-half-inch tibial and eleven-inch femoral stumps.

Perkins noted that circulatory troubles in long stumps did not seem to be as common in Eastern America as they were in Britain.

His conclusions were:

1. British limbs are better made, have better mechanism, and are better fitted than Canadian and American limbs.
2. In spite of seeing some successful Syme and Stokes Gritti cases, he still believed that the standard British methods were better.

Mr Perkins thought that some of the difference in opinion was due to the climatic conditions in Britain, predisposing to circulatory disturbance, whereas in the eastern part of Canada he had been told that chilblains and other troubles were uncommon, as were circulatory changes in stumps. The main difference in opinion related to the Syme amputation, which the Americans considered the ideal for the lower limb, whereas the Roehampton surgeons had found that the cases done in the First World War had proved quite unsatisfactory later, and as a result they preferred an amputation at the site of election in the leg. Again, the Stokes Gritti was not liked by the British Army surgeons. A Syme amputation could only rarely be done in war injuries, so that the matter was of mere academic interest. The Stokes Gritti could also normally be considered only as a secondary amputation.

A statistical survey of amputation cases evacuated from 2 NZEF in the Middle East from 1942 to 1945 shows that there were 273 major amputations of the lower limbs caused by battle wounds and 18 by accidental injury. Associated with these cases were no fewer than 90 fractures of the long bones and 16 major vascular injuries. There were very few complications during treatment. The most common missiles involved were shells, mines, and mortars. The largest numbers occurred in 1944 in Italy.

There were many fewer arm amputations in the same period (1942–45), 66 due to battle wounds and 13 to accidental injuries. Again there were few complications, but 5 of the cases were associated with gas gangrene. The shell was much the commonest missile involved in the arm cases.

A comparison of the wounds serious enough to cause invaliding from 1 NZEF in France in 1916–18 and from 2 NZEF in 1940–45 reveals that the most significant feature was the increased number of amputations of the lower limb in the Second World War. In a total of 7591 wounded invalided from 1 NZEF in France there were 193 major amputations of the lower limb and 156 of the upper limb, whereas in a total of only 4609 wounded invalided from 2 NZEF, there were 307 major amputations of the lower limb and 80 of the upper.

The marked increase in gross wounds of the lower limb involving amputation was undoubtedly due to the extensive use of mines as a defensive measure by the enemy. A survey has been made of the kinds of missile causing the wounds. In a series of 228 amputations of the lower limb in 2 NZEF no fewer than 66, or 29 per cent, were definitely noted as due to mine injuries. In a similar series of 45 amputations of the arm only 3, or 6 per cent, were recorded as due to mine injuries. (The only other group showing a marked relative increase in 2 NZEF compared with 1 NZEF was that of injuries to the eye, and this was also due mainly to mine explosions.)

The War Pensions Department records the following applications up till March 1952 for pensions from amputees of all three services:

	Overseas Service	New Zealand Service	Total
Upper limb	131	7	138
Lower limb	344	11	355
Fingers	225	30	255
Toes	57	15	72

2 NZEF—A MPUTATIONS OF L eg I NVALIDED TO N ew Z ealand

complications	
Gas gangrene in stump	2
Infective arthritis, other hip	1
Septic arthritis, knee	1
Osteomyelitis, stump (PW)	1
Suppurative arthritis, knee (PW)	1
Septicaemia(PW)	1
Uraemia	1
associated injuries—	
Fracture femur	18
Fracture tibia and fibula	38
Fracture tarsus	23
Fracture tibia	9
Fracture fibula	1
Fracture leg undefined	1
Vascular injury	
Ligature ext iliac	1
Ligature femoral artery	6
Ligature popliteal	9
missiles causing—	
Shell	78
Mine	63
Bomb	25
Mortar	20
Gunshot	16
Grenade	8
Bomb, anti-personnel	3
Bomb, aerial	2

Schu mine	3
Spandau	1
Crush injury	1
Booby trap	1
Machine-gun	1
Accidental	1
Undefined	4
	228

2 NZEF— Amputations of Arm Invalided to New Zealand

complications	
Gas gangrene in stump	2
Infective arthritis, other hip	1
Septic arthritis, knee	1
Osteomyelitis, stump (PW)	1
Suppurative arthritis, knee (PW)	1
Septicaemia(PW)	1
Uraemia	1
associated injuries—	
Fracture femur	18
Fracture tibia and fibula	38
Fracture tarsus	23
Fracture tibia	9
Fracture fibula	1
Fracture leg undefined	1
Vascular injury	
Ligature ext iliac	1
Ligature femoral artery	6
Ligature popliteal	9
missiles causing—	
Shell	78
Mine	63
Bomb	25
Mortar	20
Gunshot	16

Grenade	8
Bomb, anti-personnel	5
Bomb, aerial	2
Schu mine	3
Spandau	1
Crush injury	1
Booby trap	1
Machine-gun	1
Accidental	1
Undefined	4
	228

DATE OF MEDICAL BOARDING	
PW	12
1941	8
1942	52
1943	31
1944	108
1945	37
?PW	3
	251

Amputations of Arm Invalided to New Zealand

	BC	AI
Amputation at shoulder	4	
Amputation at upper arm	38	
Amputation at elbow	1	
Amputation at forearm	12	7
Amputation at wrist	1	1
Amputation arm, undefined	10	5
	66	13

associated conditions—

Gas gangrene	5
Staphylococcal septicaemia	1

Ligature axillary artery	1
Ligature brachial vessels	1
Median nerve injury	1
Fracture humerus	1

missiles causing—

Shell	28
Bomb	8
Gunshot	5
Mine	3
Machine	1

date of medical boarding—

PW	5
1941	5
1942	21
1943	6
1944	15
1945	2
	54

Amputations of Hand And Fingers Invalided to New Zealand

	BC	AI
Amputation hand	7	1
Amputation through hand	3	
Amputation thumb and index	3	
Amputation thumb	7	
Amputation fingers	56	10
	76	11

missiles causing—

Shell	39
Gunshot	6
Bomb	4
Mortar	3
Machine-gun	3
Mine	2
Grenade	1

Tank hatch	1
Phosphorus burn	1

date of medical boarding—

1942	23
1943	5
1944	27
1945	9
	64

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CHAPTER 14
Vascular Injuries

I njury to large blood vessels is very common in war wounds. Such injury is an immediate threat to both life and limb. Investigations on the battlefield have shown that the large majority of deaths on the field is due to this cause. It is well known that the large majority of the deaths in all types of war wounds occurs in the first forty-eight hours after wounding, and severe haemorrhage is again the main factor present in these cases. Where there is severe injury to a limb or internal organs damage to a main vessel has generally occurred. In abdominal injuries the early deaths are commonly associated with serious bleeding, and the same holds true in chest cases. It is for this reason that resuscitation by blood transfusion has been so eminently successful in those cases surviving long enough to reach a transfusion centre.

If life is saved, there is still present the serious danger of loss of a limb if one of the main vessels to the limb is damaged. This was known in previous campaigns, and Sir Henry Makins drew attention to it during the First World War, quoting figures to show the frequency of gangrene following ligation of main vessels. These figures showed how serious was ligature of the main vessels, but experience in the forward areas in the Second World War showed that primary ligature of main vessels is a much more serious matter -than even Makins' figures would lead one to believe.

The problem therefore is a major one, both as regards life and limb.

FIRST WORLD WAR

In the First World War bleeding was dealt with by first-aid methods in the field units, and by operative treatment at the CCS stage. The high incidence of anaerobic infection in France led to the thorough excision of wounds, even those of no great severity, and especially of those associated with any swelling or tension. This ensured that injuries to the large vessels were explored and the vessels, if found damaged, were ligatured, the wound being left widely open. There could have been little in the way of expectant treatment in cases of serious vascular injury. Gangrene following ligation of the main limb vessels was common, and subsequent amputation often necessary.

Makins stated that gangrene occurred in 25 per cent of femoral, 41 per cent of popliteal, and 25 per cent of brachial ligations. Short of gangrene, there often developed fibrosis of muscle, liquefaction of muscle, especially in the leg, and general ischaemic changes. Makins laid down at that time principles of treatment which have been followed ever since:

1. The main vein should be ligated at the same time as the artery to delay emptying the limb of blood and to retain vasodilator substances in the limb circulation.
2. Operation on aneurysm should be delayed till the collateral circulation became satisfactorily established.

There was danger of secondary haemorrhage in cases with primary damage to the vessels, especially where infection was present. Secondary haemorrhage, largely arising in previously damaged vessels, was a very common complication during the First World War.

Late Results of War Injuries: The number of cases seen in New Zealand between the wars with complications following vascular injuries sustained in the 1914–18 War was not large. Aneurysms, both arterial and arterio-venous in type, gave rise to symptoms demanding operative treatment at times. In many cases, however, the symptoms were so slight that no treatment was necessary or deemed advisable. The increase in size of the aneurysm and interference in the circulation of the limb, however, often necessitated operative treatment, which generally consisted in the quadruple ligation of the artery and the vein. If this was carried out a considerable period after the original injury, there was little danger of gangrene.

When the vessels affected were main vessels near the heart, cardiac changes generally developed. Surgical treatment, if practicable, was accorded such cases in which sudden cardiac dilatation causing death sometimes took place.

Research Work: The utilisation of arterial suture to reconstitute the main vessels was developed to some extent following research work on animals. Research work was also done on the sympathetic control of arterial tone and spasm following the work of Leriche. Heparin had been utilised to prevent the clotting of blood and so render arterial patency following suture more certain. Research, though considerable, was not sufficiently advanced to bring about any marked advances in vascular surgery by the beginning of the Second World War.

SECOND WORLD WAR

Early Treatment

First Aid: Treatment carried out in the field and in the Advanced Dressing Stations almost always consisted in the prevention of bleeding by the application of a firm pad and bandage. Crepe bandages were of special value for this purpose and shell dressings made an efficient pad. Except in very rare cases this treatment proved quite effective. If a large bleeder was seen in the wound an artery forceps was applied to control the haemorrhage temporarily.

Use of the Tourniquet: During the war the use of the tourniquet fell into disfavour. It was found that it was rarely necessary and that its use for any length of time gravely threatened the viability of the limb. The only type of case for which it was recommended was the traumatic amputation, where its application at the lowest possible site prevented further bleeding and allowed of amputation above the level of the tourniquet. It had some value also as a temporary measure at operation till the bleeding vessel was secured.

Operative Treatment at the Forward Operating Centre: All large wounds were operated on as the essential part of wound treatment, and in the course of the surgical toilet any injury to a main vessel was dealt with by ligature above and below with division of the vessel, and, at first, also of the accompanying vein. In smaller wounds operation was performed when there was marked swelling, tenseness, or bruising, especially if in a muscular area, and in these cases vascular injury was not uncommon. When there was little swelling small penetrating or perforating wounds were generally left alone. In cases of active bleeding ligation of the vessel was obviously required. It was only in the latter period of the war that arterial repair by primary suture and temporary repair by the use of plastic tubes was carried out, and then only in a few cases.

Results

The results of primary ligation of the main vessels in the limbs, especially those in the lower limbs, were very serious. A large proportion, in the case of the popliteal artery the very great majority, have ended in amputation. Makins' figures certainly were no guide with regard to the results of primary ligature. The Consultant Surgeon 2 NZEF stated at the surgical conference in Cairo in February 1942 that he had seen only one successful case at that time following primary ligation of the popliteal, and only one other case of the survival of the limb was vouched for among all the surgeons present. The results in the femoral cases were better, and in the arm cases better still and better than in Makins' figures.

With regard to the results of popliteal ligation, in our own New Zealand force, where this condition was probably observed more closely than anywhere else because of the interest displayed in it by our forward surgeons and our consultant surgeon from the beginning of the war, very few successful cases were recorded.

Thus in April 1944 it was noted that no case of ligation of the popliteal vessels escaped subsequent amputation in spite of lumbar sympathetic injections in some cases.

In May 1044 a case in a British CCS had been seen with the leg still viable after division of the fascia of the calf.

In June 1944 the Consultant Surgeon 2 NZEF was pleased to report the survival of two legs following ligation of the popliteal vessels, both having had fasciotomy performed.

Again, Lieutenant-Colonel Mason Brown in his paper read at the Rome conference in February 1945, when the fascial split was the fashion, stated that he had seen only four cases of injury to the popliteal operated on immediately after wounding. In one, ligation was carried out and the limb survived, but was crippled by severe ischaemic changes. In another, primary suture had been carried out and thrombosis of the artery had taken place, but the limb survived.

In another, gangrene of a large area of the heel had taken place and there was ischaemia of the muscle. All these three cases had had the fascia split and had had resuture of the wound later. Finally, there was a further case which Mason Brown described as the only really satisfactory result of popliteal ligation that he had seen. He asked,' Why do so few popliteal ligations find their way to the Vascular Centre? Is it because the results are so good or is it because they have already lost their limbs?' These results from the only vascular centre in Italy, where all cases were sent with vascular lesions or after ligature of main vessels, surely bear out entirely the results reported in Cairo in 1942.

Brigadier Stammers reported at the Rome conference in 1945 that he had had reports from forward surgeons of ligation of the main lower limb arteries. There was no certainty of follow-up of these cases and it was possible that some limbs were lost after evacuation. Figures obtained in this way are generally over-optimistic. His figures were 26 amputations in 36 cases of ligation of the popliteal and 21 amputations in 31 cases of ligation of the femoral artery. He described it as a dismal picture, but if the figures were complete it is likely they would be much worse than those quoted by Stammers, not taking into account the severe ischaemic changes often present in the limbs that do survive.

Brigadier Stammers later gave 80 per cent as the amputation rate in popliteal lesions in Italy, which corresponded to 2 NZEF experience after the introduction of fascial incision in the calf.

It is of interest to note that of 92,030 battle casualties in Third US Army in Europe vascular injuries totalled only 837, or 0–9 per cent. The results in the injured vessels treated by simple ligation were reported by the Army's surgical consultant to be as follows:

Artery	Number	Viable	Gangrene	Per Cent Developing Gangrene
Subclavian	9	5	4	44
Axillary	29	15	14	48
Brachial (above profunda)	69	32	37	55
Brachial (below profunda)	141	108	33	23
Cubital	4	2	2	50
Radial	25	23	2	8
Ulnar	22	21	1	4–5
Radial and ulnar	8	5	3	37
Common iliac	6	1	5	83
External iliac	6	2	4	66

Femoral (above profunda)	74	12	62	84
Femoral (below profunda)	62	27	35	56
Popliteal	196	51	145	74
Anterior tibial	21	18	3	13
Posterior tibial	69	53	16	23
Ant. and post, tibial	26	6	20	76
TOTAL	767	381	386	50

(From INter-Allied Conferences on War Medicine, p. 169)

Measures used to Prevent the Onset of Gangrene -following Ligation of a Mam Vessel

1. Restoration of Blood Volume: Resuscitation by blood transfusion was the regular routine in cases associated with marked bleeding, and this sometimes led to recrudescence of bleeding from main vessels. Following ligation, the maximum circulation in the limb through the collaterals was obtained by ensuring full blood volume and satisfactory blood pressure by the provision of adequate quantities of blood as quickly as possible.
2. Ligation of the Vein: At the beginning of the war ligation of the accompanying vein was carried out following Makins' recommendation. Several cases developed marked swelling of the limb, and it was thought the ligation of the vein might be responsible for this. It was thought that the interference of the venous return had led to thrombosis. As a consequence many surgeons gave up ligating the vein and found no difference in the results, so it became a common routine not to tie the vein as there seemed no clear reason for doing so.
3. Posture of the Limb: At first it was thought advisable to elevate the limb as would naturally take place, especially in a Thomas splint. Then it was considered that the limb should be dependent to preserve as much blood in it as possible. Finally, this was thought not to be of much moment and the limb was kept at the same level as the body.
4. Temperature of the Limb: The temperature of the limb, however, was held to be an important factor in treatment. The metabolism in the limb was lowered by cooling the limb so that less blood circulation would be required. At one time it was thought that the temperature should be lowered considerably, but it was held that this would do harm. The limb was therefore simply cooled by leaving it outside the bedclothes.
5. Sympathetic Interruption: A natural line of treatment seemed to be to attack the sympathetic system and so produce vasodilatation. This could be done by sympathectomy by dividing the lumbar nerves and removing the ganglia, or by

injecting local anaesthetics around the ganglia. The operative approach was quite impracticable in these severely shocked cases. The injection, on the other hand, was possible and was carried out for some time by forward surgeons of our own force and others. Unfortunately this was found quite unsatisfactory and afforded no relief, although sympathectomy, performed as a preliminary to operative treatment on aneurysms developing later, met with definite success in the hands of Lieutenant-Colonel A. M. Boyd in Cairo.

6. Reflex Vasodilatation: By heating the other limb (arm for leg, and vice versa) to a temperature of 45 degrees C. whilst keeping the affected limb at 15 degrees C., dilatation of the superficial and periarticular circulation will occur in the damaged limb. This was similar to the effect produced by sympathectomy and was utilised by Sir Henry Learmonth and others. In the serious cases, however, involving the primary ligation of the main vessels in the lower limb, the results were not satisfactory.

Fasciotomy

It had been observed by forward surgeons that in cases which did badly there was generally a swelling of the leg, especially in the calf, which became tense and brawny, and the calf muscles when examined were swollen and congested. Incision of the calf in the early stages relieved the congestion and the colour improved.

The Consultant Surgeon 2 NZEF suggested that the incision of the deep fascia down the centre of the calf might be of use if carried out at the time of ligation of the vessel before the calf had become tense. Similar suggestions had been made at the same time in America. In the light of 2 NZEF experience of the almost universally bad results after ligation of the popliteal artery, the procedure seemed well worth carrying out. This was first done in Italy at Cassino, in an RAMC unit at our suggestion, with satisfactory results. Further good results were obtained in our own 2 NZEF cases, and the procedure was adopted by most forward surgeons in Italy, and also later in the North-West European fronts. Doubt was expressed by some as to its efficacy, but it was agreed by all that if any tension did exist it should be done. This was surely an admission that it should be carried out in any case as it could only be of real value if done at the time of ligature, and could not be expected to be of any use later when swelling had arisen. In any case, it could do no harm because the incision could be sutured later with ease if there was no swelling.

Surgeons with experience of these cases were only too anxious to adopt any procedure which had proved of some success, as no other satisfactory alternative was available.

Whatever may eventually be thought of the procedure, it certainly saved some limbs in the Second World War, and under similar conditions in the future where the main vessel has to be tied, in the light of present experience, it should be carried out as a routine. This applies especially to the calf, but, to a lesser degree, the front of the leg and forearm should also at times be subjected to the same procedure.

An illustrative case is recorded as an appendix to this article.

Arterial Repair

Later in the war attempts were made to carry out repair of the main vessel at the original operation. Arterial sutures on special needles were made available in case primary arterial suture should be possible.

In a few cases suture was carried out with success. In the great majority of the cases this probably will never be possible, but it is certainly the ideal form of treatment, and the use of penicillin should help. Attempts were also made to repair the vessel temporarily by means of cannulae joining the two ends of the cut vessel. Plastic tubes were used, and tubes with an internal venous lining were also used in an attempt to prevent thrombosis in the vessel. Heparin was also given for the same purpose.

Major Mustard, a young Canadian surgeon, utilised plastic tubes with some temporary success, but some disheartening results later. The procedure had not reached the stage of practical application to war injuries. The aim was to preserve circulation in the main vessel for forty-eight hours, encourage some collateral circulation, and so give the limb more chance to survive. The giving of heparin was not practicable under ordinary conditions in the forward areas. The surgical consultant of Third US Army in Europe, surveying a large series, stated that the use of heparin was a procedure coupled with considerable risk, as at least one-third of all casualties had multiple wounds and fatal haemorrhage occurred in a number of heparinised patients.

Conservative Treatment of Small Wounds

In smaller wounds surgical intervention was carried out when there was marked swelling, tenseness, or bruising, especially if in a muscular area. When there was little swelling, small penetrating or perforating wounds were generally left alone. In the desert campaigns it was found that these cases generally healed up satisfactorily with little or no sepsis. In a certain percentage of these cases hidden vascular injury was present, and this showed itself later by the development of aneurysmal swellings, either in haemato-mata or as true aneurysms, or by the development of secondary haemorrhage.

It would seem that our best chance of preserving some arterial flow through a partly damaged vessel is to treat the case expectantly in the hope that the injury to the vessel will be sealed off by clot, and circulation continue long enough to preserve the limb. If an aneurysm should develop it can be dealt with at leisure.

In cases of suspected injury to the main vessel, with small wounds not involving muscle, with little swelling, and without tension, it would seem well worth while to defer operative treatment in the hope that some circulation might continue. Naturally the case must be held in the forward operating centre and carefully watched. If any bleeding should arise externally, or tense swelling of the tissues, then operation is inevitable and, unless suture is possible, ligation must be carried out. With our present dismal outlook, however, anything that can obviate ligation with any chance of success should be done. There are not many cases of this kind and they could be easily retained in the forward unit. If surgeons skilled in vascular surgery were Available to link up with the surgical specialists at the forward 200–bedded hospital, then that would be the place for such cases.

The war taught us how dangerous it is to do primary ligation of the main limb vessels, and every effort must be made in the future to carry out any safe measure that can obviate this.

Later Treatment

There was constant need for vigilance in the cases that had not had amputation performed, as, with the onset of gangrene, serious toxic symptoms arose and gas gangrene might ensue, quite apart from the presence of pain. Once the decision to amputate was made then no delay was permissible.

Secondary Haemorrhage

This was a very serious complication during the First World War. Following the second Libyan campaign, when conditions favoured unsatisfactory primary wound treatment and subsequent infection, secondary haemorrhage was relatively common. This led in many cases to secondary amputation, even of arms. During the surgical conference held in Cairo in February 1942 the question was discussed, especially as regards treatment.

Argument arose as to whether it was possible to ligate the bleeding vessel at the bleeding site or whether proximal ligation was preferable. The majority held strongly that ligation should always be done, or at least attempted, at the bleeding site and that proximal ligation was unsatisfactory and undesirable if it could be avoided. It was also held that amputation, especially in the arm, was a calamity which should seldom occur if close supervision was kept over the cases. There was generally a history of bleeding at the time and after the wound had been sustained. There was also generally sign of slight bleeding before the onset of gross secondary haemorrhage. There was slight oozing or else a bloodstained discharge. There might also be signs of poor circulation in the limb. If these signs were looked for, it was often possible to operate before any large bleeding had taken place. Also, with the help of blood transfusions, the patient's life should not be in danger if operative treatment was carried out promptly even when sharp haemorrhage had taken place. To have to amputate a limb, otherwise viable, for secondary haemorrhage was an admission of failure, and in the case of the arm was a disaster. There were two types of secondary haemorrhage. First, there was the bleeding from a temporarily sealed off injury to a main vessel. This occurred when the clot softened and the blood pressure rose. It generally took place on or about the tenth day and was not dependent in any way on infection. Ligation at the bleeding point was the obvious choice of treatment and this was simplified by applying a tourniquet temporarily to the limb, which allowed of a clear field, markedly shortened the time of operation, and prevented further bleeding.

The second type of bleeding was associated with erosion of the vessel wall and was generally due to infection, though sometimes a mechanical cause such as the pressure of a fracture was responsible. It was in these cases that ligation at the site was often difficult, but nevertheless this was desirable, and half measures such as packing should not be tolerated. It was in these cases also that amputation had sometimes been called for, the view having been taken that there might be danger to life from the combination of bleeding and sepsis, and that the saving of a doubtful limb might not be worth the risk. This situation was not an uncommon one, and a heavy responsibility rested on the surgeon. It was obvious that in the case of the arm a much bigger risk could be taken than in the case of the lower limb. In the first place the arm was so much more valuable and was irreplaceable, but an artificial leg could replace in some degree a normal limb.

Again, infection in the arm was much less serious and the risk of gas gangrene, particularly, was much less.

The risk of secondary haemorrhage must be realised when wounds of the main vessels were deliberately treated expectantly so as to save primary ligature, with its serious threat of gangrene. Such cases must of necessity be retained in the forward operating area for observation and not be evacuated till full stability had been reached. The majority of cases of secondary haemorrhage would, however, arise at the Base as they were due to unsuspected damage to main vessels, which would only be recognised when bleeding started about the tenth day. If this were realised by all surgeons in base hospitals, prompt and satisfactory treatment would be available.

Proximal ligation had the disadvantages of:

(1) The cutting off of collateral circulation in the limb.
(2) The possibility of recurrence of bleeding at the original site of the haemorrhage.
(3) The risk of sepsis at the site of proximal ligation.

Aneurysms

Injuries to main vessels which had not been dealt with at the time of wounding by ligature, or possibly suture, gave rise later to the formation of aneurysms of different types, depending on the degree of original damage to the artery or to the vein. The development of an aneurysm in an arterial haematoma has been discussed under secondary haemorrhage, and because of this complication these cases were generally operated on early and urgently. If haemorrhage did not occur, then an arterial aneurysm might develop and steadily increase in size. There might be an injury of both artery and vein and a junction formed between them either directly or by means of an intermediate channel formed in a haematoma. In the case of an arterial aneurysm there was a pulsatile swelling which gave on auscultation a systolic murmur, whereas in the case of an arterio-venous aneurysm the pulsatile swelling gave a murmur which was continuous. In the arterio-venous cases there was seldom any dilatation or pulsation in the veins.

The symptoms produced by these aneurysms depended on the size of the aneurysm, and on whether it was near to, or distant from, the heart. When there was a well-marked aneurysm near the heart, serious cardiac disturbances might arise. The majority of the distant aneurysms gave rise to little in the way of symptoms, but might demand treatment because of a steady increase in size. There might be special symptoms caused by local pressure such as that produced by the involvement of nerves in the aneurysmal area.

The treatment of these cases demanded sound judgment and much skill. As already stated the arterial haematomata would generally demand early treatment because of haemorrhage or, maybe, because of rapid increase in size. On the other hand the arterio-venous type could usually be dealt with conservatively, or with delayed operation.

The treatment could be summarised as follows:

(1) Leave alone if no symptoms, not increasing in size, and not affecting the heart.
(2) Operate if symptoms are troublesome and increasing, but allow ample time for collateral circulation to be established.
(3) Operate if signs, or probability, of marked cardiac disturbance.
(4) Operate if any signs of urgent symptoms developing.

If operation had been decided on, the question arose as to when this should be done. Realising the danger to the limb of ligature of the main vessels, it was generally agreed that reasonable time should be given for full collateral circulation to become established, and, if in any doubt, the operation should be postponed. A period of several months was necessary so as to be certain of proper circulation in the limb.

Lieutenant-Colonel Mason Brown advised that:

(1) Operation should never be carried out until the collateral circulation was safely established.
(2) Repair was easiest between the sixth week and the sixth month.
(3) If repair was not contemplated, the operation (ligation or excision) must await the maximum development of the collateral circulation.

If operation was carried out the aim should be the preservation of the main arterial circulation, if at all possible. This meant the repair of any arterial defect by suture in preference to the ligation of the vessels. This repair could be undertaken through the false aneurysm formed by the haematoma, or through the vein in the case of the arterio-venous type. The actual arterial wall must be sutured, and not the false lining of the sac. In some arterio-venous cases ligation of the communicating link might be possible, but very rarely. In many cases quadruple ligation of both artery and veins was the only practicable course.

The following six operative procedures were utilised:

(1) Arterial aneurysm: Suture of the true vessel wall after opening the false sac.
(2) Arterio-venous aneurysm: Suture of the arterial defect after exposure through the vein.
(3) Arterio-venous aneurysm: Suture of the artery and ligation of the vein.
(4) Arterial aneurysm: Ligation above and below with excision of the sac, at the same time ligating any branches that were involved. The vein might be left alone or ligated.
(5) Arterio-venous aneurysm: If there was a narrow communication between the vessels this could be ligated and divided.
(6) Arterio-venous aneurysm: Ligation of the artery and the vein above and below (quadruple ligation).

As a pre-operative measure, Boyd suggested sympathectomy, as also did Mason Brown, utilising this if trial injection suggested a favourable response. Reflex dilatation by heat could be given after operation. Heparin could also be used after operation to prevent thrombosis.

The results obtained in experienced hands had been excellent, provided adequate time had been given for the development of satisfactory collateral circulation.

There were some cases of injury to the carotid and subclavian vessels which survived and developed aneurysmal swellings. Our attitude to these was conservative, especially in the carotid cases. One case dealt with by ligation developed hemiplegia and died. One subclavian case was operated on later in New Zealand with success. Another had to have amputation of the arm shortly after wounding, and survived.

Organisation: Special Centres

The first development of a special vascular centre in the MEF was in 1943 in Cairo, when Lieutenant-Colonel A. M. Boyd, RAMC, divisional surgical officer at 63 General Hospital, was recognised as a specialist in this branch and cases were segregated under his care. This proved of great benefit to the force generally, and his special knowledge was utilised by our New Zealand medical officers when any special problems arose. He operated successfully on many cases of aneurysm.

Later in Italy a special Field Vascular Centre was established under the charge of Lieutenant-Colonel L. L. Mason Brown, RAMC. To this centre all cases with wounds of the main vessels were sent from the forward areas. This ensured that they would be under the care of a surgeon with special experience of vascular injury. It also made possible an evaluation of the problems and the results obtained under war conditions in contradistinction to those obtained by research workers. The advice that Mason Brown was able to give at the Rome surgical conference in February 1945 was of the greatest value, and if the war had been more prolonged it would have led to definite changes in the handling of these cases in the forward areas.

There could be no doubt that special centres for vascular surgery were highly desirable, both for treatment and clinical research, and that they should be set up at the outset of any future war. There might be advanced and base sections of the unit, the advanced section being placed along with the trinity of neurosurgical, facio-maxillary and ophthalmic units, close behind the CCS.

General Evaluation

The treatment of injuries to the main vessels complicating war wounds must always be governed by the conditions under which forward surgery is being carried out.

In the presence of a bleeding wound exploration is essential, and the bleeding has to be stopped at the time. It might be possible in the future, in many cases, to do primary suture of the vessel and then hold the case for about fourteen days in the forward operating centres. If this is not possible, it seems that ligation of the vessel is inevitable and, in any case, in the majority of these cases nothing else can be done.

In the case of the popliteal and the femoral vessels, this primary ligation results in the loss of the large majority of the limbs from gangrene. It is for this reason that every effort should be made to obviate ligation at this time. When no bleeding is taking place the treatment will depend on the site of the wound and the condition of the limb. If the wound is through a muscular area, and especially if the wound is large and involves much muscle, then exploration is normally required so as to prevent serious infection of the limb. If there is much swelling of the limb as the result of bleeding into the tissues, this also will demand exploration. If there is, however, only a small wound without any marked bleeding, and little in the way of swelling, a condition which is not uncommon in popliteal injuries, then there should be no exploration and the wound should be treated simply by pad and bandage, at the same time guarding against infection by parenteral penicillin.

This might enable circulation to be carried on to some degree through a partly injured vessel, and normally this will result in an arterial haematoma with the formation of a false aneurysm, prone to secondary haemorrhage but allowing of some development of a collateral circulation. It would seem that the only chance of saving many limbs following popliteal or femoral artery injury is either to treat the case conservatively, or else, if operated on, to do a primary suture of the vessel. The use of cannulae to join the vessel has so far proved unsatisfactory, but further research in this direction is desirable.

If ligation of the main vessel proves inevitable, then relief from possible tension in the distal part of the limb should be ensured by wide incision of the deep fascia. This is all the more necessary if there is any injury to the distal part of the limb. The fact that it still did not prevent the loss of the large majority of the limbs is certainly no argument against it. The desperate situation demands that anything holding out any chance of saving even one limb should be utilised.

The employment of vascular surgeons close to the forward areas might lead to better results in the future, but the bulk of the cases would still have to be dealt with by the forward surgeons in their general treatment of war wounds. There will always be very serious loss of life from vascular injury and also serious loss of limb.

A ppendix
CASE ILLUSTRATING THE RESULTS OF FASCIOTOMY

A case is recorded in full illustrating the progress following immediate ligation of the lower end of the femoral artery with associated division of the aponeurosis covering the calf muscles and the anterior compartment of the leg.

Wounded 25 September 1944 by shell with some destruction of muscle and division of the femoral artery in the lower third of Hunter's Canal. the vein being intact. This produced severe bleeding and shock for which he was given two pints of blood at the ADS, the second pint being continued in the ambulance. At the MDS he was given a third pint of blood, and operation was performed.

The report of Major Owen-Johnston, the surgeon, is as follows:

‘The femoral artery was divided near the lower limit of Hunter's Canal leaving the vein intact. There was extensive division and laceration of the soft tissues at the level of the junction of the mid and lower third of the thigh. The wound of entry, some two inches in diameter, was over the outer aspect, and that of exit, four by three inches, was over the antero-internal aspect. Almost the whole of the muscle anterior to the femur was divided, as well as a fair mass of the adductors on the inner aspect. So as at least one-third of the muscle mass of the thigh was sectioned, it was thereby less probable that a satisfactory collateral circulation would develop. Also, to minimise the possibility of the onset of Gas Gangrene, a wide area of devitalised muscle was removed-a further embarrassment of any possible collateral circulation. Where the lower femoral or popliteal artery is tied in such wounds, in almost every case the ultimate onset of mass ischaemic necrosis leads to amputation of the limb. It has recently been suggested that splitting of the aponeurosis covering the calf muscles would possibly counteract the onset of ischaemia. In my own personal experience I have found that the splitting of the aponeurosis over the anterior group of leg muscles is most helpful in relieving embarrassment of the leg circulation resulting from severe injury at a higher level. So, in this case, after dealing with the wounds, we split, throughout the entire length of the leg, the aponeurosis both over the calf and anterior group of muscles. TJie wound was treated with penicillin irrigation, and he also received penicillin intramuscularly. We examined this man again at 1 NZ Gen. Hosp. three days after the operation. His general condition was excellent; he had no complaints; his foot was warm and he could move his toes freely. If ischaemic gangrene does not develop in this case, then I think it can be accepted as a very good test of the efficacy of fasciotomy of the leg aponeurosis in preventing the onset of ischaemia, where the popliteal or lower femoral artery has been tied in battle casualties.

'On 1 Oct. 44 I examined [the patient] at 1 NZ Gen. Hosp. The state of the circulation in the foot had continued to improve. On the 30 Sept. the wounds were all inspected and sutured. The toes were warm, there was no numbness, and he could use them freely.'

Five days later at 1 NZ General Hospital his wounds were sutured without tension. Partial palsy was noted in his leg. The sutures were removed on the 12th day and except for slight superficial stitch sepsis the wounds had all healed well. The circulation of the foot was noted to be good. There was some anaesthesia present on the outer aspect of the foot and pain in the pero-neal and anterior tibial group of muscles. A plaster splint was applied to keep the foot at a right angle. He was then evacuated to 3 NZ General Hospital and boarded for New Zealand. The circulation was noted to be still subnormal and the skin of the foot mottled and the anterior and posterior tibial pulses were not felt. Sensation was impaired below the knee to the ankle, but the sensation in the sole was normal. There was paresis of flexions and extensions of the toes. Physiotherapeutic treatment was instituted. Slow improvement took place in muscle function, but marked muscle wasting was present. He was evacuated to New Zealand, being unable to walk any distance.

When he was examined in October 1945, a year after his wound, he could then walk half a mile and had improved considerably. He had gross tissue loss in adductors and vastus internus. The circulation of the foot was good, and faint pulsation was noted in dorsalis pedis and posterior tibial vessels. He had full movement in the hip, knee and ankle, and slight limitation in the foot. All the muscles of the leg were acting, but both the anterior tibial and the peroneal groups were weak. Sensory loss was confined to the saphenous distribution.

A year later, in 1946, it was noted that he tended to go over on his ankle and that he had some pain on the ball of the foot after walking. He also experienced cramp in the calf in cold weather and some tightness in the calf after walking. He had no limp. He had then strong pulsation in the dorsalis pedis and posterior tibial vessels. A metatarsal bar was provided.

On further examination in November 1947, three years after the injury, he had improved further. There was still some pain in the calf after long walks. The ankle was stronger. There was weakness of flexion of the toes but no calluses on the sole.

In November 1948 he was still experiencing cramp but had no pain in his foot, the sensation of which was normal. There was still weak action of his toe flexors. He had been granted a permanent pension of 15s. a week, equal to 25 per cent disability. He was employed driving a baker's delivery van.

There has been an excellent recovery following the immediate ligation of the lower part of the femoral artery. The radical division of the deep fascia of the calf and the anterior part of the leg in all probability contributed a great deal to the success obtained, and as the wounds of the leg were sutured five days later and healed well with no permanent disability the fascial division certainly did no harm. The association of motor and sensory nerve disability makes the outcome still more satisfactory.

Vascular Injuries Invalided from 2 NZEF, 1940–45

Battle Casualties	
ligatures—	
Brachial artery	21

Brachial artery and vein and ax. vein	1
Subclavian artery	1
Subclavian vein	1
Jugular vein	1
Axillary artery	3
Axillary vein	1
Axillary artery and vein	4
Femoral artery	4
Femoral vein	3
Superficial femoral artery	2
Superficial femoral artery and vein	2
Popliteal artery	2
Popliteal artery and vein	1
Posterior tibial artery	4
Posterior and ant. tibial artery	1
Internal iliac artery	3
lesions—	
Arterio-venous aneurysm neck	1
Aneurysm common carotid artery	2
Arterio-venous aneurysm mastoid region	1
Arterio-venous aneurysm subclavian	1
Aneurysm brachial artery	1
Aneurysm ulnar artery	1
Aneurysm femoral artery	3
Aneurysm post, tibial artery	1
Arterio-venous aneurysm popliteal	4
Arterio-venous aneurysm thigh	1
Haematoma brachial artery	1

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[SECTION]

I njury to large blood vessels is very common in war wounds. Such injury is an immediate threat to both life and limb. Investigations on the battlefield have shown that the large majority of deaths on the field is due to this cause. It is well known that the large majority of the deaths in all types of war wounds occurs in the first forty-eight hours after wounding, and severe haemorrhage is again the main factor present in these cases. Where there is severe injury to a limb or internal organs damage to a main vessel has generally occurred. In abdominal injuries the early deaths are commonly associated with serious bleeding, and the same holds true in chest cases. It is for this reason that resuscitation by blood transfusion has been so eminently successful in those cases surviving long enough to reach a transfusion centre.

If life is saved, there is still present the serious danger of loss of a limb if one of the main vessels to the limb is damaged. This was known in previous campaigns, and Sir Henry Makins drew attention to it during the First World War, quoting figures to show the frequency of gangrene following ligation of main vessels. These figures showed how serious was ligature of the main vessels, but experience in the forward areas in the Second World War showed that primary ligature of main vessels is a much more serious matter -than even Makins' figures would lead one to believe.

The problem therefore is a major one, both as regards life and limb.

FIRST WORLD WAR

In the First World War bleeding was dealt with by first-aid methods in the field units, and by operative treatment at the CCS stage. The high incidence of anaerobic infection in France led to the thorough excision of wounds, even those of no great severity, and especially of those associated with any swelling or tension. This ensured that injuries to the large vessels were explored and the vessels, if found damaged, were ligatured, the wound being left widely open. There could have been little in the way of expectant treatment in cases of serious vascular injury. Gangrene following ligation of the main limb vessels was common, and subsequent amputation often necessary.

Makins stated that gangrene occurred in 25 per cent of femoral, 41 per cent of popliteal, and 25 per cent of brachial ligations. Short of gangrene, there often developed fibrosis of muscle, liquefaction of muscle, especially in the leg, and general ischaemic changes. Makins laid down at that time principles of treatment which have been followed ever since:

1. The main vein should be ligated at the same time as the artery to delay emptying the limb of blood and to retain vasodilator substances in the limb circulation.
2. Operation on aneurysm should be delayed till the collateral circulation became satisfactorily established.

There was danger of secondary haemorrhage in cases with primary damage to the vessels, especially where infection was present. Secondary haemorrhage, largely arising in previously damaged vessels, was a very common complication during the First World War.

Late Results of War Injuries: The number of cases seen in New Zealand between the wars with complications following vascular injuries sustained in the 1914–18 War was not large. Aneurysms, both arterial and arterio-venous in type, gave rise to symptoms demanding operative treatment at times. In many cases, however, the symptoms were so slight that no treatment was necessary or deemed advisable. The increase in size of the aneurysm and interference in the circulation of the limb, however, often necessitated operative treatment, which generally consisted in the quadruple ligation of the artery and the vein. If this was carried out a considerable period after the original injury, there was little danger of gangrene.

When the vessels affected were main vessels near the heart, cardiac changes generally developed. Surgical treatment, if practicable, was accorded such cases in which sudden cardiac dilatation causing death sometimes took place.

Research Work: The utilisation of arterial suture to reconstitute the main vessels was developed to some extent following research work on animals. Research work was also done on the sympathetic control of arterial tone and spasm following the work of Leriche. Heparin had been utilised to prevent the clotting of blood and so render arterial patency following suture more certain. Research, though considerable, was not sufficiently advanced to bring about any marked advances in vascular surgery by the beginning of the Second World War.

SECOND WORLD WAR

Early Treatment

First Aid: Treatment carried out in the field and in the Advanced Dressing Stations almost always consisted in the prevention of bleeding by the application of a firm pad and bandage. Crepe bandages were of special value for this purpose and shell dressings made an efficient pad. Except in very rare cases this treatment proved quite effective. If a large bleeder was seen in the wound an artery forceps was applied to control the haemorrhage temporarily.

Use of the Tourniquet: During the war the use of the tourniquet fell into disfavour. It was found that it was rarely necessary and that its use for any length of time gravely threatened the viability of the limb. The only type of case for which it was recommended was the traumatic amputation, where its application at the lowest possible site prevented further bleeding and allowed of amputation above the level of the tourniquet. It had some value also as a temporary measure at operation till the bleeding vessel was secured.

Operative Treatment at the Forward Operating Centre: All large wounds were operated on as the essential part of wound treatment, and in the course of the surgical toilet any injury to a main vessel was dealt with by ligature above and below with division of the vessel, and, at first, also of the accompanying vein. In smaller wounds operation was performed when there was marked swelling, tenseness, or bruising, especially if in a muscular area, and in these cases vascular injury was not uncommon. When there was little swelling small penetrating or perforating wounds were generally left alone. In cases of active bleeding ligation of the vessel was obviously required. It was only in the latter period of the war that arterial repair by primary suture and temporary repair by the use of plastic tubes was carried out, and then only in a few cases.

Results

The results of primary ligation of the main vessels in the limbs, especially those in the lower limbs, were very serious. A large proportion, in the case of the popliteal artery the very great majority, have ended in amputation. Makins' figures certainly were no guide with regard to the results of primary ligature. The Consultant Surgeon 2 NZEF stated at the surgical conference in Cairo in February 1942 that he had seen only one successful case at that time following primary ligation of the popliteal, and only one other case of the survival of the limb was vouched for among all the surgeons present. The results in the femoral cases were better, and in the arm cases better still and better than in Makins' figures.

With regard to the results of popliteal ligation, in our own New Zealand force, where this condition was probably observed more closely than anywhere else because of the interest displayed in it by our forward surgeons and our consultant surgeon from the beginning of the war, very few successful cases were recorded.

Thus in April 1944 it was noted that no case of ligation of the popliteal vessels escaped subsequent amputation in spite of lumbar sympathetic injections in some cases.

In May 1044 a case in a British CCS had been seen with the leg still viable after division of the fascia of the calf.

In June 1944 the Consultant Surgeon 2 NZEF was pleased to report the survival of two legs following ligation of the popliteal vessels, both having had fasciotomy performed.

Again, Lieutenant-Colonel Mason Brown in his paper read at the Rome conference in February 1945, when the fascial split was the fashion, stated that he had seen only four cases of injury to the popliteal operated on immediately after wounding. In one, ligation was carried out and the limb survived, but was crippled by severe ischaemic changes. In another, primary suture had been carried out and thrombosis of the artery had taken place, but the limb survived.

In another, gangrene of a large area of the heel had taken place and there was ischaemia of the muscle. All these three cases had had the fascia split and had had resuture of the wound later. Finally, there was a further case which Mason Brown described as the only really satisfactory result of popliteal ligation that he had seen. He asked,' Why do so few popliteal ligations find their way to the Vascular Centre? Is it because the results are so good or is it because they have already lost their limbs?' These results from the only vascular centre in Italy, where all cases were sent with vascular lesions or after ligature of main vessels, surely bear out entirely the results reported in Cairo in 1942.

Brigadier Stammers reported at the Rome conference in 1945 that he had had reports from forward surgeons of ligation of the main lower limb arteries. There was no certainty of follow-up of these cases and it was possible that some limbs were lost after evacuation. Figures obtained in this way are generally over-optimistic. His figures were 26 amputations in 36 cases of ligation of the popliteal and 21 amputations in 31 cases of ligation of the femoral artery. He described it as a dismal picture, but if the figures were complete it is likely they would be much worse than those quoted by Stammers, not taking into account the severe ischaemic changes often present in the limbs that do survive.

Brigadier Stammers later gave 80 per cent as the amputation rate in popliteal lesions in Italy, which corresponded to 2 NZEF experience after the introduction of fascial incision in the calf.

It is of interest to note that of 92,030 battle casualties in Third US Army in Europe vascular injuries totalled only 837, or 0–9 per cent. The results in the injured vessels treated by simple ligation were reported by the Army's surgical consultant to be as follows:

Artery	Number	Viable	Gangrene	Per Cent Developing Gangrene
Subclavian	9	5	4	44
Axillary	29	15	14	48
Brachial (above profunda)	69	32	37	55
Brachial (below profunda)	141	108	33	23
Cubital	4	2	2	50
Radial	25	23	2	8
Ulnar	22	21	1	4–5
Radial and ulnar	8	5	3	37
Common iliac	6	1	5	83
External iliac	6	2	4	66

Femoral (above profunda)	74	12	62	84
Femoral (below profunda)	62	27	35	56
Popliteal	196	51	145	74
Anterior tibial	21	18	3	13
Posterior tibial	69	53	16	23
Ant. and post, tibial	26	6	20	76
TOTAL	767	381	386	50

(From INter-Allied Conferences on War Medicine, p. 169)

Measures used to Prevent the Onset of Gangrene -following Ligation of a Mam Vessel

1. Restoration of Blood Volume: Resuscitation by blood transfusion was the regular routine in cases associated with marked bleeding, and this sometimes led to recrudescence of bleeding from main vessels. Following ligation, the maximum circulation in the limb through the collaterals was obtained by ensuring full blood volume and satisfactory blood pressure by the provision of adequate quantities of blood as quickly as possible.
2. Ligation of the Vein: At the beginning of the war ligation of the accompanying vein was carried out following Makins' recommendation. Several cases developed marked swelling of the limb, and it was thought the ligation of the vein might be responsible for this. It was thought that the interference of the venous return had led to thrombosis. As a consequence many surgeons gave up ligating the vein and found no difference in the results, so it became a common routine not to tie the vein as there seemed no clear reason for doing so.
3. Posture of the Limb: At first it was thought advisable to elevate the limb as would naturally take place, especially in a Thomas splint. Then it was considered that the limb should be dependent to preserve as much blood in it as possible. Finally, this was thought not to be of much moment and the limb was kept at the same level as the body.
4. Temperature of the Limb: The temperature of the limb, however, was held to be an important factor in treatment. The metabolism in the limb was lowered by cooling the limb so that less blood circulation would be required. At one time it was thought that the temperature should be lowered considerably, but it was held that this would do harm. The limb was therefore simply cooled by leaving it outside the bedclothes.
5. Sympathetic Interruption: A natural line of treatment seemed to be to attack the sympathetic system and so produce vasodilatation. This could be done by sympathectomy by dividing the lumbar nerves and removing the ganglia, or by

injecting local anaesthetics around the ganglia. The operative approach was quite impracticable in these severely shocked cases. The injection, on the other hand, was possible and was carried out for some time by forward surgeons of our own force and others. Unfortunately this was found quite unsatisfactory and afforded no relief, although sympathectomy, performed as a preliminary to operative treatment on aneurysms developing later, met with definite success in the hands of Lieutenant-Colonel A. M. Boyd in Cairo.

6. Reflex Vasodilatation: By heating the other limb (arm for leg, and vice versa) to a temperature of 45 degrees C. whilst keeping the affected limb at 15 degrees C., dilatation of the superficial and periarticular circulation will occur in the damaged limb. This was similar to the effect produced by sympathectomy and was utilised by Sir Henry Learmonth and others. In the serious cases, however, involving the primary ligation of the main vessels in the lower limb, the results were not satisfactory.

Fasciotomy

It had been observed by forward surgeons that in cases which did badly there was generally a swelling of the leg, especially in the calf, which became tense and brawny, and the calf muscles when examined were swollen and congested. Incision of the calf in the early stages relieved the congestion and the colour improved.

The Consultant Surgeon 2 NZEF suggested that the incision of the deep fascia down the centre of the calf might be of use if carried out at the time of ligation of the vessel before the calf had become tense. Similar suggestions had been made at the same time in America. In the light of 2 NZEF experience of the almost universally bad results after ligation of the popliteal artery, the procedure seemed well worth carrying out. This was first done in Italy at Cassino, in an RAMC unit at our suggestion, with satisfactory results. Further good results were obtained in our own 2 NZEF cases, and the procedure was adopted by most forward surgeons in Italy, and also later in the North-West European fronts. Doubt was expressed by some as to its efficacy, but it was agreed by all that if any tension did exist it should be done. This was surely an admission that it should be carried out in any case as it could only be of real value if done at the time of ligature, and could not be expected to be of any use later when swelling had arisen. In any case, it could do no harm because the incision could be sutured later with ease if there was no swelling.

Surgeons with experience of these cases were only too anxious to adopt any procedure which had proved of some success, as no other satisfactory alternative was available.

Whatever may eventually be thought of the procedure, it certainly saved some limbs in the Second World War, and under similar conditions in the future where the main vessel has to be tied, in the light of present experience, it should be carried out as a routine. This applies especially to the calf, but, to a lesser degree, the front of the leg and forearm should also at times be subjected to the same procedure.

An illustrative case is recorded as an appendix to this article.

Arterial Repair

Later in the war attempts were made to carry out repair of the main vessel at the original operation. Arterial sutures on special needles were made available in case primary arterial suture should be possible.

In a few cases suture was carried out with success. In the great majority of the cases this probably will never be possible, but it is certainly the ideal form of treatment, and the use of penicillin should help. Attempts were also made to repair the vessel temporarily by means of cannulae joining the two ends of the cut vessel. Plastic tubes were used, and tubes with an internal venous lining were also used in an attempt to prevent thrombosis in the vessel. Heparin was also given for the same purpose.

Major Mustard, a young Canadian surgeon, utilised plastic tubes with some temporary success, but some disheartening results later. The procedure had not reached the stage of practical application to war injuries. The aim was to preserve circulation in the main vessel for forty-eight hours, encourage some collateral circulation, and so give the limb more chance to survive. The giving of heparin was not practicable under ordinary conditions in the forward areas. The surgical consultant of Third US Army in Europe, surveying a large series, stated that the use of heparin was a procedure coupled with considerable risk, as at least one-third of all casualties had multiple wounds and fatal haemorrhage occurred in a number of heparinised patients.

Conservative Treatment of Small Wounds

In smaller wounds surgical intervention was carried out when there was marked swelling, tenseness, or bruising, especially if in a muscular area. When there was little swelling, small penetrating or perforating wounds were generally left alone. In the desert campaigns it was found that these cases generally healed up satisfactorily with little or no sepsis. In a certain percentage of these cases hidden vascular injury was present, and this showed itself later by the development of aneurysmal swellings, either in haemato-mata or as true aneurysms, or by the development of secondary haemorrhage.

It would seem that our best chance of preserving some arterial flow through a partly damaged vessel is to treat the case expectantly in the hope that the injury to the vessel will be sealed off by clot, and circulation continue long enough to preserve the limb. If an aneurysm should develop it can be dealt with at leisure.

In cases of suspected injury to the main vessel, with small wounds not involving muscle, with little swelling, and without tension, it would seem well worth while to defer operative treatment in the hope that some circulation might continue. Naturally the case must be held in the forward operating centre and carefully watched. If any bleeding should arise externally, or tense swelling of the tissues, then operation is inevitable and, unless suture is possible, ligation must be carried out. With our present dismal outlook, however, anything that can obviate ligation with any chance of success should be done. There are not many cases of this kind and they could be easily retained in the forward unit. If surgeons skilled in vascular surgery were Available to link up with the surgical specialists at the forward 200–bedded hospital, then that would be the place for such cases.

The war taught us how dangerous it is to do primary ligation of the main limb vessels, and every effort must be made in the future to carry out any safe measure that can obviate this.

Later Treatment

There was constant need for vigilance in the cases that had not had amputation performed, as, with the onset of gangrene, serious toxic symptoms arose and gas gangrene might ensue, quite apart from the presence of pain. Once the decision to amputate was made then no delay was permissible.

Secondary Haemorrhage

This was a very serious complication during the First World War. Following the second Libyan campaign, when conditions favoured unsatisfactory primary wound treatment and subsequent infection, secondary haemorrhage was relatively common. This led in many cases to secondary amputation, even of arms. During the surgical conference held in Cairo in February 1942 the question was discussed, especially as regards treatment.

Argument arose as to whether it was possible to ligate the bleeding vessel at the bleeding site or whether proximal ligation was preferable. The majority held strongly that ligation should always be done, or at least attempted, at the bleeding site and that proximal ligation was unsatisfactory and undesirable if it could be avoided. It was also held that amputation, especially in the arm, was a calamity which should seldom occur if close supervision was kept over the cases. There was generally a history of bleeding at the time and after the wound had been sustained. There was also generally sign of slight bleeding before the onset of gross secondary haemorrhage. There was slight oozing or else a bloodstained discharge. There might also be signs of poor circulation in the limb. If these signs were looked for, it was often possible to operate before any large bleeding had taken place. Also, with the help of blood transfusions, the patient's life should not be in danger if operative treatment was carried out promptly even when sharp haemorrhage had taken place. To have to amputate a limb, otherwise viable, for secondary haemorrhage was an admission of failure, and in the case of the arm was a disaster. There were two types of secondary haemorrhage. First, there was the bleeding from a temporarily sealed off injury to a main vessel. This occurred when the clot softened and the blood pressure rose. It generally took place on or about the tenth day and was not dependent in any way on infection. Ligation at the bleeding point was the obvious choice of treatment and this was simplified by applying a tourniquet temporarily to the limb, which allowed of a clear field, markedly shortened the time of operation, and prevented further bleeding.

The second type of bleeding was associated with erosion of the vessel wall and was generally due to infection, though sometimes a mechanical cause such as the pressure of a fracture was responsible. It was in these cases that ligation at the site was often difficult, but nevertheless this was desirable, and half measures such as packing should not be tolerated. It was in these cases also that amputation had sometimes been called for, the view having been taken that there might be danger to life from the combination of bleeding and sepsis, and that the saving of a doubtful limb might not be worth the risk. This situation was not an uncommon one, and a heavy responsibility rested on the surgeon. It was obvious that in the case of the arm a much bigger risk could be taken than in the case of the lower limb. In the first place the arm was so much more valuable and was irreplaceable, but an artificial leg could replace in some degree a normal limb.

Again, infection in the arm was much less serious and the risk of gas gangrene, particularly, was much less.

The risk of secondary haemorrhage must be realised when wounds of the main vessels were deliberately treated expectantly so as to save primary ligature, with its serious threat of gangrene. Such cases must of necessity be retained in the forward operating area for observation and not be evacuated till full stability had been reached. The majority of cases of secondary haemorrhage would, however, arise at the Base as they were due to unsuspected damage to main vessels, which would only be recognised when bleeding started about the tenth day. If this were realised by all surgeons in base hospitals, prompt and satisfactory treatment would be available.

Proximal ligation had the disadvantages of:

(1) The cutting off of collateral circulation in the limb.
(2) The possibility of recurrence of bleeding at the original site of the haemorrhage.
(3) The risk of sepsis at the site of proximal ligation.

Aneurysms

Injuries to main vessels which had not been dealt with at the time of wounding by ligature, or possibly suture, gave rise later to the formation of aneurysms of different types, depending on the degree of original damage to the artery or to the vein. The development of an aneurysm in an arterial haematoma has been discussed under secondary haemorrhage, and because of this complication these cases were generally operated on early and urgently. If haemorrhage did not occur, then an arterial aneurysm might develop and steadily increase in size. There might be an injury of both artery and vein and a junction formed between them either directly or by means of an intermediate channel formed in a haematoma. In the case of an arterial aneurysm there was a pulsatile swelling which gave on auscultation a systolic murmur, whereas in the case of an arterio-venous aneurysm the pulsatile swelling gave a murmur which was continuous. In the arterio-venous cases there was seldom any dilatation or pulsation in the veins.

The symptoms produced by these aneurysms depended on the size of the aneurysm, and on whether it was near to, or distant from, the heart. When there was a well-marked aneurysm near the heart, serious cardiac disturbances might arise. The majority of the distant aneurysms gave rise to little in the way of symptoms, but might demand treatment because of a steady increase in size. There might be special symptoms caused by local pressure such as that produced by the involvement of nerves in the aneurysmal area.

The treatment of these cases demanded sound judgment and much skill. As already stated the arterial haematomata would generally demand early treatment because of haemorrhage or, maybe, because of rapid increase in size. On the other hand the arterio-venous type could usually be dealt with conservatively, or with delayed operation.

The treatment could be summarised as follows:

(1) Leave alone if no symptoms, not increasing in size, and not affecting the heart.

(2) Operate if symptoms are troublesome and increasing, but allow ample time for collateral circulation to be established.

(3) Operate if signs, or probability, of marked cardiac disturbance.

(4) Operate if any signs of urgent symptoms developing.

If operation had been decided on, the question arose as to when this should be done. Realising the danger to the limb of ligature of the main vessels, it was generally agreed that reasonable time should be given for full collateral circulation to become established, and, if in any doubt, the operation should be postponed. A period of several months was necessary so as to be certain of proper circulation in the limb.

Lieutenant-Colonel Mason Brown advised that:

(1) Operation should never be carried out until the collateral circulation was safely established.
(2) Repair was easiest between the sixth week and the sixth month.
(3) If repair was not contemplated, the operation (ligation or excision) must await the maximum development of the collateral circulation.

If operation was carried out the aim should be the preservation of the main arterial circulation, if at all possible. This meant the repair of any arterial defect by suture in preference to the ligation of the vessels. This repair could be undertaken through the false aneurysm formed by the haematoma, or through the vein in the case of the arterio-venous type. The actual arterial wall must be sutured, and not the false lining of the sac. In some arterio-venous cases ligation of the communicating link might be possible, but very rarely. In many cases quadruple ligation of both artery and veins was the only practicable course.

The following six operative procedures were utilised:

(1) Arterial aneurysm: Suture of the true vessel wall after opening the false sac.
(2) Arterio-venous aneurysm: Suture of the arterial defect after exposure through the vein.
(3) Arterio-venous aneurysm: Suture of the artery and ligation of the vein.
(4) Arterial aneurysm: Ligation above and below with excision of the sac, at the same time ligating any branches that were involved. The vein might be left alone or ligated.
(5) Arterio-venous aneurysm: If there was a narrow communication between the vessels this could be ligated and divided.
(6) Arterio-venous aneurysm: Ligation of the artery and the vein above and below (quadruple ligation).

As a pre-operative measure, Boyd suggested sympathectomy, as also did Mason Brown, utilising this if trial injection suggested a favourable response. Reflex dilatation by heat could be given after operation. Heparin could also be used after operation to prevent thrombosis.

The results obtained in experienced hands had been excellent, provided adequate time had been given for the development of satisfactory collateral circulation.

There were some cases of injury to the carotid and subclavian vessels which survived and developed aneurysmal swellings. Our attitude to these was conservative, especially in the carotid cases. One case dealt with by ligation developed hemiplegia and died. One subclavian case was operated on later in New Zealand with success. Another had to have amputation of the arm shortly after wounding, and survived.

Organisation: Special Centres

The first development of a special vascular centre in the MEF was in 1943 in Cairo, when Lieutenant-Colonel A. M. Boyd, RAMC, divisional surgical officer at 63 General Hospital, was recognised as a specialist in this branch and cases were segregated under his care. This proved of great benefit to the force generally, and his special knowledge was utilised by our New Zealand medical officers when any special problems arose. He operated successfully on many cases of aneurysm.

Later in Italy a special Field Vascular Centre was established under the charge of Lieutenant-Colonel L. L. Mason Brown, RAMC. To this centre all cases with wounds of the main vessels were sent from the forward areas. This ensured that they would be under the care of a surgeon with special experience of vascular injury. It also made possible an evaluation of the problems and the results obtained under war conditions in contradistinction to those obtained by research workers. The advice that Mason Brown was able to give at the Rome surgical conference in February 1945 was of the greatest value, and if the war had been more prolonged it would have led to definite changes in the handling of these cases in the forward areas.

There could be no doubt that special centres for vascular surgery were highly desirable, both for treatment and clinical research, and that they should be set up at the outset of any future war. There might be advanced and base sections of the unit, the advanced section being placed along with the trinity of neurosurgical, facio-maxillary and ophthalmic units, close behind the CCS.

General Evaluation

The treatment of injuries to the main vessels complicating war wounds must always be governed by the conditions under which forward surgery is being carried out.

In the presence of a bleeding wound exploration is essential, and the bleeding has to be stopped at the time. It might be possible in the future, in many cases, to do primary suture of the vessel and then hold the case for about fourteen days in the forward operating centres. If this is not possible, it seems that ligation of the vessel is inevitable and, in any case, in the majority of these cases nothing else can be done.

In the case of the popliteal and the femoral vessels, this primary ligation results in the loss of the large majority of the limbs from gangrene. It is for this reason that every effort should be made to obviate ligation at this time. When no bleeding is taking place the treatment will depend on the site of the wound and the condition of the limb. If the wound is through a muscular area, and especially if the wound is large and involves much muscle, then exploration is normally required so as to prevent serious infection of the limb. If there is much swelling of the limb as the result of bleeding into the tissues, this also will demand exploration. If there is, however, only a small wound without any marked bleeding, and little in the way of swelling, a condition which is not uncommon in popliteal injuries, then there should be no exploration and the wound should be treated simply by pad and bandage, at the same time guarding against infection by parenteral penicillin.

This might enable circulation to be carried on to some degree through a partly injured vessel, and normally this will result in an arterial haematoma with the formation of a false aneurysm, prone to secondary haemorrhage but allowing of some development of a collateral circulation. It would seem that the only chance of saving many limbs following popliteal or femoral artery injury is either to treat the case conservatively, or else, if operated on, to do a primary suture of the vessel. The use of cannulae to join the vessel has so far proved unsatisfactory, but further research in this direction is desirable.

If ligation of the main vessel proves inevitable, then relief from possible tension in the distal part of the limb should be ensured by wide incision of the deep fascia. This is all the more necessary if there is any injury to the distal part of the limb. The fact that it still did not prevent the loss of the large majority of the limbs is certainly no argument against it. The desperate situation demands that anything holding out any chance of saving even one limb should be utilised.

The employment of vascular surgeons close to the forward areas might lead to better results in the future, but the bulk of the cases would still have to be dealt with by the forward surgeons in their general treatment of war wounds. There will always be very serious loss of life from vascular injury and also serious loss of limb.

APPENDIX — CASE ILLUSTRATING THE RESULTS OF FASCIOTOMY

A ppendix
CASE ILLUSTRATING THE RESULTS OF FASCIOTOMY

A case is recorded in full illustrating the progress following immediate ligation of the lower end of the femoral artery with associated division of the aponeurosis covering the calf muscles and the anterior compartment of the leg.

Wounded 25 September 1944 by shell with some destruction of muscle and division of the femoral artery in the lower third of Hunter's Canal. the vein being intact. This produced severe bleeding and shock for which he was given two pints of blood at the ADS, the second pint being continued in the ambulance. At the MDS he was given a third pint of blood, and operation was performed.

The report of Major Owen-Johnston, the surgeon, is as follows:

'The femoral artery was divided near the lower limit of Hunter's Canal leaving the vein intact. There was extensive division and laceration of the soft tissues at the level of the junction of the mid and lower third of the thigh. The wound of entry, some two inches in diameter, was over the outer aspect, and that of exit, four by three inches, was over the antero-internal aspect. Almost the whole of the muscle anterior to the femur was divided, as well as a fair mass of the adductors on the inner aspect. So as at least one-third of the muscle mass of the thigh was sectioned, it was thereby less probable that a satisfactory collateral circulation would develop. Also, to minimise the possibility of the onset of Gas Gangrene, a wide area of devitalised muscle was removed-a further embarrassment of any possible collateral circulation. Where the lower femoral or popliteal artery is tied in such wounds, in almost every case the ultimate onset of mass ischaemic necrosis leads to amputation of the limb. It has recently been suggested that splitting of the aponeurosis covering the calf muscles would possibly counteract the onset of ischaemia. In my own personal experience I have found that the splitting of the aponeurosis over the anterior group of leg muscles is most helpful in relieving embarrassment of the leg circulation resulting from severe injury at a higher level.

So, in this case, after dealing with the wounds, we split, throughout the entire length of the leg, the aponeurosis both over the calf and anterior group of muscles. TJie wound was treated with penicillin irrigation, and he also received penicillin intramuscularly. We examined this man again at 1 NZ Gen. Hosp. three days after the operation. His general condition was excellent; he had no complaints; his foot was warm and he could move his toes freely. If ischaemic gangrene does not develop in this case, then I think it can be accepted as a very good test of the efficacy of fasciotomy of the leg aponeurosis in preventing the onset of ischaemia, where the popliteal or lower femoral artery has been tied in battle casualties.

'On 1 Oct. 44 I examined [the patient] at 1 NZ Gen. Hosp. The state of the circulation in the foot had continued to improve. On the 30 Sept. the wounds were all inspected and sutured. The toes were warm, there was no numbness, and he could use them freely.'

Five days later at 1 NZ General Hospital his wounds were sutured without tension. Partial palsy was noted in his leg. The sutures were removed on the 12th day and except for slight superficial stitch sepsis the wounds had all healed well. The circulation of the foot was noted to be good. There was some anaesthesia present on the outer aspect of the foot and pain in the pero-neal and anterior tibial group of muscles. A plaster splint was applied to keep the foot at a right angle. He was then evacuated to 3 NZ General Hospital and boarded for New Zealand. The circulation was noted to be still subnormal and the skin of the foot mottled and the anterior and posterior tibial pulses were not felt. Sensation was impaired below the knee to the ankle, but the sensation in the sole was normal. There was paresis of flexions and extensions of the toes. Physiotherapeutic treatment was instituted. Slow improvement took place in muscle function, but marked muscle wasting was present. He was evacuated to New Zealand, being unable to walk any distance.

When he was examined in October 1945, a year after his wound, he could then walk half a mile and had improved considerably. He had gross tissue loss in adductors and vastus internus. The circulation of the foot was good, and faint pulsation was noted in dorsalis pedis and posterior tibial vessels. He had full movement in the hip, knee and ankle, and slight limitation in the foot. All the muscles of the leg were acting, but both the anterior tibial and the peroneal groups were weak. Sensory loss was confined to the saphenous distribution.

A year later, in 1946, it was noted that he tended to go over on his ankle and that he had some pain on the ball of the foot after walking. He also experienced cramp in the calf in cold weather and some tightness in the calf after walking. He had no limp. He had then strong pulsation in the dorsalis pedis and posterior tibial vessels. A metatarsal bar was provided.

On further examination in November 1947, three years after the injury, he had improved further. There was still some pain in the calf after long walks. The ankle was stronger. There was weakness of flexion of the toes but no calluses on the sole.

In November 1948 he was still experiencing cramp but had no pain in his foot, the sensation of which was normal. There was still weak action of his toe flexors. He had been granted a permanent pension of 15s. a week, equal to 25 per cent disability. He was employed driving a baker's delivery van.

There has been an excellent recovery following the immediate ligation of the lower part of the femoral artery. The radical division of the deep fascia of the calf and the anterior part of the leg in all probability contributed a great deal to the success obtained, and as the wounds of the leg were sutured five days later and healed well with no permanent disability the fascial division certainly did no harm. The association of motor and sensory nerve disability makes the outcome still more satisfactory.

Vascular Injuries Invalided from 2 NZEF, 1940–45

Battle Casualties	
ligatures—	
Brachial artery	21
Brachial artery and vein and ax. vein	1
Subclavian artery	1
Subclavian vein	1
Jugular vein	1
Axillary artery	3
Axillary vein	1
Axillary artery and vein	4
Femoral artery	4

Femoral vein	3
Superficial femoral artery	2
Superficial femoral artery and vein	2
Popliteal artery	2
Popliteal artery and vein	1
Posterior tibial artery	4
Posterior and ant. tibial artery	1
Internal iliac artery	3
lesions—	
Arterio-venous aneurysm neck	1
Aneurysm common carotid artery	2
Arterio-venous aneurysm mastoid region	1
Arterio-venous aneurysm subclavian	1
Aneurysm brachial artery	1
Aneurysm ulnar artery	1
Aneurysm femoral artery	3
Aneurysm post, tibial artery	1
Arterio-venous aneurysm popliteal	4
Arterio-venous aneurysm thigh	1
Haematoma brachial artery	1

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CHAPTER 15 — BURNS

CHAPTER 15
Burns

FIRST WORLD WAR

IN the First World War severe burns were not as common as in the Second World War, though there were at times the special burns associated with mustard gas. This is accounted for by the limited use of petrol in the First World War.

The treatment of burns consisted in the application of various antiseptic dressings. Picric acid in a 1 per cent aqueous solution was commonly used. Ambrine sprayed on to the burnt area was also utilised extensively and was very useful for the more superficial burns, providing a protective and soothing dressing and preventing cross infection. The application of vaseline and tulle gras dressings was a development of the same principle. With ambrine for the more superficial and picric acid for the deeper burns, good results were undoubtedly obtained, but in the absence of adequate resuscitatory measures, and the non-recognition of the profound blood changes present, there was a high mortality from shock.

As a primary application, carron oil had been used before the war, but had been discarded. Later in the war eusol and then Dakin's solution was used as a dressing, both to prevent and to clear up infection. Skin grafting was utilised in the treatment of the severe burns, after preparation with Dakin's solution. The treatment by picric acid carried with it some danger of absorption when used over large raw surfaces, but it was generally a very satisfactory form of treatment.

A radical alteration in the treatment took place after 1925 when tannic acid was introduced by Davidson, and reports were published in America claiming a marked decrease in mortality following its use in several of the larger hospitals. At the same time there was a better appreciation of the treatment of the severe shock associated with extensive burns, and it is possible that part at least of the decrease in mortality was due to the better treatment of shock and the generally better treatment of the patient. The tannic acid treatment then became almost universal, and at the beginning of the Second World War it was the treatment of choice.

SECOND WORLD WAR

Classification of Burns

Before the Second World War burns were classified into many categories depending on the depth of the burn in relation to the different layers of the skin, commencing with the hyperaemia of the skin and extending to the complete destruction of all skin layers. For practical purposes this was of little or no use, and a simple classification of burns into (1) superficial (partial skin loss), and (2) deep (complete skin loss) was adopted and proved quite satisfactory.

Burns accounted for about 10 per cent of all army casualties, and accidental burns were two-thirds of the total. The most common cause was the use of petrol for lighting fires and also as fuel, such as in the Benghazi boiler used for making tea. In spite of repeated warnings petrol was recklessly used by the troops. Non-accidental burns casualties were seen in personnel of armoured cars and tanks.

First-aid Treatment

In the early period of the war in the Middle East first-aid treatment consisted in treatment of the severe shock generally experienced in these cases, and the covering over of any exposed part of the burnt area with sterile dressings. Shock was relieved by warmth from blankets, by copious warm drinks, and by the relief of pain through moderately large doses of morphia. Later, sterile vaseline gauze and tulle gras were supplied to the field units, and these dressings were utilised as a primary dressing for any exposed burn. Plasma and serum were also available, and were administered even in the RAP in the serious cases before evacuation to the forward operating centre.

Resuscitation

It was realised from the beginning of the war that severe shock was always present in any extensive burn, and that if more than a third of the surface of the body was affected the prognosis was grave. The treatment at the forward operating centre, either the CCS or an MDS, was at first the continuance of the first-aid treatment of warmth, free fluids, and morphia, with the addition of intravenous glucose saline, especially when vomiting was present. Blood transfusion was made available in the Middle East and steadily became the regular treatment for shock in wounded cases. It was not given to patients suffering from shock associated with burns in the same way, as it was realised that in burns it was not whole blood loss that was responsible for the condition of shock seen in these cases. Marked haemoconcentration of the blood in severe burns had been recognised prior to the war, and this led to the use of plasma instead of whole blood as the logical treatment for shock in burns cases. It had been known for a long time that there was considerable loss of plasma from the burnt surface, and it had more recently been recognised that there was also a great loss into the tissues around the burnt area. This loss had been estimated at 70 per cent of the total blood volume when one-sixth of the body surface was burnt. The loss from the surface had been one reason for the popularity of the tannic acid treatment, which had largely prevented this loss. The development of severe shock in spite of the tanning showed that the surface loss was not of major importance, and research clearly proved this to be true.

Other causes were thought to be partly responsible for shock, particularly the absorption of histamine substances from the damaged tissues, and the marked reaction from the destruction of skin. Research, however, did not disclose the presence of any histamine bodies, and the loss of plasma was held to be the main contributory factor in the production of shock, which was responsible for nearly 90 per cent of the deaths from burns.

The symptoms of shock were similar to those experienced in wounded cases suffering from loss of whole blood. There was the same fall of blood pressure, the rapid pulse, subnormal temperature, and cold clammy skin. Intravenous plasma was the logical treatment and was advised by Sir Harold Gillies and Rear Admiral Wakeley during the first year of the war. Sufficient supplies of plasma were made available in the Middle East for the treatment of burns, and plasma very soon became established as the routine treatment of shock in burns cases and remained so throughout the war. By July 1942 it was noted that the importance of shock was being more and more realised, and that the haemoconcentration associated with loss of blood plasma into the tissues was considered to be the most important factor demanding treatment. It was then found that large quantities of up to 5 to 7 pints of plasma or serum might be needed and that at first it should be given quickly. This was stressed in December 1942 by Major-General Ogilvie, who advocated the giving of 3 pints quickly in severe cases, a pint in every five minutes, and 8 to 10 pints in the first forty-eight hours. He also advised the giving of a pint of blood to every 2 pints of plasma when any considerable bleeding had occurred. In the absence of plasma or serum, whole blood was given in preference to salines or glucose during the first forty-eight hours, but in smaller quantities.

The giving of large quantites of fluid was advised to ensure a urinary output of at least 700 cc., but preferably 1500 cc.

In 1943 the Burns Sub-Committee of the Medical Research Council War Wounds Committee carried out experiments with regard to fluid loss. The amount of plasma required in relation to the haemoglobin was determined as:

Haemoglobin (Per Cent)	Plasma Required
90	0–250 cc.
95	250
100	500
105	750
110	1000
115	1500
120	1750
125	2000
130	2250

Another method was by use of a haematocrit; 100 cc. plasma were given for every point the haematocrit reading was above 45, plus 25 per cent for every gramme the blood protein was below 6 gm. per 100 cc.

Later research in the United States showed that in severe burns the blood volume might be decreased by at least 2 litres, and the tissue volume by 6 to 10 litres by dehydration, loss of fluid from the surface, and oedema into the tissues. Replacement fluid of 800–1500 cc. was needed in the first forty-eight hours, equal quantities of plasma and saline being advised, as well as fluid by the mouth. A urinary output of 1500–2000 cc. a day was aimed at.

During 1944 the overwhelming importance of shock in the first forty-eight hours was more and more realised, and the primary treatment was concentrated on its relief by the administration of large quantities of plasma and general fluids, with rest and freedom from pain ensured by morphia. It was also realised that evacuation should not be undertaken till shock had been completely relieved. This routine continued till the end of the war.

PRIMARY LOCAL TREATMENT

Tanning

At the beginning of the war treatment by tanning was carried out in the Middle East and generally in Britain. The treatment first carried out in the Middle East consisted of the cleansing of the burnt surface, followed by tanning. Light anaesthesia was used for all but the slight cases. The clothing was removed, blisters were snipped, and the loose epidermis gently removed. The burnt area was then carefully cleansed with pledgets of sterile wool or gauze soaked in normal saline solution. Scrubbing and the use of strong antiseptics were avoided. The surface was then swabbed gently over with 1 per cent aqueous solution of gentian violet and allowed to dry. A 10 per cent solution of tannic acid or silver nitrate was then applied, either by spray or by wool pledgets, and the burn left uncovered to dry, a cage being used to keep off the bedclothes. Further application was seldom necessary, but gentian violet was used at the edge as required. It had been noted that severe painful constriction often occurred in the fingers and wrist, caused by the shrinking of the coagulum. A strip was therefore left untanned on the extensor or flexor aspect, being treated by gentian violet only.

In April 1941 the Burns Committee of the Medical Research Council recommended similar treatment, consisting in cleansing with soap and water and then by saline followed by tanning. Gas and oxygen anaesthesia was recommended. Sulphanilamide powder was dusted on to the dry burnt area before the coagulant was applied. The coagulants used were silver nitrate 10 per cent, tannic acid 10 per cent, silver nitrate 10 per cent and tannic acid 5 per cent alternatively, and triple dye (gentian violet, brilliant green, acriflavine). Sulphanilamide powder was dusted in any cracks. No coagulant, however, was used on the face, hands, wrists, or feet, and circumferential tanning was avoided. The bad results seen in cases treated by tanning of the hands, face, and flexor areas were causing surgeons to question the universal application of tanning. Plastic and orthopaedic surgeons in Britain were agreed that tanning was harmful for hands, feet, or limbs, and in the Middle East it was abolished early and vaseline gauze used instead. The late results of tanning of other areas were also unsatisfactory, and sepsis was found to be prevalent under the adherent sloughs, which were very slow to separate. This is illustrated by the following comment made early in the war: 'An assistant was actually removing, under an anaesthetic, an extensive coagulum from both legs of a burnt patient. Most of it was floating on a bath of foul smelling pus.'

Anxiety was felt at this time at the high mortality, up to 40 per cent, reported in several series of burns casualties. Early in 1942 tanning was being replaced in the MEF by the sulphanilamide and tulle gras, or vaseline gauze, treatment. In the 2 NZEF this was hastened first by the contact of our medical officers with McIndoe in England in 1940 and then with Major Rank of the Australian Forces in the Middle East.

In March 1942 Major Brownlee, our senior plastic surgeon, came to the Middle East after a period of training in England and strongly advised against tanning and advocated the sulphanilamide treatment. By April tanning had been condemned in the MEF, and supplies of vaseline gauze and tulle gras were being prepared at the Base for supply to the field units, including the RMOs.

In July 1942 an experiment carried out at 62 General Hospital, Tobruk, was reported wherein one limb of a patient had been treated by tanning and the other corresponding limb by sulphanilamide and tulle gras dressing. One hundred cases were so treated, and it was demonstrated that the tanned cases were not nearly as satisfactory as the others. This was the end of tanning in the MEF.

Necrosis of the liver was first brought to notice in America in 1940 when a case dying of burns treated with tannic acid was found at post-mortem to have acute necrosis of the liver. The association was confirmed later. In the meantime necrosis of the liver and congestion of the kidney and nephritis had been noted and ascribed to toxaemia and absorption from the damaged tissues. A heavy death rate was also noted, though most of this was due to the early and severe shock. Later investigations into, and experiments in, the treatment of burns by tannic acid showed that liver necrosis had been reported in a considerable number of burned patients treated with tannic acid. Non-fatal cases frequently showed marked disturbance of liver function in the acute phase of the burn. The liver lesion was readily reproduced experimentally. The case against tannic acid was proved.

Sulphonamide Treatment

The early application of sulphanilamide powder to gunshot wounds in the forward areas proved successful in combating sepsis. It was only to be expected that the same treatment would be applied to the burnt areas of the skin when tanning proved unsuitable. As tanning was very harmful when applied to the face, hands, wrists, feet, and flexor areas, sulphanilamide was used for burns of these areas. The treatment was successful, and as tanning was given up later for the treatment of burns of the other parts of the body, sulphanilamide took its place.

The same preliminary cleansing under anaesthetic was carried out with soap and water and saline solution. Blisters were emptied and the raised epidermis removed except in the hands and fingers, the feet and toes, and the ears where the skin was preserved. The sulphanilamide was frosted on the surface by a blower. A vaseline gauze or tulle gras dressing was applied, covered by several layers of dry gauze and cotton wool. Plaster-of-paris splints were often used for the limbs. In extensive burns it was soon learned that there was a danger of absorption of sulphanilamide and the amount dusted on was limited to 10 grammes. Serious symptoms, including delirium and coma, had been observed. Instead of the powder spray, sulphanilamide was mixed with the vaseline or used as an emulsion so as to obviate excessive absorption. Formulae for emulsions were:

(1)	Sulphanilamide	gr.	175
	Arachic oil	oz.	4
	Wool fat	oz.	½
	Aqua calcis to	oz.	8

(2)	Sulphanilamide	10
	Cottonseed oil	27
	Chlorocresol	0.2
	Wool fat	1.5
	Sod. Hydroxide (20 p.c. W/V)	2.1
	Water to	100

Full aseptic precautions were taken in dressing the burns as the likelihood of infection was realised. The dressing was normally left unchanged for fourteen days unless it became soaked.

At re-dressing local sulphanilamide was again applied, but in carefully restricted dosage. The occurrence of sensitisation to sulphonamides following local application had been observed in our hospitals in Egypt, and any large dosage or repeated dosage was deprecated. The value of the treatment was emphasized, however, when it was demonstrated that streptococcal infection was very successfully dealt with by this method. When sulphanilamide was applied locally precautions were taken to see that none was given by the mouth. On the other hand, the sulphonamides were often given by mouth and not locally. Sulphadiazine was given orally in an initial dose of 4.0 grammes, followed by 0.5 gramme four-hourly until kidney function became normal, when the dose was increased to 1 gramme.

The treatment was carried out till the burn was healed or grafted or else, as in our Force, saline bath treatment was substituted at the base hospital.

Penicillin

Penicillin was substituted for the sulphonamide treatment in 1944 as soon as adequate supplies were available. It was first used locally in a sulphathiazole base and reapplied at subsequent dressings. The extent of the burnt area often called for relatively large quantities of penicillin, and its instability and limited period of action rendered it unsatisfactory for repeated local application. As soon as supplies permitted, therefore, it was given parenterally and sulphanilamide or simple protective dressings utilised locally. Parenterally, dosage could be accurately controlled and the results were very satisfactory. The penicillin treatment was continued till early skin grafting could be carried out.

The treatment finally adopted was very much simplified and consisted essentially in covering the burnt area with an atraumatic dressing after the application of penicillin sulphathiazole, the giving of parenteral penicillin, and early skin grafting. Anaesthesia was abolished, as was any definitive cleansing of the wound.

Saline Baths

This treatment was a very old-established one, especially for an infected wound. It was utilised by McIndoe, plastic surgeon in charge of Air Force casualties in England, right from the beginning of the war. He developed a bath unit by means of which a controlled supply of saline solution could be supplied at regulated temperature to baths in which the whole patient could be immersed at regular intervals, generally for an hour daily. This involved a rather elaborate engineering mechanism which required skilled attention. The dressings were allowed to float off in the bath and fresh dressings were applied under aseptic precautions afterwards. When sulphanilamide was introduced as a local application for wounds it was also used for the dressing of the burns. Major Rank, an Australian medical officer, introduced the treatment into the MEF, using an improvised bath unit, and, impressed by his results, 2 NZEF purchased an elaborate bath unit in England and set it up at its hospital at Helwan in 1942. Captain Manchester, who had been trained in England, was in charge of the unit. Baths of 2 per cent warm saline were given for two hours daily. The treatment after bathing was: (a) if the burnt area was fairly clean, spraying of a thin film of sulphanilamide powder while still wet, then covering with tulle gras and saline pack, this being kept wet from a douche can during the day and bandaged firmly with a crepe bandage during the night. (b) If unhealthy, treating without sulphanilamide by eusol instead of saline, and otherwise as under (a) till fairly clean, when sulphanilamide and saline packs were used.

When the burnt area was healthy, as shown by rapidly ingrowing skin edges with fresh-looking granulations, and the absence of streptococci on bacteriological examination, the wound could be at once skin grafted (for which the firm bandaging had created an ideal smooth surface), or sutured, with almost certain success. The streptococcus had been proved to be the cause of delayed healing and the destruction of the growing skin edge. The other organisms were of no special significance. It normally took a week's preparation after any sloughs present were removed.

Full aseptic technique was enforced and the bath was cleaned with 1:20 lysol after each patient. Infection of the bath itself had proved a difficult problem. The Bath Unit at 1 NZ General Hospital, Helwan, was very efficient and proved invaluable not only for the cases of burns, but also for the treatment of large gunshot wounds.

In Italy an improvised bath unit was set up at 2 NZ General Hospital at Caserta in 1944. Two baths were used without any elaborate equipment. A field cooker was used to heat the water. Barrels held the solution of 20 per cent brine and chlorinated water used for the baths. The unit was kept very busy and dealt with as many as twenty cases at a time, and two sisters were fully occupied. Good results were obtained in spite of the imperfect surroundings. Parenteral penicillin, when it became available, was given to control infection.

Treatment of Burns of the Hands

The hand and wrist as well as the face and feet presented special problems in the treatment of burns. It was realised very soon that tanning was unsuitable for these cases.

The Burns Committee of the Medical Research Council in April 1941 recommended dusting with sulphanilamide and then applying a tulle gras dressing covered with gauze wrung out in warm normal saline, the gauze to be kept moist and changed every three to four hours, and the complete dressing changed daily. Saline baths for half an hour or more daily were advised. Stress was laid on asepsis.

A conference of plastic and orthopaedic surgeons in August 1941 recommended atraumatic dressings, saline baths, and early skin grafting. They called attention to the constriction and oedema often present, affecting the interossei and lumbricals, with the danger of the development of claw hand. They considered immobility in this condition could produce a frozen hand, that early mobility was essential, and that the hand should be kept in the optimum position for future function.

In the Middle East tanning was discarded very soon. Sulphanilamide with vaseline gauze and tulle gras dressings were then used in the forward areas, and at Helwan the bath treatment was carried out for New Zealand cases as a preparation for early skin grafting. Care was taken that all skin was preserved on the hands, the blisters being emptied but the epidermis left.

The marked oedematous swelling then began to cause anxiety, as it was realised that this led to coagulation in the tissues and excessive formation of fibrous tissue, with marked delay in the return of function. This was combated by enclosing the arm in a plaster splint or else applying firm bandaging over the dressings. The hand was also kept elevated. Experiments showed that this prevention of swelling enabled healing to occur more rapidly.

The firm bandaging of the hand to prevent swelling interfered with early movement, and two schools arose in consequence. One school favoured treatment by immobilisation in the optimum position of slight dorsiflexion at the wrist, 60 per cent flexion at the metacarpo-phalangeal joints, and 45 per cent at the inter-phalangeal joints with the thumbs in opposition; firm bandaging and plaster utilised with elevation of the hand; fixation of the hand for three to four weeks. The Americans belonged to this school. The other school encouraged early and repeated active movement in the burnt hand (as advocated by McIndoe). Some modified this and encouraged movement after the first period of acute reaction, lasting ten to twelve days.

The method used in the forward areas by our New Zealand units, in common with the British, was the application of penicillin and vaseline gauze dressings, and at our base hospitals we favoured pressure dressings for the first ten to fourteen days, followed by saline baths. In severe cases plaster splinting in the optimum position was carried out, but movements were carried out as soon as possible.

The Bunyan Stannard bags were also thought very suitable for hands, weak Dakin's solution being used for irrigation twice daily.

Skin grafting at the earliest possible moment was deemed the most important part of the treatment, making possible the resumption of functional activity and rehabilitation.

Infection

Infection was the common and most serious complication met with in the treatment of burns. The large areas often involved gave an excellent opportunity for the growth of pathogenic organisms and the absorption of toxic products caused serious general illness. When the tanning treatment was in use the superficial burnt area gave little trouble, but the deeper burns were commonly infected and spread was encouraged by the pocketing possible under the deep adherent sloughs, and the sloughs themselves encouraged infection. Toxaemia was generally marked from the absorption from the extensive septic areas. The treatment necessitated the complete and early removal of the sloughs with or without anaesthesia, followed by the treatment of the infected areas. Saline baths proved of great value and the application of sulphanilamide powder was shown to clear up streptococcal infection. Other antiseptics, especially Dakin's solution, were employed with success and 2 per cent acetic acid was used for pyocyaneus infection. Sulphonamides were also given by mouth. Infection became a lesser problem when the sulphonamide treatment replaced tanning, but deep sloughs had still to be dealt with and wound infection cleaned up in preparation for skin grafting. Saline baths were still used and local antiseptics and sulphonamide therapy. With the introduction of penicillin, infection became much less common and less serious, and the treatment less difficult. Parenteral penicillin generally took care of any infection present and enabled early skin grafting to be carried out. The presence of any raw area was recognised as a potential focus of infection.

Frequent changes of dressings encouraged infection, and care was taken to restrict these, especially when the sulphonamide treatment was adopted. In the final stages of the war, with sulphathiazole-penicillin applied locally and penicillin parenterally and the application of pressure dressings, especially to the hands, dressings were left alone for long periods with satisfactory results. The special value of the Bunyan bag treatment was that it did away with local dressings.

The saline bath treatment necessitated daily dressings, often of very extensive areas. The danger of infection was ever present, and this largely prevented the adoption of this form of treatment away from properly equipped hospitals.

Skin Grafts

These were utilised as the final stage in the healing of the burn and all prior treatment was a preparation for the grafting. In the Middle East the technique employed in grafting varied according to the type of case. Thiersch grafts of some thickness were preferred. They were put on the fresh raw area, or clean granulation area, on top of the thin film of sulphanilamide and a tulle gras dressing applied and bandaged on the part. If very large areas had to be grafted, pinch grafts were often used, and these were also used on small wounds, where the grafting was done as a dressing on the wounds. Pinch grafts were not as satisfactory as the split skin graft. Skin taken from other patients was found to take but subsequently did not grow, so was used solely as a temporary dressing when there was lack of skin.

In plastic work skin was always grafted on any bare area so as to prevent the development of infection.

Whole skin grafts were used in areas such as the bend of the elbow, where the deep structures were exposed and where skin mobility was essential. These grafts were made by simple lifting of a skin flap, generally from the abdomen, again grafting the raw area left by the lifted skin.

The use of the dermatome greatly facilitated the procedure and made very much more skin available. The control of infection, especially streptococcal infection, first by the sulphonamides, and later and better by penicillin, made success in grafting almost assured. The grafting on the fourth day became common and just as satisfactory as the delayed primary suture of wounds. At the end of the war in Italy Brigadier Edwards, RAMC, gave a résumé of the practice followed at that time as follows:

The raw surface is most receptive to free skin 2–4 days after the sloughs are removed, and it has become the practice to graft during this period and to inspect the graft in 4 days, and to graft again any raw areas the natural healing of which will probably be a lengthy process. In the most extensive burns, grafting may have to be performed in stages. The aim in all is to secure healing by grafting within 6 weeks of the original injury for all cases, irrespective of the extent of the burn. Such healing rates are usually achieved except in burns arriving at the centres late. Patch grafts have become the routine form of skin application, and are held in place by fixation with vaseline gauze and a pressure bandage, except in areas where pressure is not applicable. Here a gum elastic glue is used.

Anaesthesia

In the early period of the treatment of burns, cleansing and dressing in the forward areas was done under anaesthesia. It was recognised that pentothal was an unsuitable anaesthetic, but gas and oxygen was not available in the Middle East, and small doses of pentothal were often used. The cleansing of burns became steadily of less importance and anaesthesia was used less and less till it was finally abandoned.

Evacuation

It has already been stressed that severe shock was the most important problem in the management of burns. This was generally most marked in the first forty-eight hours, but often persisted for much longer. It was soon learnt that the patient's condition seriously deteriorated if he was shifted during this period. At first it was thought advisable to evacuate the cases as rapidly as possible to the base hospitals so that their treatment could be more efficiently carried out, but as the treatment became simplified there was not the same reason to shift them, and they were held in the forward areas till full recovery from shock had taken place. It was necessary, however, to evacuate them so as to be able to carry out the reparative treatment, especially early skin grafting, at the base hospital or at the special plastic units sited there. It was also necessary, especially in the period of tanning treatment, to evacuate before infection arose, as the condition of the patients also deteriorated with shifting when they were suffering from the toxaemia associated with infection. Evacuation by air was very satisfactory for these cases.

General Treatment of the Patient

In the early stages the essential treatment consisted in the administration of large quantities of blood plasma to make up for the very considerable loss of plasma into the tissues around the burnt area, and to a lesser extent from the surface of the burn.

In addition to the loss of plasma there was considerable destruction of body tissue, and also general disturbance associated with the severe damage to such a sensitive tissue as the skin. This caused a great deal of metabolic disturbance to the body and contributed to the severe shock invariably present in the serious cases. The treatment given, after the stage of shock had passed, was aimed at assisting the body to recover from the metabolic upset and to regenerate the damaged tissues. A well-marked anaemia generally followed the primary haemo-concentration and whole blood transfusion was required, generally at the tenth day and repeated at intervals later, according to the condition of the patient. Further plasma was also given to supply extra protein. A rich protein diet with vitamin and fruit juices was given. The patients had to be encouraged to take ample quantities as often their appetites were found to be very poor. Iron tonics were also given.

Convalescence and Rehabilitation

The seriously burnt patient was markedly debilitated and special steps were taken to hasten his convalescence. Physiotherapy was of importance in many cases, especially where burns involved the arms and hands, and exercises were instituted at the earliest possible moment. Occupational therapy was a valuable help to many of these patients who had a long struggle back to normal function. The psychological help given at all stages was of particular importance to those who were mutilated and seriously handicapped.

Mustard Gas Burns

No. 3 NZ General Hospital had some experience of the effects produced by mustard gas when casualties were admitted following an air raid on Bari harbour on 2 December 1943. The patients had been immersed in the sea, were cold and wet, and were suffering from severe degrees of shock, and in some cases from very severe injuries. Almost all were covered with a thick deposit of fuel oil. Lieutenant-Colonel L. A. Bennett described their condition as follows:

At the end of 12 hours a number of patients began to complain of pain in the eyes and blistering about the face and the neck. The signs in these cases were different from those diagnosed as 'flash' burns in that there was no singeing of eyebrows or hair. Rapid degeneration of the general condition occurred in a number of cases and coincidentally extensive areas of blistering appeared on covered parts of the body, notably axillary, perineal, and scrotal regions. These were diagnosed 'chemical' burns. On the 4 December information was received that the water and oil in which they had been immersed was contaminated with a dilute concentration of mustard gas. Thereupon those cases (42 in number) showing blistering and a severe degree of conjunctivitis were transferred to one ward. In all there were 14 deaths, 2 in the first few hours, and the remainder over the following 10 days.

Post mortem examinations were carried out on 10 cases. Certain findings were similar in all cases and in one group there were additional abnormal pathological appearances. Briefly described these were:

Group A (5 cases):

(i) Very extensive loss of superficial skin over face, hands, arms, buttocks, lateral wall of chest and scrotal regions.

(ii) Brownish pigmentation of remaining skin.

(iii) Marked chemosis of conjunctivae.

(iv) Intense congestion and oedema of larynx, severe degree of tracheitis (in two cases showing minute areas of actual ulceration). Similar congestion of upper end of oesophagus with pallor of the remainder of the oesophagus beyond the cricoid cartilage.

Group B (5 cases):

Similar findings as (i) to (iv) above.

(v) Signs of 'Blast' injury to lungs in all cases—also in one case in heart and kidneys. These signs were subserous haemorrhages plus other characteristic areas of haemorrhage deeper in the organs concerned.

Owing to transfer of most of these patients to other hospitals, their subsequent history is incomplete. Three patients, however, remained till 23 Dec., and they, as well as two still under treatment at 2 Jan. 1944, show no after effects of conjunctivitis and are healing satisfactorily without scar formation of 'burnt' areas.

Phosphorus Burns

A small number of phosphorus burns were seen during the war. Phosphorus was present in certain shells, bombs, mortars, and incendiary bullets. Special treatment was necessary both to neutralise the effect of the phosphorus and to remove the particles from the wound.

First aid consisted in the application of water either by immersion of the wounded area in water or the application of wet dressings. Bicarbonate of soda solution in a strength of at least 5 per cent was applied as soon as it was available to neutralise the acid oxide of phosphorus. The solution was not hot, so as to guard against conversion into the carbonate which caused pain. The wound was then swabbed with 1 per cent copper sulphate solution, which helped to stop the burning and made the particles more easily recognisable. They were then removed with forceps and the wound again soaked in bicarbonate for one to two hours. Further search in the dark for particles was made and the bicarbonate soaks continued till all action ceased. Vaseline and other greasy dressings, triple dye and brilliant green were avoided. The further treatment was the same as for the ordinary burn.

Experiments carried out by the Burns Sub-Committee of the Medical Research Council showed that the risks of phosphorus poisoning from absorption were negligible.

Summary

In the 1914–18 War the treatment of burns consisted in the application of picric acid dressings to, or the spraying of ambrine wax on, the burnt area. Glucose saline and gum acacia intravenous medication was given to relieve shock.

In 1925 treatment by tannic acid was introduced in the United States with reports of a marked lowering in mortality, and great interest was taken in the new treatment. This treatment became almost universal for severe and extensive burns. There also arose a realisation of the importance of the severe shock present and gradually the biochemical changes were worked out.

At the beginning of the 1939–45 War the tanning treatment was the approved treatment in the army, and was laid down by the co-ordinating team on burns of the War Wounds Committee of the MRC in April 1941. It had been realised already, however, that this treatment was not suitable for burns of the face, hands, wrists and feet.

In the Air Force, however, McIndoe had from the beginning of the war treated the serious aeroplane burns by saline baths and non-traumatic dressings, and utilised the sulphonamides for local and general bacterio-stasis.

In the treatment of shock, morphia in large doses and warmth, fluid by the mouth, and especially intravenous plasma and blood, were recommended. For some time tanning by different techniques remained the normal method of treatment in the army, though the saline bath treatment was adopted in certain units, especially by the plastic surgeons. The slough present in the deep burns began to give rise to trouble because of the associated sepsis and the delay in healing.

The mortality in cases treated by tanning began to cause concern, and it was then found that necrosis of the liver seen in post-mortems of those cases was caused by tannic acid absorption. This, along with the appreciation of the good results obtained by sulphonamide therapy, non-traumatic dressings and saline baths, led to the discarding of tanning. Simple wound cleansing, local sulphanilamide frosting, vaseline or tulle gras dressings, and infrequent dressings became the accepted treatment and the early application of skin grafts to the deep burns was carried out. As regards shock, the enormous loss of plasma into the tissues around the burnt areas, with the consequent haemo-concentration, was more and more realised, and very large quantities of plasma were given rapidly in the first forty-eight hours.

Cleansing under anaesthesia was delayed till shock was relieved, but later anaesthesia was completely given up, and the cleansing became gentler and gentler and finally was also given up for the ordinary clean burn.

The marked oedematous swelling was also counteracted by firm pressure dressings, especially in the hand where the oedema tended to leave behind marked adhesions.

When penicillin was introduced it was applied locally in a sulphonamide base and then, as sufficient supplies became available, full parenteral dosage was given to the severe cases. Saline baths were still used in some cases, especially when the burnt area was very extensive. Skin grafting was carried out at the earliest possible moment, either as a temporary dressing or as a final treatment. It was recognised that as long as a wound was open it was an invitation to infection, and a source of toxaemia.

At the end of the war the essential elements in the treatment of patients with serious burns were the administration of blood plasma or serum, the application of pressure dressings, the parenteral and local administration of penicillin, and the early skin grafting of all deep burns. Blood transfusion, high protein diet, iron tonics, and vitamins were all needed to counter the anaemia and debilitation present in burns cases. Early rehabilitation was also of great importance physically and psychologically.

Burns Cases Admitted to Hospital, 2 NZEF

	1943	1944	1945	Total
Battle casualties	24	58	20	102
Accidental injuries	323	436	242	10001

Cases Invalided from 2 NZEF, 1940–45

Cause	BC	AI
Phosphorus	7	2
Cordite	5	1
Petrol	3	18
Petrol tank	1	
Tank	1	
Mine	1	

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FIRST WORLD WAR

IN the First World War severe burns were not as common as in the Second World War, though there were at times the special burns associated with mustard gas. This is accounted for by the limited use of petrol in the First World War.

The treatment of burns consisted in the application of various antiseptic dressings. Picric acid in a 1 per cent aqueous solution was commonly used. Ambrine sprayed on to the burnt area was also utilised extensively and was very useful for the more superficial burns, providing a protective and soothing dressing and preventing cross infection. The application of vaseline and tulle gras dressings was a development of the same principle. With ambrine for the more superficial and picric acid for the deeper burns, good results were undoubtedly obtained, but in the absence of adequate resuscitatory measures, and the non-recognition of the profound blood changes present, there was a high mortality from shock.

As a primary application, carron oil had been used before the war, but had been discarded. Later in the war eusol and then Dakin's solution was used as a dressing, both to prevent and to clear up infection. Skin grafting was utilised in the treatment of the severe burns, after preparation with Dakin's solution. The treatment by picric acid carried with it some danger of absorption when used over large raw surfaces, but it was generally a very satisfactory form of treatment.

A radical alteration in the treatment took place after 1925 when tannic acid was introduced by Davidson, and reports were published in America claiming a marked decrease in mortality following its use in several of the larger hospitals. At the same time there was a better appreciation of the treatment of the severe shock associated with extensive burns, and it is possible that part at least of the decrease in mortality was due to the better treatment of shock and the generally better treatment of the patient. The tannic acid treatment then became almost universal, and at the beginning of the Second World War it was the treatment of choice.

SECOND WORLD WAR

Classification of Burns

Before the Second World War burns were classified into many categories depending on the depth of the burn in relation to the different layers of the skin, commencing with the hyperaemia of the skin and extending to the complete destruction of all skin layers. For practical purposes this was of little or no use, and a simple classification of burns into (1) superficial (partial skin loss), and (2) deep (complete skin loss) was adopted and proved quite satisfactory.

Burns accounted for about 10 per cent of all army casualties, and accidental burns were two-thirds of the total. The most common cause was the use of petrol for lighting fires and also as fuel, such as in the Benghazi boiler used for making tea. In spite of repeated warnings petrol was recklessly used by the troops. Non-accidental burns casualties were seen in personnel of armoured cars and tanks.

First-aid Treatment

In the early period of the war in the Middle East first-aid treatment consisted in treatment of the severe shock generally experienced in these cases, and the covering over of any exposed part of the burnt area with sterile dressings. Shock was relieved by warmth from blankets, by copious warm drinks, and by the relief of pain through moderately large doses of morphia. Later, sterile vaseline gauze and tulle gras were supplied to the field units, and these dressings were utilised as a primary dressing for any exposed burn. Plasma and serum were also available, and were administered even in the RAP in the serious cases before evacuation to the forward operating centre.

Resuscitation

It was realised from the beginning of the war that severe shock was always present in any extensive burn, and that if more than a third of the surface of the body was affected the prognosis was grave. The treatment at the forward operating centre, either the CCS or an MDS, was at first the continuance of the first-aid treatment of warmth, free fluids, and morphia, with the addition of intravenous glucose saline, especially when vomiting was present. Blood transfusion was made available in the Middle East and steadily became the regular treatment for shock in wounded cases. It was not given to patients suffering from shock associated with burns in the same way, as it was realised that in burns it was not whole blood loss that was responsible for the condition of shock seen in these cases. Marked haemoconcentration of the blood in severe burns had been recognised prior to the war, and this led to the use of plasma instead of whole blood as the logical treatment for shock in burns cases. It had been known for a long time that there was considerable loss of plasma from the burnt surface, and it had more recently been recognised that there was also a great loss into the tissues around the burnt area. This loss had been estimated at 70 per cent of the total blood volume when one-sixth of the body surface was burnt. The loss from the surface had been one reason for the popularity of the tannic acid treatment, which had largely prevented this loss. The development of severe shock in spite of the tanning showed that the surface loss was not of major importance, and research clearly proved this to be true.

Other causes were thought to be partly responsible for shock, particularly the absorption of histamine substances from the damaged tissues, and the marked reaction from the destruction of skin. Research, however, did not disclose the presence of any histamine bodies, and the loss of plasma was held to be the main contributory factor in the production of shock, which was responsible for nearly 90 per cent of the deaths from burns.

The symptoms of shock were similar to those experienced in wounded cases suffering from loss of whole blood. There was the same fall of blood pressure, the rapid pulse, subnormal temperature, and cold clammy skin. Intravenous plasma was the logical treatment and was advised by Sir Harold Gillies and Rear Admiral Wakeley during the first year of the war. Sufficient supplies of plasma were made available in the Middle East for the treatment of burns, and plasma very soon became established as the routine treatment of shock in burns cases and remained so throughout the war. By July 1942 it was noted that the importance of shock was being more and more realised, and that the haemoconcentration associated with loss of blood plasma into the tissues was considered to be the most important factor demanding treatment. It was then found that large quantities of up to 5 to 7 pints of plasma or serum might be needed and that at first it should be given quickly. This was stressed in December 1942 by Major-General Ogilvie, who advocated the giving of 3 pints quickly in severe cases, a pint in every five minutes, and 8 to 10 pints in the first forty-eight hours. He also advised the giving of a pint of blood to every 2 pints of plasma when any considerable bleeding had occurred. In the absence of plasma or serum, whole blood was given in preference to salines or glucose during the first forty-eight hours, but in smaller quantities.

The giving of large quantites of fluid was advised to ensure a urinary output of at least 700 cc., but preferably 1500 cc.

In 1943 the Burns Sub-Committee of the Medical Research Council War Wounds Committee carried out experiments with regard to fluid loss. The amount of plasma required in relation to the haemoglobin was determined as:

Haemoglobin (Per Cent)	Plasma Required
90	0–250 cc.
95	250
100	500
105	750
110	1000
115	1500
120	1750
125	2000
130	2250

Another method was by use of a haematocrit; 100 cc. plasma were given for every point the haematocrit reading was above 45, plus 25 per cent for every gramme the blood protein was below 6 gm. per 100 cc.

Later research in the United States showed that in severe burns the blood volume might be decreased by at least 2 litres, and the tissue volume by 6 to 10 litres by dehydration, loss of fluid from the surface, and oedema into the tissues. Replacement fluid of 800–1500 cc. was needed in the first forty-eight hours, equal quantities of plasma and saline being advised, as well as fluid by the mouth. A urinary output of 1500–2000 cc. a day was aimed at.

During 1944 the overwhelming importance of shock in the first forty-eight hours was more and more realised, and the primary treatment was concentrated on its relief by the administration of large quantities of plasma and general fluids, with rest and freedom from pain ensured by morphia. It was also realised that evacuation should not be undertaken till shock had been completely relieved. This routine continued till the end of the war.

PRIMARY LOCAL TREATMENT

Tanning

At the beginning of the war treatment by tanning was carried out in the Middle East and generally in Britain. The treatment first carried out in the Middle East consisted of the cleansing of the burnt surface, followed by tanning. Light anaesthesia was used for all but the slight cases. The clothing was removed, blisters were snipped, and the loose epidermis gently removed. The burnt area was then carefully cleansed with pledgets of sterile wool or gauze soaked in normal saline solution. Scrubbing and the use of strong antiseptics were avoided. The surface was then swabbed gently over with 1 per cent aqueous solution of gentian violet and allowed to dry. A 10 per cent solution of tannic acid or silver nitrate was then applied, either by spray or by wool pledgets, and the burn left uncovered to dry, a cage being used to keep off the bedclothes. Further application was seldom necessary, but gentian violet was used at the edge as required. It had been noted that severe painful constriction often occurred in the fingers and wrist, caused by the shrinking of the coagulum. A strip was therefore left untanned on the extensor or flexor aspect, being treated by gentian violet only.

In April 1941 the Burns Committee of the Medical Research Council recommended similar treatment, consisting in cleansing with soap and water and then by saline followed by tanning. Gas and oxygen anaesthesia was recommended. Sulphanilamide powder was dusted on to the dry burnt area before the coagulant was applied. The coagulants used were silver nitrate 10 per cent, tannic acid 10 per cent, silver nitrate 10 per cent and tannic acid 5 per cent alternatively, and triple dye (gentian violet, brilliant green, acriflavine). Sulphanilamide powder was dusted in any cracks. No coagulant, however, was used on the face, hands, wrists, or feet, and circumferential tanning was avoided. The bad results seen in cases treated by tanning of the hands, face, and flexor areas were causing surgeons to question the universal application of tanning. Plastic and orthopaedic surgeons in Britain were agreed that tanning was harmful for hands, feet, or limbs, and in the Middle East it was abolished early and vaseline gauze used instead. The late results of tanning of other areas were also unsatisfactory, and sepsis was found to be prevalent under the adherent sloughs, which were very slow to separate. This is illustrated by the following comment made early in the war: 'An assistant was actually removing, under an anaesthetic, an extensive coagulum from both legs of a burnt patient. Most of it was floating on a bath of foul smelling pus.'

Anxiety was felt at this time at the high mortality, up to 40 per cent, reported in several series of burns casualties. Early in 1942 tanning was being replaced in the MEF by the sulphanilamide and tulle gras, or vaseline gauze, treatment. In the 2 NZEF this was hastened first by the contact of our medical officers with McIndoe in England in 1940 and then with Major Rank of the Australian Forces in the Middle East.

In March 1942 Major Brownlee, our senior plastic surgeon, came to the Middle East after a period of training in England and strongly advised against tanning and advocated the sulphanilamide treatment. By April tanning had been condemned in the MEF, and supplies of vaseline gauze and tulle gras were being prepared at the Base for supply to the field units, including the RMOs.

In July 1942 an experiment carried out at 62 General Hospital, Tobruk, was reported wherein one limb of a patient had been treated by tanning and the other corresponding limb by sulphanilamide and tulle gras dressing. One hundred cases were so treated, and it was demonstrated that the tanned cases were not nearly as satisfactory as the others. This was the end of tanning in the MEF.

Necrosis of the liver was first brought to notice in America in 1940 when a case dying of burns treated with tannic acid was found at post-mortem to have acute necrosis of the liver. The association was confirmed later. In the meantime necrosis of the liver and congestion of the kidney and nephritis had been noted and ascribed to toxaemia and absorption from the damaged tissues. A heavy death rate was also noted, though most of this was due to the early and severe shock. Later investigations into, and experiments in, the treatment of burns by tannic acid showed that liver necrosis had been reported in a considerable number of burned patients treated with tannic acid. Non-fatal cases frequently showed marked disturbance of liver function in the acute phase of the burn. The liver lesion was readily reproduced experimentally. The case against tannic acid was proved.

Sulphonamide Treatment

The early application of sulphanilamide powder to gunshot wounds in the forward areas proved successful in combating sepsis. It was only to be expected that the same treatment would be applied to the burnt areas of the skin when tanning proved unsuitable. As tanning was very harmful when applied to the face, hands, wrists, feet, and flexor areas, sulphanilamide was used for burns of these areas. The treatment was successful, and as tanning was given up later for the treatment of burns of the other parts of the body, sulphanilamide took its place.

The same preliminary cleansing under anaesthetic was carried out with soap and water and saline solution. Blisters were emptied and the raised epidermis removed except in the hands and fingers, the feet and toes, and the ears where the skin was preserved. The sulphanilamide was frosted on the surface by a blower. A vaseline gauze or tulle gras dressing was applied, covered by several layers of dry gauze and cotton wool. Plaster-of-paris splints were often used for the limbs. In extensive burns it was soon learned that there was a danger of absorption of sulphanilamide and the amount dusted on was limited to 10 grammes. Serious symptoms, including delirium and coma, had been observed. Instead of the powder spray, sulphanilamide was mixed with the vaseline or used as an emulsion so as to obviate excessive absorption. Formulae for emulsions were:

(1)	Sulphanilamide	gr.	175
	Arachic oil	oz.	4
	Wool fat	oz.	½
	Aqua calcis to	oz.	8

(2)	Sulphanilamide	10
	Cottonseed oil	27
	Chlorocresol	0.2
	Wool fat	1.5
	Sod. Hydroxide (20 p.c. W/V)	2.1
	Water to	100

Full aseptic precautions were taken in dressing the burns as the likelihood of infection was realised. The dressing was normally left unchanged for fourteen days unless it became soaked.

At re-dressing local sulphanilamide was again applied, but in carefully restricted dosage. The occurrence of sensitisation to sulphonamides following local application had been observed in our hospitals in Egypt, and any large dosage or repeated dosage was deprecated. The value of the treatment was emphasized, however, when it was demonstrated that streptococcal infection was very successfully dealt with by this method. When sulphanilamide was applied locally precautions were taken to see that none was given by the mouth. On the other hand, the sulphonamides were often given by mouth and not locally. Sulphadiazine was given orally in an initial dose of 4.0 grammes, followed by 0.5 gramme four-hourly until kidney function became normal, when the dose was increased to 1 gramme.

The treatment was carried out till the burn was healed or grafted or else, as in our Force, saline bath treatment was substituted at the base hospital.

Penicillin

Penicillin was substituted for the sulphonamide treatment in 1944 as soon as adequate supplies were available. It was first used locally in a sulphathiazole base and reapplied at subsequent dressings. The extent of the burnt area often called for relatively large quantities of penicillin, and its instability and limited period of action rendered it unsatisfactory for repeated local application. As soon as supplies permitted, therefore, it was given parenterally and sulphanilamide or simple protective dressings utilised locally. Parenterally, dosage could be accurately controlled and the results were very satisfactory. The penicillin treatment was continued till early skin grafting could be carried out.

The treatment finally adopted was very much simplified and consisted essentially in covering the burnt area with an atraumatic dressing after the application of penicillin sulphathiazole, the giving of parenteral penicillin, and early skin grafting. Anaesthesia was abolished, as was any definitive cleansing of the wound.

Saline Baths

This treatment was a very old-established one, especially for an infected wound. It was utilised by McIndoe, plastic surgeon in charge of Air Force casualties in England, right from the beginning of the war. He developed a bath unit by means of which a controlled supply of saline solution could be supplied at regulated temperature to baths in which the whole patient could be immersed at regular intervals, generally for an hour daily. This involved a rather elaborate engineering mechanism which required skilled attention. The dressings were allowed to float off in the bath and fresh dressings were applied under aseptic precautions afterwards. When sulphanilamide was introduced as a local application for wounds it was also used for the dressing of the burns. Major Rank, an Australian medical officer, introduced the treatment into the MEF, using an improvised bath unit, and, impressed by his results, 2 NZEF purchased an elaborate bath unit in England and set it up at its hospital at Helwan in 1942. Captain Manchester, who had been trained in England, was in charge of the unit. Baths of 2 per cent warm saline were given for two hours daily. The treatment after bathing was: (a) if the burnt area was fairly clean, spraying of a thin film of sulphanilamide powder while still wet, then covering with tulle gras and saline pack, this being kept wet from a douche can during the day and bandaged firmly with a crepe bandage during the night. (b) If unhealthy, treating without sulphanilamide by eusol instead of saline, and otherwise as under (a) till fairly clean, when sulphanilamide and saline packs were used.

When the burnt area was healthy, as shown by rapidly ingrowing skin edges with fresh-looking granulations, and the absence of streptococci on bacteriological examination, the wound could be at once skin grafted (for which the firm bandaging had created an ideal smooth surface), or sutured, with almost certain success. The streptococcus had been proved to be the cause of delayed healing and the destruction of the growing skin edge. The other organisms were of no special significance. It normally took a week's preparation after any sloughs present were removed.

Full aseptic technique was enforced and the bath was cleaned with 1:20 lysol after each patient. Infection of the bath itself had proved a difficult problem. The Bath Unit at 1 NZ General Hospital, Helwan, was very efficient and proved invaluable not only for the cases of burns, but also for the treatment of large gunshot wounds.

In Italy an improvised bath unit was set up at 2 NZ General Hospital at Caserta in 1944. Two baths were used without any elaborate equipment. A field cooker was used to heat the water. Barrels held the solution of 20 per cent brine and chlorinated water used for the baths. The unit was kept very busy and dealt with as many as twenty cases at a time, and two sisters were fully occupied. Good results were obtained in spite of the imperfect surroundings. Parenteral penicillin, when it became available, was given to control infection.

Treatment of Burns of the Hands

The hand and wrist as well as the face and feet presented special problems in the treatment of burns. It was realised very soon that tanning was unsuitable for these cases.

The Burns Committee of the Medical Research Council in April 1941 recommended dusting with sulphanilamide and then applying a tulle gras dressing covered with gauze wrung out in warm normal saline, the gauze to be kept moist and changed every three to four hours, and the complete dressing changed daily. Saline baths for half an hour or more daily were advised. Stress was laid on asepsis.

A conference of plastic and orthopaedic surgeons in August 1941 recommended atraumatic dressings, saline baths, and early skin grafting. They called attention to the constriction and oedema often present, affecting the interossei and lumbricals, with the danger of the development of claw hand. They considered immobility in this condition could produce a frozen hand, that early mobility was essential, and that the hand should be kept in the optimum position for future function.

In the Middle East tanning was discarded very soon. Sulphanilamide with vaseline gauze and tulle gras dressings were then used in the forward areas, and at Helwan the bath treatment was carried out for New Zealand cases as a preparation for early skin grafting. Care was taken that all skin was preserved on the hands, the blisters being emptied but the epidermis left.

The marked oedematous swelling then began to cause anxiety, as it was realised that this led to coagulation in the tissues and excessive formation of fibrous tissue, with marked delay in the return of function. This was combated by enclosing the arm in a plaster splint or else applying firm bandaging over the dressings. The hand was also kept elevated. Experiments showed that this prevention of swelling enabled healing to occur more rapidly.

The firm bandaging of the hand to prevent swelling interfered with early movement, and two schools arose in consequence. One school favoured treatment by immobilisation in the optimum position of slight dorsiflexion at the wrist, 60 per cent flexion at the metacarpo-phalangeal joints, and 45 per cent at the inter-phalangeal joints with the thumbs in opposition; firm bandaging and plaster utilised with elevation of the hand; fixation of the hand for three to four weeks. The Americans belonged to this school. The other school encouraged early and repeated active movement in the burnt hand (as advocated by McIndoe). Some modified this and encouraged movement after the first period of acute reaction, lasting ten to twelve days.

The method used in the forward areas by our New Zealand units, in common with the British, was the application of penicillin and vaseline gauze dressings, and at our base hospitals we favoured pressure dressings for the first ten to fourteen days, followed by saline baths. In severe cases plaster splinting in the optimum position was carried out, but movements were carried out as soon as possible.

The Bunyan Stannard bags were also thought very suitable for hands, weak Dakin's solution being used for irrigation twice daily.

Skin grafting at the earliest possible moment was deemed the most important part of the treatment, making possible the resumption of functional activity and rehabilitation.

Infection

Infection was the common and most serious complication met with in the treatment of burns. The large areas often involved gave an excellent opportunity for the growth of pathogenic organisms and the absorption of toxic products caused serious general illness. When the tanning treatment was in use the superficial burnt area gave little trouble, but the deeper burns were commonly infected and spread was encouraged by the pocketing possible under the deep adherent sloughs, and the sloughs themselves encouraged infection. Toxaemia was generally marked from the absorption from the extensive septic areas. The treatment necessitated the complete and early removal of the sloughs with or without anaesthesia, followed by the treatment of the infected areas. Saline baths proved of great value and the application of sulphanilamide powder was shown to clear up streptococcal infection. Other antiseptics, especially Dakin's solution, were employed with success and 2 per cent acetic acid was used for pyocyaneus infection. Sulphonamides were also given by mouth. Infection became a lesser problem when the sulphonamide treatment replaced tanning, but deep sloughs had still to be dealt with and wound infection cleaned up in preparation for skin grafting. Saline baths were still used and local antiseptics and sulphonamide therapy. With the introduction of penicillin, infection became much less common and less serious, and the treatment less difficult. Parenteral penicillin generally took care of any infection present and enabled early skin grafting to be carried out. The presence of any raw area was recognised as a potential focus of infection.

Frequent changes of dressings encouraged infection, and care was taken to restrict these, especially when the sulphonamide treatment was adopted. In the final stages of the war, with sulphathiazole-penicillin applied locally and penicillin parenterally and the application of pressure dressings, especially to the hands, dressings were left alone for long periods with satisfactory results. The special value of the Bunyan bag treatment was that it did away with local dressings.

The saline bath treatment necessitated daily dressings, often of very extensive areas. The danger of infection was ever present, and this largely prevented the adoption of this form of treatment away from properly equipped hospitals.

Skin Grafts

These were utilised as the final stage in the healing of the burn and all prior treatment was a preparation for the grafting. In the Middle East the technique employed in grafting varied according to the type of case. Thiersch grafts of some thickness were preferred. They were put on the fresh raw area, or clean granulation area, on top of the thin film of sulphanilamide and a tulle gras dressing applied and bandaged on the part. If very large areas had to be grafted, pinch grafts were often used, and these were also used on small wounds, where the grafting was done as a dressing on the wounds. Pinch grafts were not as satisfactory as the split skin graft. Skin taken from other patients was found to take but subsequently did not grow, so was used solely as a temporary dressing when there was lack of skin.

In plastic work skin was always grafted on any bare area so as to prevent the development of infection.

Whole skin grafts were used in areas such as the bend of the elbow, where the deep structures were exposed and where skin mobility was essential. These grafts were made by simple lifting of a skin flap, generally from the abdomen, again grafting the raw area left by the lifted skin.

The use of the dermatome greatly facilitated the procedure and made very much more skin available. The control of infection, especially streptococcal infection, first by the sulphonamides, and later and better by penicillin, made success in grafting almost assured. The grafting on the fourth day became common and just as satisfactory as the delayed primary suture of wounds. At the end of the war in Italy Brigadier Edwards, RAMC, gave a résumé of the practice followed at that time as follows:

The raw surface is most receptive to free skin 2–4 days after the sloughs are removed, and it has become the practice to graft during this period and to inspect the graft in 4 days, and to graft again any raw areas the natural healing of which will probably be a lengthy process. In the most extensive burns, grafting may have to be performed in stages. The aim in all is to secure healing by grafting within 6 weeks of the original injury for all cases, irrespective of the extent of the burn. Such healing rates are usually achieved except in burns arriving at the centres late. Patch grafts have become the routine form of skin application, and are held in place by fixation with vaseline gauze and a pressure bandage, except in areas where pressure is not applicable. Here a gum elastic glue is used.

Anaesthesia

In the early period of the treatment of burns, cleansing and dressing in the forward areas was done under anaesthesia. It was recognised that pentothal was an unsuitable anaesthetic, but gas and oxygen was not available in the Middle East, and small doses of pentothal were often used. The cleansing of burns became steadily of less importance and anaesthesia was used less and less till it was finally abandoned.

Evacuation

It has already been stressed that severe shock was the most important problem in the management of burns. This was generally most marked in the first forty-eight hours, but often persisted for much longer. It was soon learnt that the patient's condition seriously deteriorated if he was shifted during this period. At first it was thought advisable to evacuate the cases as rapidly as possible to the base hospitals so that their treatment could be more efficiently carried out, but as the treatment became simplified there was not the same reason to shift them, and they were held in the forward areas till full recovery from shock had taken place. It was necessary, however, to evacuate them so as to be able to carry out the reparative treatment, especially early skin grafting, at the base hospital or at the special plastic units sited there. It was also necessary, especially in the period of tanning treatment, to evacuate before infection arose, as the condition of the patients also deteriorated with shifting when they were suffering from the toxaemia associated with infection. Evacuation by air was very satisfactory for these cases.

General Treatment of the Patient

In the early stages the essential treatment consisted in the administration of large quantities of blood plasma to make up for the very considerable loss of plasma into the tissues around the burnt area, and to a lesser extent from the surface of the burn.

In addition to the loss of plasma there was considerable destruction of body tissue, and also general disturbance associated with the severe damage to such a sensitive tissue as the skin. This caused a great deal of metabolic disturbance to the body and contributed to the severe shock invariably present in the serious cases. The treatment given, after the stage of shock had passed, was aimed at assisting the body to recover from the metabolic upset and to regenerate the damaged tissues. A well-marked anaemia generally followed the primary haemo-concentration and whole blood transfusion was required, generally at the tenth day and repeated at intervals later, according to the condition of the patient. Further plasma was also given to supply extra protein. A rich protein diet with vitamin and fruit juices was given. The patients had to be encouraged to take ample quantities as often their appetites were found to be very poor. Iron tonics were also given.

Convalescence and Rehabilitation

The seriously burnt patient was markedly debilitated and special steps were taken to hasten his convalescence. Physiotherapy was of importance in many cases, especially where burns involved the arms and hands, and exercises were instituted at the earliest possible moment. Occupational therapy was a valuable help to many of these patients who had a long struggle back to normal function. The psychological help given at all stages was of particular importance to those who were mutilated and seriously handicapped.

Mustard Gas Burns

No. 3 NZ General Hospital had some experience of the effects produced by mustard gas when casualties were admitted following an air raid on Bari harbour on 2 December 1943. The patients had been immersed in the sea, were cold and wet, and were suffering from severe degrees of shock, and in some cases from very severe injuries. Almost all were covered with a thick deposit of fuel oil. Lieutenant-Colonel L. A. Bennett described their condition as follows:

At the end of 12 hours a number of patients began to complain of pain in the eyes and blistering about the face and the neck. The signs in these cases were different from those diagnosed as 'flash' burns in that there was no singeing of eyebrows or hair. Rapid degeneration of the general condition occurred in a number of cases and coincidentally extensive areas of blistering appeared on covered parts of the body, notably axillary, perineal, and scrotal regions. These were diagnosed 'chemical' burns. On the 4 December information was received that the water and oil in which they had been immersed was contaminated with a dilute concentration of mustard gas. Thereupon those cases (42 in number) showing blistering and a severe degree of conjunctivitis were transferred to one ward. In all there were 14 deaths, 2 in the first few hours, and the remainder over the following 10 days.

Post mortem examinations were carried out on 10 cases. Certain findings were similar in all cases and in one group there were additional abnormal pathological appearances. Briefly described these were:

Group A (5 cases):

(i) Very extensive loss of superficial skin over face, hands, arms, buttocks, lateral wall of chest and scrotal regions.

(ii) Brownish pigmentation of remaining skin.

(iii) Marked chemosis of conjunctivae.

(iv) Intense congestion and oedema of larynx, severe degree of tracheitis (in two cases showing minute areas of actual ulceration). Similar congestion of upper end of oesophagus with pallor of the remainder of the oesophagus beyond the cricoid cartilage.

Group B (5 cases):

Similar findings as (i) to (iv) above.

(v) Signs of 'Blast' injury to lungs in all cases—also in one case in heart and kidneys. These signs were subserous haemorrhages plus other characteristic areas of haemorrhage deeper in the organs concerned.

Owing to transfer of most of these patients to other hospitals, their subsequent history is incomplete. Three patients, however, remained till 23 Dec., and they, as well as two still under treatment at 2 Jan. 1944, show no after effects of conjunctivitis and are healing satisfactorily without scar formation of 'burnt' areas.

Phosphorus Burns

A small number of phosphorus burns were seen during the war. Phosphorus was present in certain shells, bombs, mortars, and incendiary bullets. Special treatment was necessary both to neutralise the effect of the phosphorus and to remove the particles from the wound.

First aid consisted in the application of water either by immersion of the wounded area in water or the application of wet dressings. Bicarbonate of soda solution in a strength of at least 5 per cent was applied as soon as it was available to neutralise the acid oxide of phosphorus. The solution was not hot, so as to guard against conversion into the carbonate which caused pain. The wound was then swabbed with 1 per cent copper sulphate solution, which helped to stop the burning and made the particles more easily recognisable. They were then removed with forceps and the wound again soaked in bicarbonate for one to two hours. Further search in the dark for particles was made and the bicarbonate soaks continued till all action ceased. Vaseline and other greasy dressings, triple dye and brilliant green were avoided. The further treatment was the same as for the ordinary burn.

Experiments carried out by the Burns Sub-Committee of the Medical Research Council showed that the risks of phosphorus poisoning from absorption were negligible.

Summary

In the 1914–18 War the treatment of burns consisted in the application of picric acid dressings to, or the spraying of ambrine wax on, the burnt area. Glucose saline and gum acacia intravenous medication was given to relieve shock.

In 1925 treatment by tannic acid was introduced in the United States with reports of a marked lowering in mortality, and great interest was taken in the new treatment. This treatment became almost universal for severe and extensive burns. There also arose a realisation of the importance of the severe shock present and gradually the biochemical changes were worked out.

At the beginning of the 1939–45 War the tanning treatment was the approved treatment in the army, and was laid down by the co-ordinating team on burns of the War Wounds Committee of the MRC in April 1941. It had been realised already, however, that this treatment was not suitable for burns of the face, hands, wrists and feet.

In the Air Force, however, McIndoe had from the beginning of the war treated the serious aeroplane burns by saline baths and non-traumatic dressings, and utilised the sulphonamides for local and general bacterio-stasis.

In the treatment of shock, morphia in large doses and warmth, fluid by the mouth, and especially intravenous plasma and blood, were recommended. For some time tanning by different techniques remained the normal method of treatment in the army, though the saline bath treatment was adopted in certain units, especially by the plastic surgeons. The slough present in the deep burns began to give rise to trouble because of the associated sepsis and the delay in healing.

The mortality in cases treated by tanning began to cause concern, and it was then found that necrosis of the liver seen in post-mortems of those cases was caused by tannic acid absorption. This, along with the appreciation of the good results obtained by sulphonamide therapy, non-traumatic dressings and saline baths, led to the discarding of tanning. Simple wound cleansing, local sulphanilamide frosting, vaseline or tulle gras dressings, and infrequent dressings became the accepted treatment and the early application of skin grafts to the deep burns was carried out. As regards shock, the enormous loss of plasma into the tissues around the burnt areas, with the consequent haemo-concentration, was more and more realised, and very large quantities of plasma were given rapidly in the first forty-eight hours.

Cleansing under anaesthesia was delayed till shock was relieved, but later anaesthesia was completely given up, and the cleansing became gentler and gentler and finally was also given up for the ordinary clean burn.

The marked oedematous swelling was also counteracted by firm pressure dressings, especially in the hand where the oedema tended to leave behind marked adhesions.

When penicillin was introduced it was applied locally in a sulphonamide base and then, as sufficient supplies became available, full parenteral dosage was given to the severe cases. Saline baths were still used in some cases, especially when the burnt area was very extensive. Skin grafting was carried out at the earliest possible moment, either as a temporary dressing or as a final treatment. It was recognised that as long as a wound was open it was an invitation to infection, and a source of toxaemia.

At the end of the war the essential elements in the treatment of patients with serious burns were the administration of blood plasma or serum, the application of pressure dressings, the parenteral and local administration of penicillin, and the early skin grafting of all deep burns. Blood transfusion, high protein diet, iron tonics, and vitamins were all needed to counter the anaemia and debilitation present in burns cases. Early rehabilitation was also of great importance physically and psychologically.

Burns Cases Admitted to Hospital, 2 NZEF

	1943	1944	1945	Total
Battle casualties	24	58	20	102
Accidental injuries	323	436	242	10001

Cases Invalided from 2 NZEF, 1940–45

Cause	BC	AI
Phosphorus	7	2
Cordite	5	1
Petrol	3	18
Petrol tank	1	
Tank	1	
Mine	1	

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CHAPTER 16 — PLASTIC SURGERY

Contents

WAR SURGERY AND MEDICINE

[SECTION]

IN order to make clear the problems which confronted reconstructive surgery during the Second World War it is necessary to trace very briefly the development of plastic surgery from the beginning of the First World War.

In the 1914–18 War the fighting was largely static and trench warfare predominated. The result was a great number of distressing and mutilating, but not fatal, facial injuries. It became imperative, therefore, that these cases should receive expert attention, and it was in response to this demand that modern plastic surgery was born. Consequently, it is not surprising that the plastic surgeons devoted almost all of their time to facial surgery, and as a result plastic surgery came to mean facial surgery.

During the period between the wars considerable progress in plastic surgery was made, and the scope was increased, particularly in the direction of re-surfacing large superficial wounds resulting from industrial and civil accidents, and in treating contractures produced by the spontaneous healing of burns. In spite of this, plastic surgery still remained to a large extent facial surgery. At the time of the outbreak of the Second World War the general public, and indeed many members of the medical profession, thought of the plastic surgeon as a facial surgeon only.

During the Second World War, however, the nature of warfare was different. It became mobile on the land, on the sea, and in the air. It was a war of machines, most of which were driven by inflammable fuel. The result was that many extensive and unusual burns were caused, and this created a demand for plastic surgery, both in healing the burns and in after treatment of contractures produced. The 'Airmen's Burn', which was so common during the Battle of Britain, caused extensive damage to the eyelids, with marked cicatricial ectropion. Urgent plastic surgery was necessary to save the eye from corneal ulceration.

Extensive burns were caused to the dorsum of the hands, and here again a great deal of work was produced for the plastic surgeon in re-surfacing these lesions and restoring function. [1]

On the land, land mines, aerial bombs, mortar bombs, and shells produced severe injuries to the limbs, and often necessitated amputation. It was, in some cases, impossible to cover the amputation stump with skin and soft tissue, and healing resulted in a tender, unstable terminal scar. In order to make it suitable for the wearing of a prosthesis it became necessary to import a large amount of skin and subcutaneous tissue to replace the scar.

In other cases compound fractures of the long bones of the legs were associated with soft-tissue defects, and although they united and the skin healed, the scar was of an unstable nature and was continually breaking down when weight-bearing and active use was resumed. The result was that many of these adherent and unstable scars had to be replaced with skin and subcutaneous tissue.

In other cases damage to long bones was followed by non-union, and in these cases, before a bone graft could be successfully inserted, the scar in relation to the fracture had to be excised and replaced with a large flap of skin and subcutaneous tissue. It was thus possible for the orthopaedic surgeon to do his bone graft through healthy skin, and in tissue with a good blood supply.

Facial injuries, though still present, and often difficult, were not so great in number. We can say, therefore, that during the last war there was a vastly increased scope for the use of plastic surgical principles, particularly in the limbs. There are few injuries in war which have no civilian counterpart, and if the war has served no other useful purpose it has made it possible to treat in large numbers civilian cases of types which before were for the most part untreated.

It is clear, therefore, that while modern plastic surgery as practised during the Second World War included a great deal of maxillo-facial work, nevertheless the scope was widened so as to include all superficial soft-tissue injuries, and a good deal of this article deals with plastic surgical reconstructive work on the limbs.

It will be convenient at this point to give a brief review of the methods used by the plastic surgeon.

When tissue is not missing but only displaced, he removes the scar-tissue fetters which hold the parts in their incorrect anatomical position. They will then be free to move back to their normal relationship with other parts, and they are kept there by stitching until healing is sufficiently advanced.

If, on the other hand, there is tissue actually missing, the plastic surgeon must then assess the loss in terms of skin, subcutaneous tissue, muscle, bone and mucous membrane. For restoring the loss there are only four methods available. They are:

1. Local Flaps: These are flaps of skin, subcutaneous tissue, possibly muscle or even bone, produced in the neighbourhood of the defect and redistributed in such a way as to make good the initial defect without producing a second defect worse than the first. These local flaps are particularly useful about the face when the amount of soft-tissue loss is not great. They are also of some value in certain limb repairs and they always give the best possible result provided they are suitable for the repair. It is the method always thought of first.
2. Free Grafts: These are grafts of skin, bone, cartilage, fascia lata, and sometimes fat, which are removed from the body completely and then placed in their new position. They have no connection with the vascular system of the body during the period of their transfer and depend for their continued existence on rapidly acquiring a new blood supply in their recipient area. When suitable, these methods give quick results and are of great value.
   (a) Skin grafts are particularly useful in resurfacing areas which have resulted in skin loss only. They have their greatest application in treating the results of full-thickness skin destruction in burns. They are often, particularly in limb repair, used in combination with other plastic surgical methods, but are also invaluable for lining the lower buccal sulcus where it is obliterated, and for lining eye sockets where the conjunctiva has been lost.
   (b) Bone grafts are used specially in the treatment of ununited fractures of the mandible, to restore skull defects, and also to restore the nasal bridge line.
   (c) Cartilage grafts are used to restore contour defects.
   (d) Grafts of fascia lata. In traumatic surgery their main use is in treating inveterate facial paralysis.
   (e) Grafts of fat are occasionally used to fill contour defects.

3. Pedicle Flaps: When neither local flaps nor free grafts will do, pedicle flaps may be used. These pedicle flaps are flaps of skin and subcutaneous tissue as a rule and they require to have a connection with the vascular system at every stage of their transfer. They may be long and narrow, when it is convenient to turn them into a tube, or they may be short and broad, when they remain untubed. Their use is slow and tedious, but for some aspects of repair they are indispensable.

They are used in facial repairs and are also of pre-eminent value in repairing the defects of the limbs where skin and subcutaneous tissue, and even muscle and bone, have been lost.

4. Prosthetic Appliances: Sometimes when none of these plastic surgical methods will give a good result it is necessary to use a prosthetic appliance. Artificial eyes are good examples of this, but use is also made of artificial noses, artificial ears and other parts—in some cases with extremely pleasing results.

These methods are, however, seldom used alone and are frequently combined together to produce the particular repair required in any specific case.

No attempt is made to give a detailed account of all aspects of the work done, but merely to give a brief account of general principles followed; wherever possible methods are demonstrated simply by means of illustrations and their captions.

[See Illustration Section following p. 374.]

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[1] See chapter on

Burns, pp. 340– 56.

NEW ZEALAND SPECIALISTS IN UNITED KINGDOM

New Zealand Specialists in United Kingdom

The development of plastic surgery during the First World War owed much to a New Zealander, Sir Harold Gillies, who was in charge of the special hospital established at Sidcup to deal with the more difficult maxillo-facial injuries. All cases of this type were sent to Sidcup from the New Zealand military hospitals in England, and New Zealand medical and dental officers were appointed to the staff and later carried out the work in New Zealand.

At the beginning of the Second World War Sir Harold Gillies offered to train New Zealand surgeons and dentists in England so that efficient treatment might be available to men of the New Zealand Military Forces, and the offer was accepted. It so happened that New Zealanders had become leaders in plastic surgery in Britain, and our officers were trained under Sir Archibald McIndoe and Mr R. Mowlem, as well as under Sir Harold Gillies himself. Altogether four surgeons and as many dentists were trained, and this enabled us to set up a sub-unit at the base hospital at Helwan in 1942, and also to attach surgeons and dentists to each of the other two hospitals, as well as to staff adequately the main unit at Burwood Hospital in New Zealand.

Arrangements in Middle East

In the period prior to the attachment of the specially trained officers to our hospitals our New Zealand maxillo-facial cases were referred for treatment to special British units attached to British general hospitals, where they were retained till their definitive treatment had been carried out and they were ready for transfer to one of our own hospitals, either preparatory to return to duty or for evacuation to New Zealand. Close contact with the British units and our patients under their charge was kept by our surgeons and consultants, thus ensuring full co-operation and the best form of initial treatment by our units in the forward areas, as well as the referring of all suitable cases to the special units whose help was valued very highly by us. It was determined early that only the minimum of wound treatment should be carried out in the forward areas on maxillo-facial cases, as better results followed from treatment by the special units at the Base. Dentists with special aptitude and equipment were on the staffs of the Field Ambulances and CCS and were thus able to carry out the initial treatment satisfactorily.

It was decided by 2 NZEF early in the war in the Middle East that only those cases which could be quickly and simply returned to their units should be treated overseas. Other cases requiring long-range surgery were given their preliminary treatment in the Middle East and prepared for evacuation to New Zealand, where a special unit was set up to deal with them.

PLASTIC AND MAXILLO-FACIAL SURGERY IN THE MIDDLE EAST

The following types of cases were treated:

(1) Fractures of the facial skeleton, often associated with soft-tissue defects.

(2) Large traumatic soft-tissue defects, often associated with compound fractures of the long bones.

Each of these will be discussed in turn.

FRACTURES OF THE FACIAL SKELETON

(a) Mandibular Fractures.—The principles used:

(i) Civilian Type: In mandibular fractures of the civilian type with a good number of standing teeth, the principle used was to extract any teeth in the line of fracture, and then to use simple eyelet wiring with inter-maxillary fixation. This is a simple method of treating this type of fracture, produces excellent occlusion, and does not impose any work on the prosthetic laboratory.

(ii) Battle Casualties associated with Soft-tissue Damage: In this type of case the simple method of eyelet wiring was found to be quite unsuitable, so cast-metal cap splints, made in sections and then joined by connecting bars after reduction of the fracture, were used throughout. Splints were frequently put on both upper and lower jaws, and inter-maxillary fixation by means of a precision lock gave added immobilisation. Where the lower buccal sulcus was obliterated, or was thought likely to become obliterated, the splint was planned in such a way as to provide for an appliance to carry an epithelial inlay mould at a later date.

(iii) Battle Casualty Fractures associated with Bone Loss: In these cases cast-metal cap splints as described above were used to preserve the occlusion of the remaining teeth, and maintain the gap between the bone ends. The cases were then evacuated to New Zealand for bone grafting as a long-range measure.

(iv) Condylar Fractures: Generally speaking, these fractures were treated by immobilising them in correct occlusion for one month.

(v) Edentulous Cases:

1. Fractures Near the Angle with a Short Edentulous Posterior Fragment: By the time we started treating these cases the method of controlling

these hitherto extremely difficult cases by means of extra-oral pins had been applied in England. The principle in its turn had been borrowed from that introduced by the American, Roger Anderson, into orthopaedic surgery. No previous method had given adequate control of the short edentulous posterior fragment which was adducted and rotated by the pull of the internal pterygoid muscle. Where there were standing teeth on the anterior fragment the principle that we used was to apply a cast-metal cap splint to these teeth fitted with a removable extra-oral bar. If there was a tooth in the line of fracture, this was extracted, and then two Kirschner wires of 5/64 inch diameter were drilled into the posterior fragment at an angle to each other. These two were then clamped to each other by means of universal joints and a T-piece. The fracture was then reduced, and by means of two more universal joints and a connecting bar the T-piece and the extra-oral bar were joined firmly together. If there were standing teeth in the maxilla, inter-maxillary fixation was added by means of another metal cap splint, and a precision lock. If not, an acrylic bite block was used for the upper jaw, and the lower jaw was kept in correct relation to it by means of a plaster head cap and universal joints connected to the extra-oral bar on the lower splint. Immobilisation was continued from three weeks to a month.

2. Completely Edentulous Mandibular Fractures: These were treated by Roger Anderson pinning of fragments and joining them by means of universal joints and connecting bars, using Gunning-type splints for intermaxillary fixation, with a plaster head cap where necessary.[See Illustration Section (Figures 1 and 5)]

(b) Fractures of the Middle Third of the Face.—It was in these cases that a paper published by W. James and B. W. Fickling in February 1941 was of the greatest possible help. Their work was really a translation of a paper by Renée le Fort, written as long ago as 1901. He carried out certain experiments to find out the lines of weakness of the facial skeleton, and found that there were three main lines of weakness in the middle third of the face:

(i) Transversely above the tooth sockets and through the floor of the nose.

(ii) Transversely at a somewhat higher level below the malar bones, through the infra-orbital foramina, and across the mid-line through the nasal processes of the maxillae.

(iii) Transversely at a still higher level through the fronto-malar sutures laterally and the root of the nose in the mid-line. This line separates the whole of the facial skeleton from the base of the skull.

These three fracture lines, which have since been named, respectively, low transverse, pyramidal, and horizontal, constitute the three main lines of weakness, and all fractures in this situation are found to follow these lines in part, wholly, or in various combinations, unilaterally, or bilaterally. For example, the ordinary depressed fracture of the malar bone is a combination of the pyramidal and the horizontal of unilateral type.

It is convenient to discuss fractures of the middle third of the face under the following headings:

1. Low transverse fracture.
2. Pyramidal fracture.
3. Horizontal fracture.
4. Depressed fracture of the malar bone.

It is clear that the first three fractures, if severe enough in degree, can upset the dental occlusion, damage the nasal airways, or cause diplopia, or various other severe long-range effects. The essence of treatment was found to be the securing of immediate reduction of the fragments and their immobilisation.

Transverse Fracture: This fracture usually caused an upset of the dental occlusion by presenting a condition of open bite. It was treated by applying a cast-metal cap splint, fitted with an extra-oral bar, to the mandibular teeth. A plaster head-cap was applied, and by means of universal joints the mandible was immobilised in its normal plane of occlusion. A similar cast-metal cap splint was attached to the maxillary teeth and, using hooks fitted at strategic points to both splints, strong rubber bands (made by cutting sections from a rubber catheter) were fitted to secure inter-maxillary fixation. It was found that even in neglected cases of impacted fracture with open bite, twenty-four hours was sufficient to effect reduction. This immobilisation was continued until there was no tendency for the deformity to recur.

Pyramidal Fracture: This was treated in the same way as the low transverse, but there was frequently a nasal fracture associated, and this required reduction as well. If this was done early it was found that no other fixation was usually necessary. Malar fracture with displacement was sometimes associated, and this was reduced by means of the Gillies temporal approach.

Horizontal Fracture: This was sometimes associated with fracture of the base of the skull, and cerebro-spinal fluid rhinorrhoea. In these cases the whole facial skeleton was floating at the level of the base of the skull, and was immobilised in exactly the same way as above. Later, however, these cases were treated by exposing the fronto-malar sutures, and wiring them with stainless steel wire, in addition to inter-maxillary fixation if dental occlusion was grossly upset.

Depressed Fracture of the Malar Bone: This was a very common fracture among the troops, and was treated almost entirely by the Gillies temporal approach. It was seldom found necessary to pack the antrum if the cases were got early.

LARGE TRAUMATIC SOFT-TISSUE DEFECTS OFTEN ASSOCIATED WITH COMPOUND FRACTURES OF THE LONG BONES

In 1943, following the severe fighting of the Alamein period, a number of cases with severe mutilating wounds were being treated in our base hospitals in Egypt. Amongst these were cases of compound fracture of the long bones in which there was also a great loss of skin and soft tissue.

It was by no means rare to see exposed bone ends in the depths of a skin defect 18 inches by 10 inches. This might be due to the missile causing the injury actually carrying away the skin completely, or by so avulsing it that large portions sloughed owing to the inadequacy of the remaining blood supply. Obviously the treatment of the fracture took precedence over everything else, but some attempt had to be made to secure the earliest possible healing of the associated wound. If left to heal spontaneously, some of these wounds would have certainly taken months, and possibly years, to heal. During this time activity of the limb would necessarily have been limited so that the best possible functional result would not be obtained. Furthermore, scars resulting from spontaneously healed wounds of such size are often unstable, cause contractures, and limit function considerably. While lacerations in which there was no tissue loss healed rapidly under closed plaster, wounds in which there was actual tissue loss healed much more slowly.

At this time the New Zealand Plastic Surgical Unit had been formed and an elaborate saline bath unit had been set up at Helwan hospital, primarily for the treatment of burns. The plastic team at the hospital was then given the opportunity of treating these difficult and unsatisfactory cases, and made the attempt in spite of gross suppuration at the site of fracture to try to secure complete healing of these wounds in one operation.

An account of the valuable work carried out is given by Major Manchester, who was in charge of the unit.

Preparation of the Wound for Grafting

Enough was known at that time about wound healing and bacteriology in general to enable us to aim at skin grafting to cover tissue loss and to secure a complete take of the grafted skin.

The following remarks apply to the grafting of granulating surfaces in general, and we will later see how the fracture cases differ.

The preliminary wound treatment was based on the assumption that a wound would heal extremely rapidly from the edges provided there was nothing to inhibit it. It was not a question of 'stimulating' healing, but of removing the inhibitory factors. These inhibitory factors were exactly those which prevented grafts from taking. There were three main ones:

1. Bacterial infection.
2. Trauma.
3. Ischaemia.

Each of these will be discussed in turn.

Bacterial Infection

In studying the bacteriology of a wound as a preliminary to grafting, a most thorough investigation had to be made and repeated at frequent intervals.

It was necessary to take direct smears at the bedside from all parts of the wound, and also from the exudate on the dressing as soon as it was removed, in addition to the usual culture. It was not uncommon to find organisms in direct smears which did not grow on culture owing to the inhibitory effects of other organisms.

It was obvious, therefore, that examination of the swab taken from the wound and perhaps left for an hour or more to dry was hopelessly inadequate. The common organisms found infecting granulating wounds were as follows:

(a) Haemolytic Streptococcus: The presence of this organism in even small numbers in a granulating wound caused marked inhibition of healing and prevented the complete taking of grafts. It was especially difficult to deal with, because when present in small numbers it was easily overlooked in the direct smear as it often occurred in diplococcal form, when the amount of exudate was not great. A graft might easily be performed under the mistaken impression that the organism was absent, but it could be recovered in chain form in almost pure culture from the exudate after perhaps two days, when it is obvious that the graft had failed. Moreover, on culture, the organism when present in small numbers was rapidly overgrown by other bacteria, especially Pseudomonas Pyocyanea and Bacillus Proteus. This difficulty could be overcome, however, by using a medium which was favourable to the growth of the pyogenic cocci but unfavourable to that of the gram-negative bacilli. Such media could be made by incorporating gentian violet or 8 per cent agar instead of the usual 3 per cent agar. When haemolytic streptococcus was present in a wound it was extremely difficult to get rid of, in spite of the common belief that all that was necessary was to apply sulphanilamide powder. Some strains were sensitive to the sulphonamides and these disappeared after a few days' application of the powder locally; but many were sulphonamide-resistant, and these presented a real problem in preparing a granulating surface for grafting. It was almost impossible to secure a complete 'take' when this organism was present.

(b) Staphylococcus Aureus was not nearly so difficult to deal with as the haemolytic streptococcus. It was possible for a graft to take completely in its presence, provided the numbers were not too great.

(c) Pseudomonas Pyocyanea produced a large amount of green exudate and overgrew cultures, masking the presence of other organisms. It was commonly stated that a wound infected with Pseudomonas Pyocyanea would not accept a graft. It was, however, possible for the largest graft to take in a wound infected with it.

[See Illustration Section (Figure 8)]

In our opinion its bad reputation in this respect was due to the presence of haemolytic streptococci whose growth it masked in culture, with the result that grafting was done under the mistaken impression that the wound was free from the streptococcus. Hence the necessity for direct smears and differential culture media. Its growth in wounds could be checked by using 1 per cent acetic acid dressings, but it was likely that this merely stopped growth in the exudate and did not affect the organism in the granulation tissue itself.

(d) Bacillus Proteus resembled Pseudomonas Pyocyanea in that it did not appreciably affect wound healing nor the acceptance of grafts, but in culture it rapidly overgrew the pyogenic cocci unless measures were taken to prevent it.

(e) Non-Haemolytic Streptococcus and Staphylococcus Albus: Their presence in a wound was of no practical significance so far as rapid healing and graft taking were concerned.

(f) Diphtheroids: These organisms were commonly found infecting granulating surfaces, but were of no practical significance. Morphologically they resembled the Corynebacterium Diphtheriae, but could easily be distinguished by laboratory methods. The clinical behaviour of the wound, however, left little doubt which organism was present.

(g) Corynebacterium Diphtheriae: No account of wound bacteriology would be complete without mentioning this organism. It was undoubtedly the most virulent of all wound infections and the most difficult to treat. Grafting in its presence was out of the question.

The only common organism, therefore, which caused much anxiety when preparing a case for grafting was the haemolytic streptococcus, but it was not so easy to be sure of its presence or absence as was generally believed.

Trauma

The granulation tissue of a wound, when given a fair chance, has by virtue of its own natural defence a much more sustained bacteriostatic and bacteriocidal power than any antiseptic which can be applied to its surface. A wound is thus best able to combat infection when it is subjected to no trauma, and when the tissue cells are bathed in a physiological and isotonic medium. Trauma is applied to a wound either mechanically or chemically.

Mechanical Trauma: A dressing which stuck to the wound and had to be forcibly removed caused bleeding and opened up fresh tissue to bacterial infection. It also damaged the proliferating epithelial edge, and the repair work of hours or days might be undone.

Chemical Trauma: Strong antiseptics and coagulants were often applied to wounds. It was extremely doubtful whether these usefully inhibited bacterial growth in vivo, and it was almost certain that they damaged the living tissues and reduced their own natural resistance. Some antiseptics such as the acridine compounds did not, however, inflict much trauma, and if antiseptics had to be used these were the ones of choice.

Ischaemia

Unless a wound has a good blood supply it cannot possibly heal rapidly for two reasons: Firstly, it is unable to resist and overcome bacterial infection; and, secondly, it is unable to support epithelial proliferation. An ischaemic wound presents a typical appearance. [See Illustration Section (Figure 6).] It has a densely scarred base and periphery through which the vessels are unable to maintain a sufficient blood supply. It has a rolled edge and a greyish base. Good examples are varicose ulcers which are due to inadequate circulation in the leg. They frequently heal rapidly when their blood supply is improved by recumbency and with treatment of the underlying cause, the varicose veins.

If bacterial infection and traumatic dressings are allowed to persist over a long period, wounds commonly develop a dense plaque of scar tissue in their base and periphery, and then grafting is out of the question unless the wound and scar tissue are ruthlessly excised until healthy tissue is exposed. Ischaemia should be prevented by securing rapid healing.

The wound treatment employed in preparation for grafting was based on these principles and aimed at mitigating the three inhibitory factors by reducing the number of infecting bacteria, by the use of an atraumatic dressing technique, and by preventing the development of ischaemia.

Dressings: Until the introduction of penicillin, dressings had to be frequent. Their aim was to absorb the exudate which formed a culture medium for the organisms which were discharged from the wound. By changing them frequently the smallest amount of exudate remained in contact, and thus by mechanical means it was possible to reduce the number of bacteria present.

By the use of the tulle gras and normal saline technique, both mechanical and chemical, trauma were avoided. First a layer of tulle gras was applied direct to the granulation tissue. Well-made tulle gras could be removed without trauma after many hours in contact with the wound. Its advantage over vaseline gauze was that it allowed the exudate to escape through its meshes. Outside this, a dressing made of several thicknesses of gauze wrung out in normal saline was applied and the dressing completed by a layer of cotton wool and a firm bandage.

During the early stages the dressings were changed four times daily. The day before the operation the frequency was increased to eight times daily. These frequent dressings had to be carried out in a place properly equipped to avoid nose and throat and dust-borne infection, and by a properly trained staff alive to these dangers. It was possible by this means to reduce the number of bacteria in a wound to such an extent that it was difficult to inoculate a culture from it.

This general routine for preparation of the granulating wound could be supplemented by the use locally of a bacteriostatic. The sulphonamide drugs were disappointing, because by no means all strains of haemolytic streptococci were sensitive to them. If after one week's treatment the haemolytic streptococci were still present, the drug was discontinued, as the organisms almost certainly belonged to a resistant strain.

When to Operate

Deciding when to operate with a good chance of success was perhaps the most difficult part of the whole procedure. Many factors had to be taken into consideration.

GENERAL FACTORS

Pyrexia: When even a very large wound is sufficiently free from infection to accept a graft there should be no pyrexia. At the very most, the temperature should not rise above 99 degrees F.

LOCAL FACTORS

(a) Exudate: There should be very little exudate on a dressing after it has been left in situ for twelve hours.

(Proliferation: The epithelial edge should be purple and rapidly advancing.

b)

(c) Colour: Healthy vascular granulations should be bright red and bleed at the slightest trauma.

(d) Surface: The surface should be quite smooth, flat, and velvety. It should show the impressions of the tulle gras upon it for a while after this has been removed. If it is irregular and knobbly the granulations are oedematous, and this means that they are infected.

(e) Pain: The granulations should be painless to touch. Painful granulations are septic granulations.

(f) Bacteriology: The wound should be free from haemolytic streptococci. It is possible to secure a good take if they are present in infinitesimal numbers, and it is justifiable to make an attempt only after a strenuous effort to remove them has failed.

If the direct smears and cultures show only small numbers of other organisms and all provisos are satisfied, a graft may be performed and 100 per cent take can confidently be expected.

Technique in Fracture Cases

We will now see how the fracture cases differ, and how the technique had to be modified accordingly. They differ in that in the centre of the soft tissue is a mass of dead and infected bone which pours pus rich in bacteria over the rest of the granulating surface. Obviously, then, the infected cavity must be kept separate as far as possible from the rest of the wound, both during the preliminary dressing period and subsequent management. During the preliminary period the infected cavities were lightly packed with ribbon gauze in sufficient quantity to absorb all the exudate thrown off during the period between dressings. This part of the dressing was done first, and only when it had been attended to was the rest of the dressing performed. It was essential that the pus from the bony cavity should not be allowed to reinfect the wound.

Cases of compound fracture of the femoral shaft in a Thomas splint were first chosen for grafting because of the ease of carrying out the wound toilet without interfering with the immobilisation of the fracture. In these cases union was already firm but not yet solid at the time of operation.

It seems hardly necessary to add that the cases were chosen and treated in full collaboration with the orthopaedic surgeon, he and the plastic surgeon working together as a team.

Operation: The aim was to secure complete healing in one operation of all but the infected bone area, which must have free drainage and be accessible for frequent dressing at all times.

The first stage was to produce the skin. This was done first as a clean operation after estimating the amount required. It was cut in pieces as large as possible, and not too thick as the thinner grafts were more viable.

A pattern was then made by laying two or three layers of gauze over the wound and marking the periphery in Bonney's Blue. The infected bone cavity was marked out in the same way. The gauze was then laid on a table, wound side uppermost, and covered over by a single piece of tulle gras, the pattern readily showing through it. The skin was then carefully arranged to cover the whole marked area except for the part corresponding to the infected cavity. Here even the tulle gras was cut away, leaving a window. Great care was taken to arrange the junction between any two adjacent pieces of skin accurately, and with a clear-cut overlapping edge, otherwise local failure would result.

The tulle gras, together with the graft, was now accurately applied to the wound so that the window corresponded to the bony cavity. A few anchoring stitches were placed into healthy skin around the periphery and a pressure dressing built up of paraffin wool and cotton wool, but again so as to leave a window opposite the bone cavity. A crepe bandage was then applied, avoiding the window. The whole thickness of the window was waterproofed by saturating it with collodion or mastisol and the cavity lightly packed with ribbon gauze.

So far as the post-operative treatment is concerned, the only part that required any attention was the uncovered bony cavity, to which access was got through the window in the dressing. The ribbon gauze with which the cavity was lightly packed was removed every four hours and renewed, in order to keep the exudate from overflowing and making the dressing messy.

At the end of a week the dressings were removed and any redundant pieces of skin clipped away, and any junctional areas which still required to heal were dressed four-hourly as before the operation. In this way the whole wound, except for the actual cavity, was quickly and stably healed.

If the technique had been faithfully and accurately carried out, the skin formed an adequate covering for all purposes, with a few possible exceptions. If, however, it was found at some later stage to be unsatisfactory, it could be excised and repaired by some other method, such as by the use of tubed pedicles. This could be done at leisure and as a clean operation throughout.

The healing of these large wounds was usually followed by a rapid improvement in the patient's general condition. His weight usually rose rapidly and his morale improved.

Later in the war when penicillin was introduced much of the work above described in preparing granulating surfaces was rendered superfluous. It was found that by using systemic penicillin the frequency of dressings could be reduced to one every few days, and the period of preparation correspondingly reduced; but, apart from that, the technique remained essentially as stated above.

[See–Illustration Section (Figures 8–9)]

[For long-range plastic surgery see Illustration Section (Figures 10–25) following p. 374]

Mandibular Bone Grafting

Certain conditions are necessary for success in bone grafting the mandible. They are:

1. The immobilisation of the fragments to be grafted.
2. The control of infection.
3. The use of suitable bone.

In the early part of the war much had yet to be learnt about all these three points but as the war drew to a close great improvements had been made in all three. We will now discuss each of the points in turn:

1. The Immobilisation of the Fragments

(a) In cases with standing teeth. In these cases the method of immobilisation was as follows. A cast metal cap splint was attached to the standing teeth on each fragment. Provision was made for the subsequent union of these two pieces by means of a fish plate and screws. A similar but single splint was then applied to the maxillary teeth. The two mandibular fragments were then brought into their correct occlusional relationship with the splint on the upper. A fish plate was then designed to join the two halves of the lower splint and when it was screwed into position the lower splint was thereby made single. The lower was then united to the upper splint by means of a removable precision lock. In this way it was possible to discontinue the inter-maxillary fixation at any time but to leave the mandibular fixation intact. When it seemed obvious that a bone graft would become necessary in any particular case, the splints were always designed in the first instance with this object in view. In this way the correct relationships were maintained between the fragments and then it simply became a question of bridging the gap.

(b) In edentulous cases. In these cases the method used was that of extra-oral pin fixation. The two fragments involved were securely pinned and after the correct occlusional relationship was established the two fragments were joined by means of universal joints and bars.

(c) Cases where only one fragment was edentulous. In the case of the fragment which had standing teeth the immobilisation was secured by using cast metal cap splints in the manner described above. Provision was made, however, for a removable bar to be attached to the splint which was capable of extrusion through the mouth. The edentulous fragment was then pinned and after suitable reduction the two fragments were joined by means of universal joints and connecting bars. Wherever it was possible to use inter-maxillary fixation as well, we used it, but frequently in edentulous cases no inter-maxillary fixation was used. Towards the end of the war we seldom had cause for anxiety regarding fixation. We found that when we had cases of successful initial grafting followed by absorption of the graft it was nearly always due to dispensing with the fixation too soon.

2. The Control of Infection

In the early part of the war we had difficulty in controlling infection and, when a bone graft seemed likely to be necessary, we got rid of all the teeth in the neighbourhood of the projected bone graft from the beginning. In this way all foci of infection were removed. We also made it a rule that no case was bone grafted until six months after complete healing following the last trace of sepsis. Great care was also taken with regard to sepsis when working near the mouth.

With the advent of penicillin, however, we found it possible to modify this programme and we were able to do our bone grafts under penicillin cover as soon as the patient was in fit condition. Indeed, in some cases it was done even before the wounds were completely healed. Penicillin, therefore, made bone grafting possible much earlier and made it much more certain.

3. The Use of Suitable Bone

At the beginning of the Second World War the standard source of bone in many English clinics was the crest of the ilium. In the early days an attempt was made to get the bone ends cut to some sort of accurate shape such as may be used in cabinet-making and to bridge the gap with a solid piece of bone shaped to fit it, and as near as possible conform to the normal contour of the mandible. Later, however, owing largely to the work of Mr Rainsford Mowlem at Hillend Hospital, St. Albans, a change was made to the use of cancellous chips, also taken from the ilium. It was found that these had a greater resistance to infection, besides eliminating elaborate fitting in the operative technique. While we used this method, nevertheless we also used a large block of ilium as well and used the chips to fill in any defects and to make the contour accurate.

The advances that took place during the Second World War then were: (i) Much-improved methods of fixation, particularly in edentulous cases. (ii) Better control of infection by using antibiotics. (iii) The use of cancellous bone, which is more viable under conditions of infection.

THE TREATMENT OF MAXILLO-FACIAL INJURIES —FROM THE DENTAL ASPECT

THE TREATMENT OF MAXILLO-FACIAL INJURIES —FROM THE DENTAL ASPECT

Scope and General Principles

The treatment of major injuries of the lower half of the face is essentially a matter of teamwork between plastic surgeon and dental surgeon. The way in which the dental surgeon is likely to be involved may, for the sake of conciseness, be stated under the following headings:

Early Treatment:

(a) Assisting with intra-oral surgery involving the removal or conservation of comminuted bone fragments, displaced teeth and lacerated soft tissue.
(b) Reduction and fixation of fractures of the mandible and maxilla.

Delayed Treatment:

(a) Generally assisting with bone grafts to the mandible, and with intra-oral skin grafts.
(b) The provision of temporary or permanent prostheses.

Note: The term 'early treatment' refers to early specialised treatment, and not to what may be described as first aid or preliminary field treatment.

It is advisable to outline the principles of treatment in order to provide a background, against which methods of treatment and general policy may be recorded as they evolved during the Second World War.

As far as the healing of wounds in general is concerned, the jaws and face have one great advantage, and that is their copious blood supply; consequently, in major injuries of the jaws it is possible to be much more conservative with comminuted bone fragments and lacerated soft tissue than it is in other regions of the body. (Figure 2.) On the other hand, the jaws have one great disadvantage in this respect, and that is the presence of teeth; teeth adjacent to the site of fracture may be the cause of complications if they are fractured themselves, displaced, have their adjacent mucoperiosteum detached, or even if they are intact. It is remarkable to see how much more readily healing and union occur in a grossly comminuted fracture of an edentulous mandible than in a similar fracture where teeth are present.

When, however, it comes to a question of reduction and fixation of jaw fractures, the presence of teeth is usually an advantage. In minor injuries sufficient fixation for a fractured mandible was often obtained by wiring the mandibular teeth to those of the maxilla (‘inter-dental’ wiring). But in major injuries it was necessary to construct ‘cap’ splints, of cast silver, which fitted accurately over the mandibular teeth and were cemented on to them so as to bridge the region of the fracture. (Figure 3.)

In many cases, however, owing to lack of teeth or the fact that the fracture was in a posterior region of the mandible, neither inter-dental wiring nor cap splints was effective. In such cases the most satisfactory method of fixation was by intra-osseous pin fixation; the pins were inserted extra-orally through the skin surface and drilled into the bone fragments where they were left anchored with their ends projecting through the skin; a pair of pins was placed in each fragment, and after reduction the two pairs were rigidly joined by a special clamping appliance. (Figures 1 and 5.)

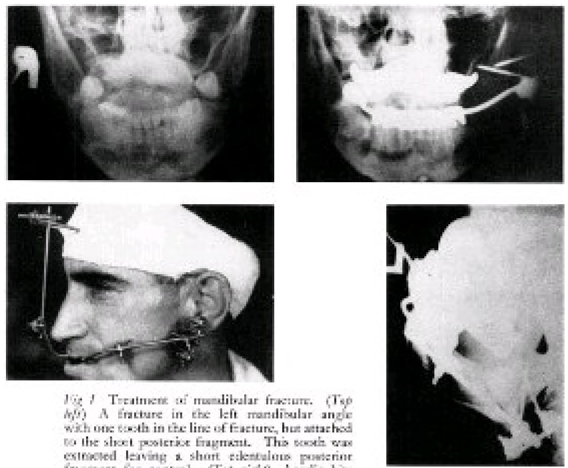

Fig 1 Treatment of mandibular fracture. (*Top left*) A fracture in the left mandibular angle with one tooth in the line of fracture, but attached to the short posterior fragment. This tooth was extracted leaving a short edentulous posterior fragment for control. (*Top right*) Acrylic bite block on the upper jaw, cast metal cap splint on the lower, with extra-oral bars and pins in position on the posterior fragment. (*Lower left*) Arrangement of plaster head cap, extra-oral bars and Roger Anderson pins. (*Lower right*) Position of fragments with splinting

Fig 1 Treatment of mandibular fracture. (Top left) A fracture in the left mandibular angle with one tooth in the line of fracture, but attached to the short posterior fragment. This tooth was extracted leaving a short edentulous posterior fragment for control. (Top right) Acrylic bite block on the upper jaw, cast metal cap splint on the lower, with extra-oral bars and pins in position on the posterior fragment. (Lower left) Arrangement of plaster head cap, extral-oral bars and Roger Anderson pins. (Lower right) Position of fragments with splinting

(See pages 362, 374)

Fig 2 Illustrating the ability of mutilated facial tissue to survive (*left*) before operation. (*right*) Seven days after operation : all primary suturing successful ; area of tissue loss is healthy and granulating ; general condition obviously excellent

This casualty occurred in 1941, before the advent of penicillin

Fig 2 Illustrating the ability of mutilated facial tissue to survive (left) before operation. (right) Seven days after operation: all primary suturing successful; area of tissue loss is healthy and granulating; general condition obviously excellent

(See page 374)

This casualty occurred in 1941, before the advent of penicillin

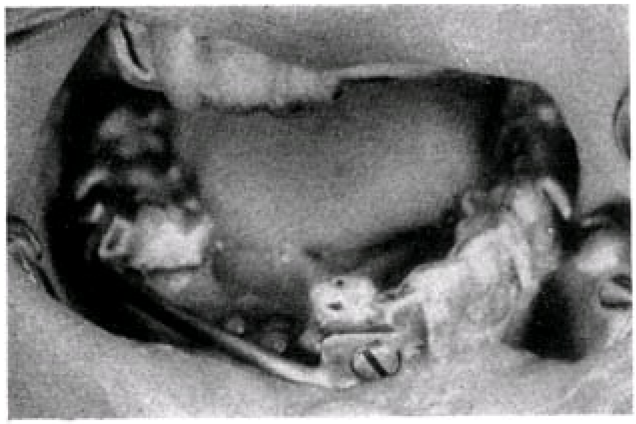

Fig 3 Intra-oral view of a sectional dental cap splint fixation

Fig 3 Intra-oral view of a sectional dental cap splint fixation

(See page 374)

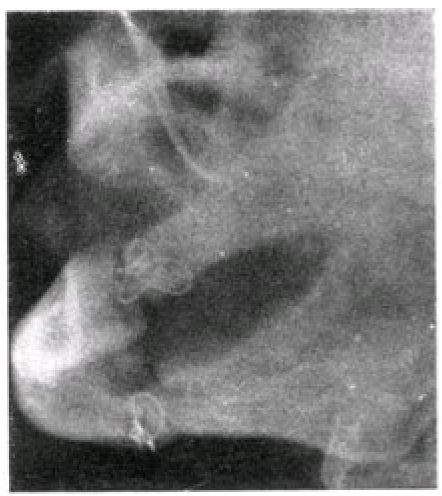

Fig 4 Fixation of displaced mandible by direct bone wiring

Fig 4 Fixation of displaced mandible by direct bone wiring

(See page 375)

Fig 5 A mandibular fracture treated in the same way as Fig 1, but using cast metal cap splints on both the upper and lower jaws with a precision lock for intermaxillary fixation

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(See pages 362, 374, 376)

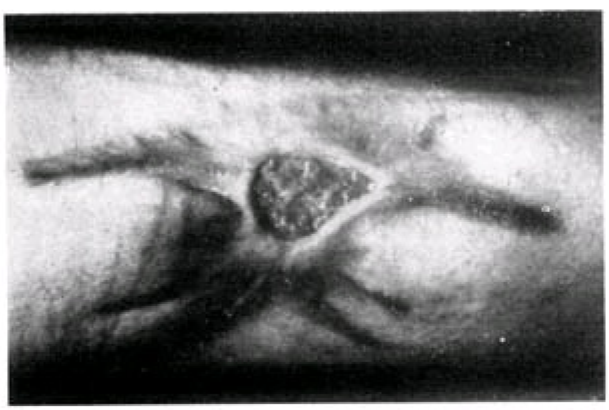

Fig 6 An example of a typical ischaemic wound. Note the dense scar tissue around the periphery, the rolled edge, and the knobbly granulating base. It was a whitish grey colour, and not the normal healthy red. It was on the outer side of the leg and not on the subcutaneous surface of the tibia

Fig 6 An example of a typical ischaemic wound. Note the dense scar tissue around the periphery, the rolled edge, and the knobbly granulating base. It was a whitish grey colour, and not the normal healthy red. It was on the outer side of the leg and not on the subcutaneous surface of the tibia

(See page 368)

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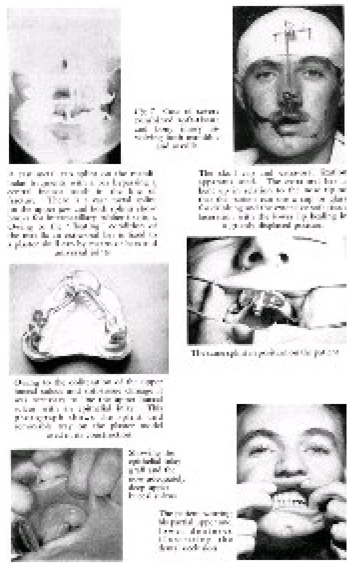

Fig 7 Case of severe combined soft-tissue and bony injury involving both mandible and maxilla

A cast metal cap splint on the mandibular fragments with a bar bypassing a central incisor tooth in the line of fracture. There is a cast metal splint on the upper jaw and both splints show hooks for intermaxillary rubber fixation. Owing to the ‘floating’ condition of the maxilla an extra-oral bar is fixed to a plaster skull cap by means of bars and universal joints

Owing to the obliteration of the upper buccal sulcus and soft-tissue damage it was necessary to line the upper buccal sulcus with an epithelial inlay. This photograph shows the splint and removable tray on the plaster model used in its construction

Showing the epithelial inlay graft and the now adequately deep upper buccal sulcus

The skull cap and extra-oral fixation apparatus used. The extra-oral bar is bent up in relation to the nose tip so that the patient can use a cup or glass for drinking and the extensive soft-tissue laceration with the lower lip healing in a grossly displaced position

The same splint in position on the patient

The patient wearing his partial upper and lower dentures illustrating the

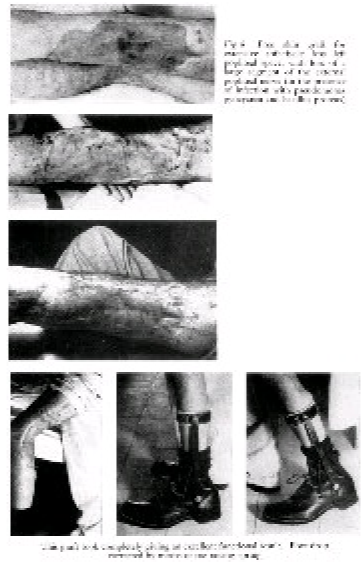

Fig 8 Free skin graft for extensive soft-tissue loss left popliteal space, with loss of a large segment of the external popliteal nerve (in the presence of infection with pseudomonas pyocyanea and bacillus proteus)

(See pages 366, 371)

This graft took completely giving an excellent functional result. Foot drop corrected by means of toe-raising spring

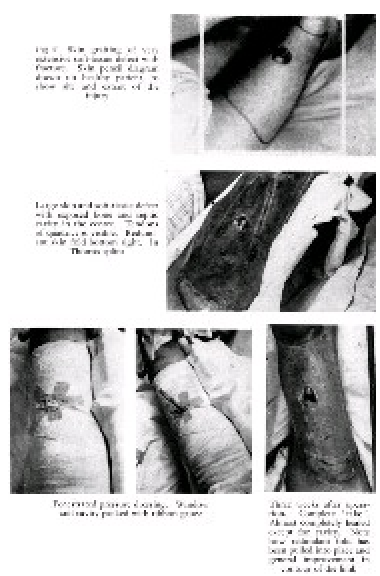

Fig 9 Skin grafting of very extensive soft-tissue defect with fracture. Skin pencil diagram drawn on healthy patient, to show site and extent of the injury

(See page 371)

Large skin and soft-tissue defect with exposed bone and septic cavity in the centre. Tendons of quadriceps visible. Redundant skin fold bottom right. In Thomas splint

Fenestrated pressure dressing. Window and cavity packed with ribbon gauze

Three weeks after operation. Complete ‘take’. Almost completelyhealed except for cavity. Note how redundant fold has been pulled into place and general improvement in contour of the limb

LONG-RANGE PLASTIC SURGERY

(See page 371)

For the long-range work it was recognised that the resources of a complete plastic surgery unit were required, including a surgical team, a dental team, physiotherapy department, and occupational therapy department; these were provided at the Plastic Surgery Unit, Burwood Hospital, Christchurch. The complete range of plastic surgery was done here and included

(1) Facial reconstructions and
(2) Repair of soft-tissue defects associated with limb injuries

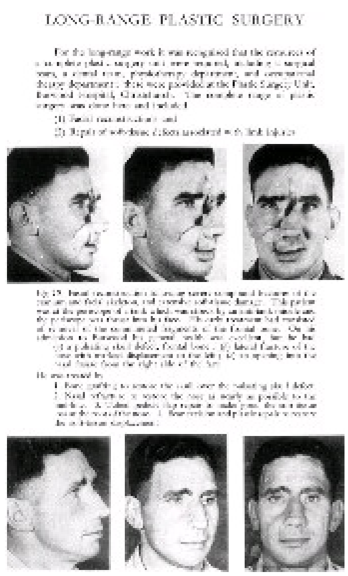
LONG-RANGE PLASTIC SURGERY

Fig 10 Facial reconstruction following severe compound fractures of the cranium and facial skeleton, and extensive soft-tissue damage. This patient was at the periscope of a tank which was struck by an anti-tank missile and the periscope was thrust into his face. His early treatment had consisted of removal of the comminuted fragments of the frontal bone. On his admission to Burwood his general health was excellent, but he had (a) a pulsating skull defect, frontal bone; (b) lateral fracture of the nose with marked displacement to the left; (c) an opening into the nasal fossae from the right side of the face

He was treated by

1. Bone grafting to restore the skull over the pulsating skull defect.
2. Nasal refracture to restore the nose as nearly as possible to the mid-line. 3. Tubed pedicle flap repair to make good the soft-tissue loss at the root of the nose. 4. Scar excision and plastic repair to restore the soft-tissue displacement

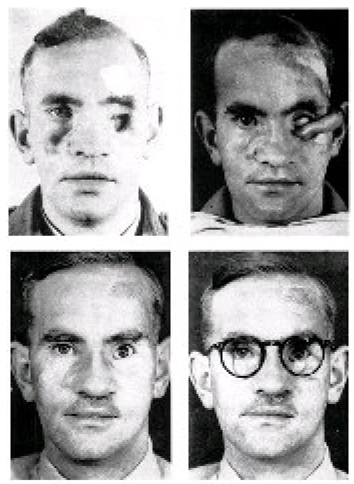

Fig 11 Facial reconstruction. Extensive facial injury with loss of left eye and lower eyelid due to missile entering below right eye, crossing the nasal fossae and emerging in the region of the left eye. Patient was treated by means of 1. Forehead flap repair to restore left lower lid together with local plastic operation on the conjuctiva, scar excision and plastic repair right cheek. 2. Bone grafting to restore nasal bridge line. 3. Manu

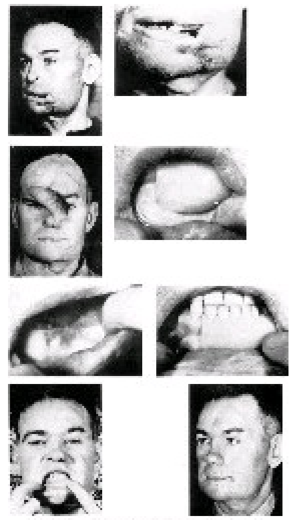

Fig 12 Extensive facial injury with compound fracture lower jaw obliteration of left lower buccal sulcus, loss of left nasal ala and extensive soft-tissue damage submental region. Reconstruction by means of
1. Local soft-tissue plastic repair, chin region. 2. Forehead flap repair left nasal ala. 3. Free skin grafting left lower buccal sulcus. 4. Construction of suitable partial lower denture

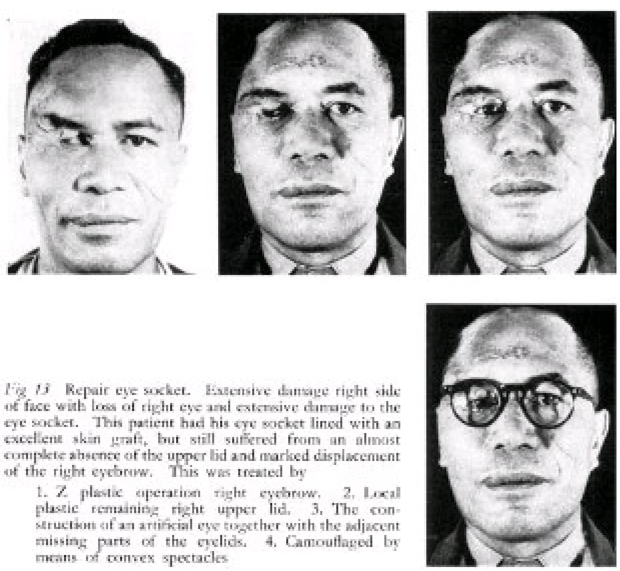

Fig 13 Repair eye socket. Extensive damage right side of face with loss of right eye and extensive damage to the eye socket. This patient had his eye socket lined with an excellent skin graft, but still suffered from an almost complete absence of the upper lid and marked displacement of the right eyebrow. This was treated by
1. Z plastic operation right eyebrow. 2. Local plastic remaining right upper lid. 3. The construction of an artificial eye together with the adjacent missing parts of the eyelids. 4. Camouflaged by means of convex spectacles

Fig 13 Repair eye socket. Extensive damage right side of face with loss of right eye and extensive damage to the eye socket. This patient had his eye socket lined with an excellent skin graft, but still suffered from an almost complete absence of the upper lid and marked displacement of the right eyebrow. This was treated by
1. Z plastic operation right eyebrow. 2. Local plastic remaining right upper lid. 3. The construction of an artificial eye together with the adjacent missing parts of the eyelids. 4. Camouflaged by means of convex spectacles

Fig 14 Repair upper lip. Severe injury right side of face with loss of the full thickness right side upper lip. Treated by

1. Scar excision and plastic repair right cheek. 2. Tube pedicle flap repair upper lip

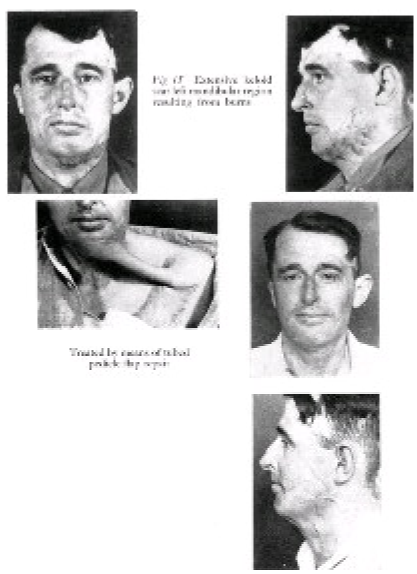

Fig 15 Extensive keloid scar left mandibular region resulting from burns Treated by means of tubed pedicle flap repair

Fig 16 Soft-tissue injury right lower lid. Treated by scar excision and plastic repair

Fig 16 Soft-tissue injury right lower lid. Treated by scar excision and plastic repair

Fig 17 Similar injury right upper lid. Treatment same as for Fig 16

Fig 17 Similar injury right upper lid. Treatment same as for Fig 16

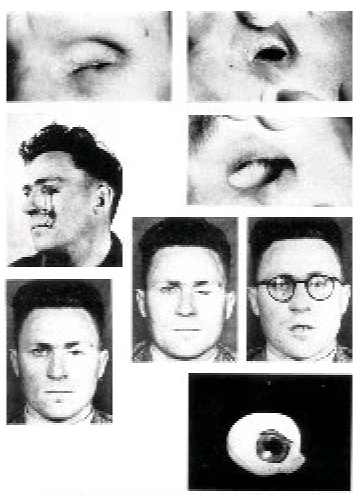

Fig 18 Injury left eye region with (1) Contracted socket due to loss of conjunctiva; (2) loss of margin left lower lid

Treated by free skin graft applied on stent mould, kept in position by cast metal cap splint on upper teeth, with extra-oral bar. Loss of levator function upper lid and marginal defect lower lid corrected by means of specially fashioned prosthesis. This had a clear acrylic support for the upper lid with the missing portion of lower lid simulated in tinted acrylic. Camouflaged by means of spectacles

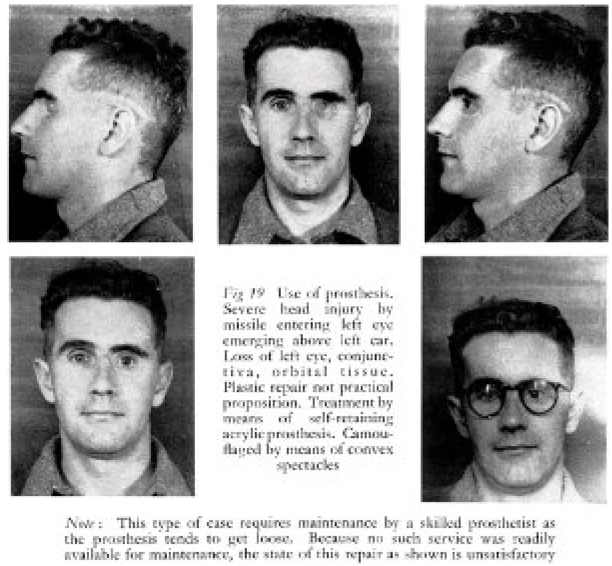

Fig 19 Use of prosthesis. Severe head injury by missile entering left eye emerging above left ear. Loss of left eye, conjunctiva, orbital issue. Plastic repair not practical proposition. Treatment by means of self-retaining acrylic prosthesis. Camoflaged by means of convex spectacles

Note: This type of case requires maintenance by a skilled prosthetist as the prosthesis tends to get loose. Because no such service was readily available for maintenance, the state of this repair as shown is unsatisfactory

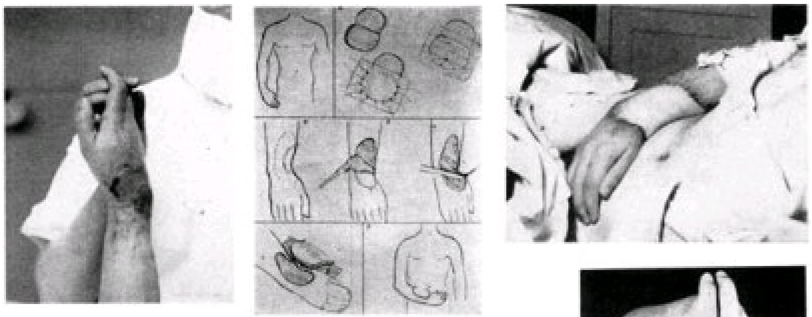

Fig 20 Soft-tissue repair wrist. Severe injury right wrist with loss of lower end of radius, large soft-tissue defect, lack of stability at wrist. Required bone graft, but needed adequate soft-tissue repair as a preliminary. Treated by means of direct abdominal flap as illustrated, followed by orthopaedic treatment

Fig 20 Soft-tissue repair wrist. Sever injury right wrist with loss of lower end of radius, large soft-tissue defect, lack of stability at wrist. Required bone graft, but needed adequate soft-tissue repair as a preliminary. Treated by means of direct abdominal flap as illustrated, followed by orthopaedic treatment

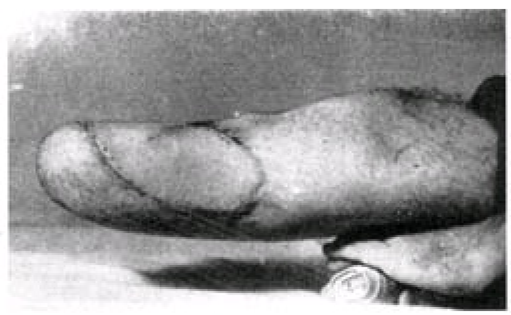

Fig 21 Flap repair of amputation stump with a scar densely adherent to subcutaneous surface of tibia which made it unsuitable for fitting of artificial limb. Tubed pedicle flap repair using abdominal flap transported on right wrist

Fig 21 Flap repair of amputation stump with a scar densely adherent to subcutaneous surface of tibia which made it unsuitable for fitting of artificial limb. Tubed pedicle flap repair using abdominal flap transported on right wrist

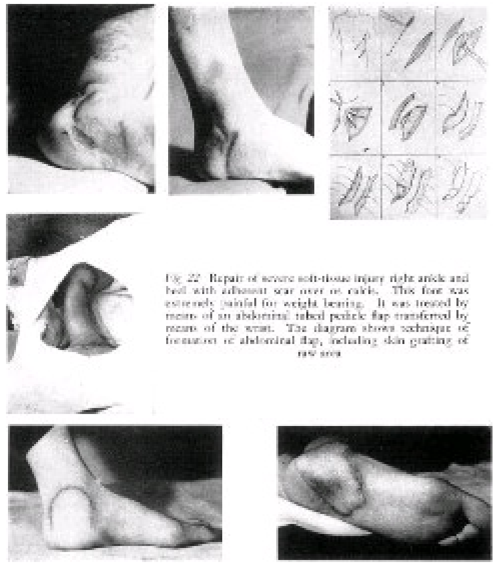

Fig 22 Repair of sever soft-tissue injury right ankle and heel with adherent scar over os calcis. This foot was extremely painful for weight bearing. It was treated by means of an abdominal tubed pedicle flap transferred by means of the wrist. The diagram shows technique of formation of abdominal flap, including skin grafting of raw area

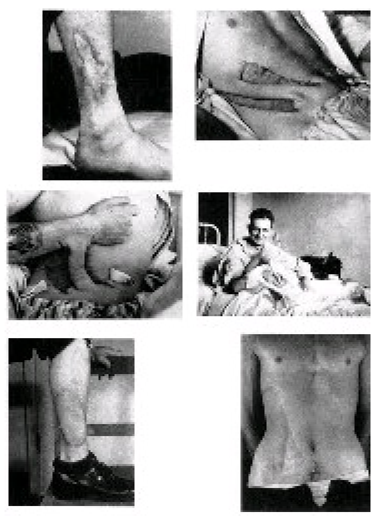

Fig 23 Unstable scar constantly breaking down right peroneal region, treated by means of an abdominal tubed pedicle flap transferred by the right wrist

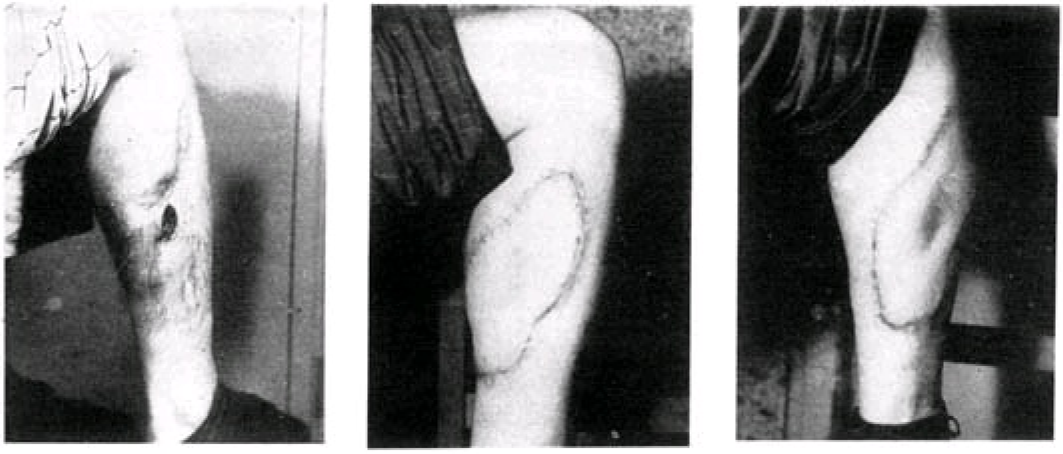

Fig 24 Repair of unstable scar right calf. Treated in same way as Fig 23

Fig 24 Repair of unstable scar right calf. Treated in same way as Fig 23

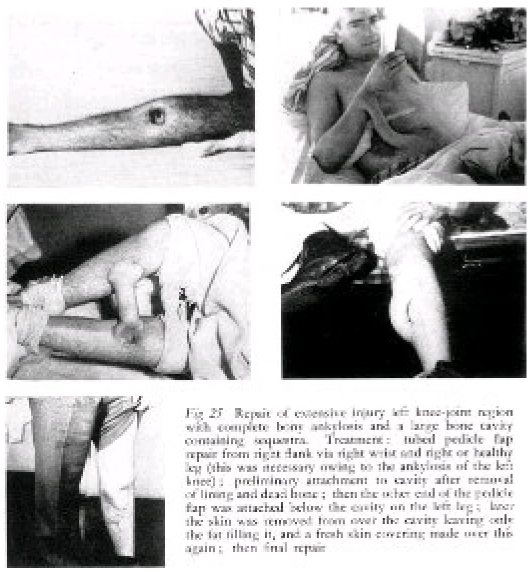

Fig 25 Repair of extensive injury left knee-joint region with complete bony ankylosis and a large bone cavity containing sequestra. Treatment: tubed pedicle flap repair from right flank via right wrist and right or healthy leg (this was necessary owing to the ankylosis of the left knee); preliminary attachment to cavity after removal of lining and dead bone; then the other end of the pedicle flap was attached below the cavity on the left leg; later the skin was removed from over the cavity leaving only the fat filling it, and a fresh skin covering made over this again; then final repair

Several other methods of fixation were employed for fractured mandibles where one or both fragments did not carry teeth. These included circumferential wiring, Darcissac's method, and direct bone wiring. The last of these, direct bone wiring, was a valuable last resort in certain cases where early treatment had been a failure and a non-union had resulted, with gross displacement due to muscle traction.

(Figure 4.)

It is worth pointing out that problems of fixation are nearly all concerned with the mandible. If there has been any degree of displacement at all, the mandible can be an extremely difficult bone to maintain in its reduced position, in a state free from mobility between the bone ends. On the other hand the maxilla, by comparison, seldom presents any difficulty, once it has been reduced.

In cases which ultimately require bone grafts and reconstructive plastic surgery, there must necessarily be a long delay till sepsis is cleared and healing completed. In the later stages of the war attempts were made at early bone grafts.

In plastic surgery, the commonest procedure involving the dental surgeon was that of making an intra-oral skin graft, the so-called 'epithelial inlay', to enlarge the depth of the buccal sulcus of the oral cavity. This was often necessary where bone loss following the original injury had left no alveolar ridge, thus eliminating the sulcus and making the wearing of an artificial denture impossible. The problem for the dental surgeon was to provide mechanical support for a mould which was used to hold a Thiersch graft in position till it had taken.

Sometimes an epithelial inlay was made for a more extreme purpose, in order to provide a large 'socket' into which an intraoral prosthesis (obturator) could be fitted to restore lost facial contour resulting from bone loss, particularly in the region of the premaxilla or the chin. An obturator such as this was usually constructed as part of an artificial denture. Similarly, an obturator constructed as part of a denture might be used to close an oral-nasal or oral-antral gap, or to provide an artificial soft palate.

Treatment and Policy during Second World War

Considerable improvements in methods of treatment were made during this war. At an early stage specialised centres were established in England for the treatment of jaw injuries, together with all other cases requiring plastic surgery. From the work at these centres two outstanding developments in the treatment of mandibular fractures soon made their appearance.

The first was the perfection of a new type of cap splint known as the 'sectional' cap splint. The old type, known as the 'continuous' cap splint, which had been used during the First World War, had very serious limitations. Although the sectional cap splint required much more care and work in its construction, it had very many advantages; to mention only one of these, the process of reduction and fixation was transformed from a hit-and-miss struggle to a smooth operation of comparative precision and certainty. (Figure 5.)

The second development was the introduction of the pin fixation method, already described. Although the principle involved in this method was not new, its adaptation for use in fractures of the mandible required a great deal of trial and error before the technical difficulties were mastered sufficiently to make it a really effective procedure. But this was achieved, and the method proved to be the answer to a long-standing problem. In the First World War many very bad results, from the point of view of both appearance and function, had been inevitable owing to the unsolved problem of controlling a badly-fractured mandible when there were insufficient teeth present to carry a cap splint, or when the fracture was in the posterior region of the mandible.

Another idea that seemed to develop during the Second World War was the use of plaster 'skull' caps. In the immobilisation of fractured mandibles and maxillae, the principle of encasing the actual part in plaster is quite useless; but during the war carefully placed plaster skull caps were found to be very useful in some cases as a means of anchorage for a floating maxilla, or for a mandible which required immobilisation as a whole. It was necessary for there to be enough teeth present, in maxilla or mandible respectively, to carry a cap splint. (Figure 7.)

Besides these improvements in methods of treatment there was also a considerable change in the policy governing treatment. These methods of fixation are only able to be effectively employed by a specially trained and equipped team, including plastic surgeon, dental surgeon, dental mechanic and dental laboratory. (This does not apply so completely in the case of pin fixation.) In the 2 NZEF such a team was operating with the most advanced general hospital, and casualties which would benefit from immediate treatment on these lines were given priority of evacuation as far as possible. There were, of course, many occasions when such a team would have been more effectively placed with a CCS, and in as much as equipment and trained personnel would permit, this policy was followed in the later stages of the war.

The dental officers attached to the Field Ambulances were equipped to perform first-aid treatment in the nature of temporary immobilisation by wiring or the application of jaw-supporting bandages, and were instructed in the principles of conservation of intra-oral tissue so that they could co-operate with the surgeons of the Field Ambulances in any emergency treatment. However, the policy was laid down that this first-aid treatment was to be reduced to a minimum or avoided altogether—in the previous war the tendency had been to greatly overdo it, with very bad results—and every effort was to be made to get a casualty with a major jaw injury evacuated as quickly as possible to the advanced general hospital (or to the CCS if it carried a team). In many instances of course, particularly in the North African campaign, such rapid evacuation was impossible and improvised methods of fixation—not mere first-aid treatment—had to be employed by dental officers of the Field Ambulance or CCS. An account of how such treatment was carried out by New Zealand dental officers for casualties in Greece and in phases of the North African campaign is given in the Official War History of the New Zealand Dental Corps.

It is well to emphasize the importance of pursuing a policy of 'immediate specialised treatment' for major jaw injuries, even though this was not always possible, as exemplified above. The fundamental importance is that, in many cases, subsequent bone grafts and prolonged plastic reconstruction may thus be avoided by taking full advantage of the great possibilities of tissue conservation; it is only by relatively immediate application of specialised treatment that this can be achieved. Of subsidiary importance is the fact that such treatment usually produces a dramatic change in the comfort of the patient, in his ability to take food, and consequently in his general resistance.

It is interesting to note that the advent of penicillin did strengthen the effectiveness of this immediate treatment by making it possible to be still more conservative with mutilated tissue in the presence of sepsis. Also it made it possible to retain, temporarily, teeth which were valuable as a means of fixation but which would otherwise have quickly become abscessed; however, retention of such teeth could only be continued for as long as the penicillin was being administered; thus the advantage was a limited one.

Of cases requiring 'delayed' treatment, all but comparatively minor cases were evacuated to New Zealand and admitted to the plastic surgical unit at Burwood, Christchurch, which was established early in 1943. The nature of the dental aspect of the treatment for such cases has already been summarised. As far as the Second World War is concerned the significant fact is that there was comparatively little work for the dental surgeon in this field, whereas in the First World War there had been a great deal. The reason for this was, in the first place, the lower incidence of major jaw injuries in this war due to the absence of trench warfare; but also, to some extent, it was the result of the improved methods of early treatment and the policy of making that treatment really 'immediate' wherever possible. The surgical technique of bone grafts to the mandible was varied considerably during this war, but we are here concerned only with the dental aspect of this problem; improvements in methods of fixation, already described, were a great asset in this difficult field, and some very elaborate cap splint designs, often in conjunction with pin fixation or plaster skull-cap anchorage, were used.

Prostheses are often a very valuable last resort, but it is again notable that there was far less need for them in this last war than in the previous one, not only for the reasons given already but also as a result of improved methods of plastic surgery. But whenever prostheses were necessary they were constructed in acrylic, which was vastly superior to vulcanite, the material used during the First World War; acrylic is much more hygienic and can be built to varying shapes and contours much more easily.

In conclusion, it must be emphasized that the foregoing record of treatment (both early and delayed), and of policy, is nothing more than a summary of the salient features. There were always so many varying circumstances that the best procedure, particularly in the matter of temporary field treatment, was often a completely individual problem. Details and examples of such problems will be found in the references listed.

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CHAPTER 17
Accidental Injuries

THE accidental injury rate in 2 NZEF was consistently high and was the cause of many hospital admissions and a number of deaths. The mechanisation of the Division with its thousands of motor vehicles, together with those of other Allied troops in the war zones and normal civilian traffic, meant that there was always a steady toll of traffic accidents, whether the Division was in action or not.

When night moves were necessary in the course of operations there was an inevitable increase in accidents. The increased use of jeeps in the later stages of war also seemed to add to the accident toll.

The motor cycle was responsible for many serious and some fatal accidents. This was inevitable as the cycles were used by despatch riders in the forward areas over rough terrain and poor roads. They travelled fast and fearlessly as their messages were often urgent. Even under the best conditions motor-cycle accidents were common. Crash helmets were worn from the beginning of the war, and protective shields were added to the motor cycles in Egypt in an endeavour to prevent serious injuries. The Americans used the jeep in place of the cycle, partly for this reason, and jeeps were substituted to some extent in the British Army when they became available.

The common use, especially in the Division, of petrol fires and primus stoves for cooking led to a large number of accidental injuries in the form of burns from explosions.

Added to this were the injuries received in the course of recreational training–mostly football injuries. These were unavoidable and justified by the preservation of health and morale in our force.

Many of the injuries were serious and fractures were common, involving prolonged hospital treatment and evacuation to New Zealand. Altogether about 10 per cent of 2 NZEF personnel were admitted to hospital annually from accidental injuries. In the years 1943 to 1945 these totalled 9846, while battle casualties admitted to hospital in the same period totalled 8274. (In the last seven months of

1945, however, there were no battle casualties.) In 1944, when there were men wounded in battle in every month of the year in Italy, the number of wounded admitted to hospital was 4209, and the admissions with accidental injuries were 3738. Deaths from accidents (some 300) were much more numerous than deaths from disease.

Like disease, accidents are in some measure preventable by appropriate administrative action; and a more searching examination of the sources of accidents could presumably point the way to a considerable conservation of manpower.

A ccidental I njuries: P arts of B ody I njured in C ases E vacuated to N ew Z ealand, 1940–45

Fractures of femur	49
Fractures of tibia and fibula	192
Fractures of humerus	30
Fractures of forearm	61
Fractures of feet	3
Fractures of jaw	19
Amputations of leg	21
Amputation of arm	1
Head injuries	82
Spinal injuries	52
Nerve lesions	28
Eye injuries	24
Knee-joint injuries	7
Shoulder-joint injuries	7
Chest injuries	10
Abdominal injuries	6
Ear injuries	5
Burns	31
Other injuries	15
	—
	643

WAR SURGERY AND MEDICINE

[SECTION]

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Chest injuries	10
Abdominal injuries	6
Ear injuries	5
Burns	31
Other injuries	15
	—
	643

CHAPTER 18
Knee-joint Injuries

INJURIES of the knee joint are of considerable importance to a New Zealand force because of the frequency of the occurrence of this injury in our national game of Rugby football. Accidental injuries were found to be extremely common in the army, and in these there was a high proportion of knee injuries.

First World War

In the First World War knee disabilities were common and were found very difficult to treat satisfactorily. Operation was not often carried out as results were not held to justify this treatment in the forces overseas. At the Convalescent Depot at Hornchurch particular attention was given to the rehabilitation of the chronic knee cases. Temporary plaster splinting associated with activity and strenuous physiotherapeutic measures were adopted, but with very little effect. It was found very difficult to render the men fit for further active service.

Between the wars orthopaedic surgery developed considerably, largely following the impetus given by the First World War. Operative treatment for the common semilunar cartilage injuries became the regular routine, and the results were generally satisfactory. Trained surgeons specialising in orthopaedic surgery were available for service in the Second World War.

Second World War

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Diagnosis: The history, and by this is meant the man's own unprompted story, was of the utmost importance. In cartilage injuries there was usually a story of an abduction rotation strain, with severe pain and later swelling. Locking might occur, and this might suddenly unlock or require manipulation to reduce it. Repetition of these symptoms commonly followed, as the avascular cartilage did not undergo repair except when the lesion was at the periphery. On examination of the knee, tenderness was often noted over the site of the anterior attachment of the cartilage. Limitation of extension was often present. The knee was then manipulated, reconstituting the abduction and the rotation outwards, at the same time bending and then straightening the knee. A distinct click was felt, and often heard, and some indication of the site of the injury to the cartilage obtained by the position at which the click appeared. For external cartilage injury the knee was adducted and rotated inwards and then extended. With practice, confidence in this test increased, and manipulations other than those outlined might be found useful. X-rays normally showed nothing except some possible narrowing of the joint space, but it might show other pathology such as a loose body or arthritic changes.

Operation was performed to remove disability and to prevent secondary degenerative changes in the joint, resulting from repeated trauma. Before operation the limb was elevated and a tourniquet applied to prevent bleeding in the joint and to improve vision. Very careful preparation and operative asepsis, and the no-touch technique, was essential.

Simple incisions were almost universally employed, the larger incisions such as the splitting of the patella being reserved for cases where general exploration of the joint was required. As it was deemed advisable never to operate on these cases till the diagnosis had been fully confirmed and proved by physiotherapeutic tests, the larger incisions were very rarely used. A good light was necessary. A small blunt hook was valuable in elucidating the injury and a strong clamp was required to grasp the cartilage during removal, which was carried out by cutting along the rim with a short tenotomy knife or similar instrument. The excision of the whole cartilage was generally carried out, including the posterior horn, which was apt to give rise to further trouble if it was left behind. Often damage to this portion could not be seen till the cartilage was being removed. If the meniscus was cystic the whole cartilage was generally removed.

The synovial membrane was sutured by a continuous catgut stitch and the skin sutured. At the end of the operation a firm bandage was applied over a bulky dressing of gamgee or wool, and then the tourniquet removed. This prevented bleeding in the joint.

After-treatment: This consisted in rest to the joint, combined with immediate continued and persistent functional use of the quadriceps muscles. This gave a stable and strong joint with full movement in three to four weeks, when the patient was normally sent to a convalescent depot for graduated training till he was fit to return to his unit.

Throughout the war there were never more than twenty men graded down for knee disabilities at any one time.

Results

A survey of the results of treatment in the 2 NZEF in Egypt was undertaken in 1942, all cases operated on up to that time, or those who had been reclassified as unfit for full duty, being included. The cases were checked carefully to assure that cases Grade I were actually posted as such. The results were:

	Ruptured Semilumar Cartilage	
	Internal	External
Patients operated on overseas	31	13
Doing full duty in Division	71 per cent	61·6 per cent
Doing base duties in MEF	16 per cent	15·4 per cent
Evacuated to New Zealand	13 per cent	23 per cent

(Two cases operated on in New Zealand prior to the war, for ruptured internal cartilage, were employed on base duties, and two cases not operated on had been invalided to New Zealand.)

It seemed established that, in ruptured internal cartilages, with cases uncomplicated by:

(a) injuries to other structures in the knee joint;
(b) osteoarthritis or osteochondritis dessicans;
(c) incomplete operation;

the operation of meniscectomy normally resulted in the men being fit for full duty; also the most common cause of failure to get a satisfactory result in an uncomplicated case was wasting of the quadriceps. This was a preventable cause, and quadriceps training both before and after operation was insisted upon.

The type of operation performed on ruptured external cartilages was generally carried out by a simple small joint incision. The larger arthrotomy sometimes done did not seem to militate against full recovery of the knee. The complete removal of the cartilage was aimed at. Post-operative treatment consisted either of retention in plaster for a fortnight or simple pressure bandage for twentyfour hours. Early quadriceps function was insisted upon.

Osteochondritis dessicans

There were seven cases, six of which had arthrotomy, three by a transpatellar incision. Loose bodies were removed in three cases and an internal meniscus in one. Of the six cases operated on, three became Grade I, two fit for base duties, and only one was evacuated to New Zealand. These results were surprising and gratifying and fully justified operation.

The following observation was made:'This tends to show that a fair degree of arthritis can be present in the knee joint without causing any marked disability, and emphasising the important distinction between pathological changes and function. It also proves that it is worth while to treat the cases surgically if any definite indications arise. Again it seems to discount the presence of any real disability in slight degrees of chronic osteoarthritis in joints generally, a common observation in civil life.'

This review clinched the opinion in our force that the operative treatment of semilunar cartilage injury and also of osteochondritis dessicans was fully justified, if proper selection of cases was made and especially if the older men were excluded.

This remained our practice throughout the war, and a considerable number of men were operated on in the base hospitals by the orthopaedic surgeons. The results continued to justify the treatment. More and more emphasis was put on the importance of full efficiency of the quadriceps muscle as the most important factor in the control of the stability of the knee joint.

Lesions of the Internal Lateral Ligament

These may be:

(a) Slight degrees of injury insufficient to cause any increased mobility in the knee and resulting only in bruising and tenderness at the insertion of the ligament, or

(Severe trauma with increased mobility of the knee.

b)

The treatment consisted under (a) in rest associated with adequate quadriceps exercises, and under (b) in the application of a plaster splint in extension for a minimum of six weeks, as well as the quadriceps exercises.

Lesions of the crucial ligament were also treated in plaster with quadriceps exercises. The severe internal lateral ligament and crucial ligament cases were automatically evacuated to New Zealand, operation being considered unjustifiable overseas.

Experience in Other Forces

In an article by Graham of the Australian Army Medical Corps on internal derangement of the knee in the Middle East, similar results were recorded. Out of 128 cases operated on, no fewer than 104 were rendered fit for service and 15 more fit for service at the Base. As much as possible of the meniscus was removed. No pad or bandage was used after operation. Football was found to be the chief causative factor.

A statistical survey covering 800 cases was carried out in the British Army in the United Kingdom in 1943, and football was shown to account for nearly 60 per cent of the cases.

Apart from locking, the most frequently observed signs of diagnostic value were local tenderness, persistent effusion, limitation of extension, and the results of manipulation. Early active use of the quadriceps in walking was the most important part of aftertreatment. Grouping post-operative cases with early transfer to a convalescent ward and resumption of light duties promoted early recovery.

Hospitalisation was prolonged both for conservative and for operative treatment and caused much wastage. Pain and locking were the main symptoms; tenderness at the joint line and wasting of the quadriceps the main signs. The results of sub-total meniscectomy were satisfactory. The review also confirmed our opinion of the results of severe injuries of the internal lateral and crucial ligaments and the uselessness of operative treatment of these injuries in the army.

Review

Our experience during the war showed that the most important factor in the treatment of knee conditions was the preservation and development of the muscular control of the joint. Rest at the beginning for the injured tissues was also necessary, followed by the gradual resumption of voluntary joint movement. Passive movement was generally uncalled for and harmful. At a later stage, in a few specially selected cases, manipulation might be practised. When the cases were carefully selected, with the exclusion of the older men and of those suffering from other knee disabilities, operation for the removal of damaged semilunar cartilages, and also of loose bodies in cases of osteochondritis dessicans, was definitely successful in the large majority of the cases. Quadriceps exercises were essential both as a pre-operative and post-operative measure. Graduated training was necessary before a man resumed full military duty with the Division. Severe injuries to the internal lateral and crucial ligaments, on the other hand, demanded discharge from the army.

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[SECTION]

INJURIES of the knee joint are of considerable importance to a New Zealand force because of the frequency of the occurrence of this injury in our national game of Rugby football. Accidental injuries were found to be extremely common in the army, and in these there was a high proportion of knee injuries.

First World War

In the First World War knee disabilities were common and were found very difficult to treat satisfactorily. Operation was not often carried out as results were not held to justify this treatment in the forces overseas. At the Convalescent Depot at Hornchurch particular attention was given to the rehabilitation of the chronic knee cases. Temporary plaster splinting associated with activity and strenuous physiotherapeutic measures were adopted, but with very little effect. It was found very difficult to render the men fit for further active service.

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CHAPTER 19
Wounds of the Knee and Hip Joints

WOUNDS OF THE KNEE JOINT

WOUNDS of the knee joint have always been of considerable importance not only because of possible loss of function of the joint, but particularly because of the serious effects produced by infection often leading to the loss of the limb and sometimes to loss of life.

First World War

Infection of knee-joint wounds was common during the 1914–18 War, and many methods were adopted to combat it. Excision of the wound was carried out, and in a clean wound the synovial membrane was sutured and the skin wound left open and treated with antiseptic dressings. When sepsis developed the joint was opened and drained. This was normally done by lateral incisions at either side of the patella opening up the suprapatellar pouch. Posterior drainage was at times carried out, but it was recognised that it was not efficient. The whole of the front of the joint was also laid open by cutting across the patellar tendon and stitching the large flap, including the patella, on to the front of the thigh, at the same time bending the knee. This produced very marked damage to the joint and an almost certain stiff knee afterwards. With the institution of the Carrel-Dakin treatment, tubes were inserted into the joint and regular irrigation carried out through the two long lateral incisions. The joint was rested in a Thomas splint with some extension, whether clean or infected.

The Belgians instituted early ambulatory treatment associated with lateral drainage and claimed good results, but this treatment was not adopted by the British Army and was contrary to the accepted principles of the treatment of infection. BIPP was used both on the wound and as an emulsion injected into the joint. Irrigation of the joint by the Carrel-Dakin method was the most successful form of treatment of the infected joint, and undoubtedly saved many limbs.

Amputation, however, was necessary in a considerable proportion of the cases, especially in the earlier period of the war. Serious infection produced a profound toxaemia, and the infection commonly spread outside the joint into the tissues of the thigh and the popliteal space. If the limb was saved, ankylosis of the joint often followed. The knee-joint cases were a constant anxiety to the surgeon.

Second World War

The treatment of wounds of the knee joint was essentially the same as that carried out during the First World War, namely, excision and suture of the synovial membrane. The perforating injuries with small puncture wounds were not operated on. Larger wounds were excised. In penetrating wounds with a retained foreign body the foreign body was removed if of large size and if it was handy at operation, or if located satisfactorily by X-ray. Bony injury was not explored except in the process of removal of a large foreign body, or as part of wound excision. In the latter part of the war the patella was completely excised in compound fractures into the joint. Small or unlocated foreign bodies were left alone at the primary operation, which was strictly conservative in type. Sulphonamides were applied to the wound and then given by mouth generally at four-hourly intervals for six to seven days. The limb was splinted in a Thomas splint to ensure essential rest. A posterior slab or gutter splint was at first utilised with the Thomas, and later the modified Tobruk splint was used with flexion of 10–15 degrees and moderate extension. Some surgeons used plaster splints, considering that immobilisation was of more importance than traction. Foreign bodies were removed from the joint after X-ray localisation, not earlier than six weeks after wounding and generally later. Many small foreign bodies in quiescent areas of the joint were left alone and gave rise to no trouble.

Following this treatment very little infection arose during the North African campaign, though when it did arise drainage was necessary and amputation sometimes had to be carried out. Posterior drainage was given up and lateral drainage relied on. In the latter part of the war the patient was nursed on his face to facilitate drainage, and this proved successful. Sulphathiazole in oil was injected into the joint at one period, but was thought to produce undue irritation. When penicillin was available it was instilled into the joint and also used as an irrigation as well as parenterally.

Delayed primary suture of knee wounds was carried out at the end of the war and penicillin given (from the time of wounding) to all knee cases. Little sepsis eventuated and penicillin generally controlled any infection satisfactorily. Early quadriceps exercises and gentle knee movements ensured satisfactory function of the joint in the great majority of the cases without serious bony injury or sepsis.

The results obtained in knee-joint wounds of the Second World War were markedly superior to those of the First World War. Conservative original operation, adequate rest to the joint by splintage, and the bacteriostatic effect of the sulphonamides and penicillin had abolished much of the previous anxiety in the treatment of knee wounds. The excision of the patella, when it was at all extensively fractured, had contributed also to the results. Amputation was still required if the patients showed signs of serious lack of resistance to infection and started going downhill. Cases of this kind, though fortunately much less common than in the First World War, still caused anxiety and demanded careful watching and good judgment in deciding the right moment for amputation. Loss of limb had to be accepted in order to save life.

WOUNDS OF THE HIP JOINT

These constituted a very serious problem. During the First World War the Balkan frame was used as a splint and special net beds were also constructed, but neither was very satisfactory. In septic cases posterior drainage was instituted.

In the Second World War plaster spicas were utilised both for transport and for treatment. In some cases a double Hodgen splint was used in hospitals with success. In septic cases posterior drainage was used, and some surgeons provided more adequate drainage by chiselling off the great trochanter and displacing it upwards.

The sulphonamides were applied locally and given by mouth till superseded by penicillin both for the prevention and treatment of infection. The infected cases were generally very seriously ill, with marked toxaemia and anaemia, and recovery was often a hard and prolonged struggle. Skilled nursing was essential. Blood transfusions and liberal high protein diet were of great value. Adequate doses of parenteral penicillin, given from the time of wounding till all danger of infection had passed, proved the most satisfactory treatment of the hip-joint injuries.

Knee-joint Wounds Invalided from 2 NZEF

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associated injuries in group (85 cases)—	
Haemarthrosis joint	3
Excision patella	2
Rupture ant. crucial lig.	1
Simp. dislocation knee	1
Ligature popliteal vein	1
Inj. ext. popliteal nerve	1
complications—	
Suppurative arthritis knee	3
Infection patella	1
Persistent synovitis	1
Partial ankylosis	1
Bony ankylosis (PW)	2
Fibrous ankylosis (PW)	1
missile causing—	
Shell	30
Machine-gun	10
Mortar	8
Gunshot	8
Bomb	6
Mine	4
Other	4
date of medical boarding—	
1941	3
1942	20
1943	9
1944	31
1945	6
PW	6

Hip-joint Injuries Invalided from 2 NZEF

fracture—	BC	AI
With suppurative arthritis	5	
Dislocation with fracture acetabulum	1	2
Dislocation hip		2
Other injuries	4	
	10	4

Pelvic Injuries Invalided from 2 NZEF

fracture—	BC	AI
Ilium	43	2
Ilium involg sacro-iliac joint	3	
Ilium involg hip joint	1	
Ilium acetabulum	1	
Ilium acetabulum involg hip joint	2	
Sacrum	11	3
Sacrum involg sacro-iliac joint	6	
Sacrum and ilium	1	
Sacrum and ischium	4	
Sacrum and pubis	3	
Ischium and pubis	1	
Ischium and dislocation hip	1	
Pelvis	21	22
Pubis involg urethra	1	
Ilium involg urethra	1	
Sacro-iliac subluxation	3	
	100	30

associated injuries—	
Rupture bladder intra-peritoneal	1
Rupture bladder extra-peritoneal	1
Rupture prostatic urethra	3
Femoral thrombosis	1

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First World War

Infection of knee-joint wounds was common during the 1914–18 War, and many methods were adopted to combat it. Excision of the wound was carried out, and in a clean wound the synovial membrane was sutured and the skin wound left open and treated with antiseptic dressings. When sepsis developed the joint was opened and drained. This was normally done by lateral incisions at either side of the patella opening up the suprapatellar pouch. Posterior drainage was at times carried out, but it was recognised that it was not efficient. The whole of the front of the joint was also laid open by cutting across the patellar tendon and stitching the large flap, including the patella, on to the front of the thigh, at the same time bending the knee. This produced very marked damage to the joint and an almost certain stiff knee afterwards. With the institution of the Carrel-Dakin treatment, tubes were inserted into the joint and regular irrigation carried out through the two long lateral incisions. The joint was rested in a Thomas splint with some extension, whether clean or infected.

The Belgians instituted early ambulatory treatment associated with lateral drainage and claimed good results, but this treatment was not adopted by the British Army and was contrary to the accepted principles of the treatment of infection. BIPP was used both on the wound and as an emulsion injected into the joint. Irrigation of the joint by the Carrel-Dakin method was the most successful form of treatment of the infected joint, and undoubtedly saved many limbs.

Amputation, however, was necessary in a considerable proportion of the cases, especially in the earlier period of the war. Serious infection produced a profound toxaemia, and the infection commonly spread outside the joint into the tissues of the thigh and the popliteal space. If the limb was saved, ankylosis of the joint often followed. The knee-joint cases were a constant anxiety to the surgeon.

Second World War

The treatment of wounds of the knee joint was essentially the same as that carried out during the First World War, namely, excision and suture of the synovial membrane. The perforating injuries with small puncture wounds were not operated on. Larger wounds were excised. In penetrating wounds with a retained foreign body the foreign body was removed if of large size and if it was handy at operation, or if located satisfactorily by X-ray. Bony injury was not explored except in the process of removal of a large foreign body, or as part of wound excision. In the latter part of the war the patella was completely excised in compound fractures into the joint. Small or unlocated foreign bodies were left alone at the primary operation, which was strictly conservative in type. Sulphonamides were applied to the wound and then given by mouth generally at four-hourly intervals for six to seven days. The limb was splinted in a Thomas splint to ensure essential rest. A posterior slab or gutter splint was at first utilised with the Thomas, and later the modified Tobruk splint was used with flexion of 10–15 degrees and moderate extension. Some surgeons used plaster splints, considering that immobilisation was of more importance than traction. Foreign bodies were removed from the joint after X-ray localisation, not earlier than six weeks after wounding and generally later. Many small foreign bodies in quiescent areas of the joint were left alone and gave rise to no trouble.

Following this treatment very little infection arose during the North African campaign, though when it did arise drainage was necessary and amputation sometimes had to be carried out. Posterior drainage was given up and lateral drainage relied on. In the latter part of the war the patient was nursed on his face to facilitate drainage, and this proved successful. Sulphathiazole in oil was injected into the joint at one period, but was thought to produce undue irritation. When penicillin was available it was instilled into the joint and also used as an irrigation as well as parenterally.

Delayed primary suture of knee wounds was carried out at the end of the war and penicillin given (from the time of wounding) to all knee cases. Little sepsis eventuated and penicillin generally controlled any infection satisfactorily. Early quadriceps exercises and gentle knee movements ensured satisfactory function of the joint in the great majority of the cases without serious bony injury or sepsis.

The results obtained in knee-joint wounds of the Second World War were markedly superior to those of the First World War. Conservative original operation, adequate rest to the joint by splintage, and the bacteriostatic effect of the sulphonamides and penicillin had abolished much of the previous anxiety in the treatment of knee wounds. The excision of the patella, when it was at all extensively fractured, had contributed also to the results. Amputation was still required if the patients showed signs of serious lack of resistance to infection and started going downhill. Cases of this kind, though fortunately much less common than in the First World War, still caused anxiety and demanded careful watching and good judgment in deciding the right moment for amputation. Loss of limb had to be accepted in order to save life.

WOUNDS OF THE HIP JOINT

These constituted a very serious problem. During the First World War the Balkan frame was used as a splint and special net beds were also constructed, but neither was very satisfactory. In septic cases posterior drainage was instituted.

In the Second World War plaster spicas were utilised both for transport and for treatment. In some cases a double Hodgen splint was used in hospitals with success. In septic cases posterior drainage was used, and some surgeons provided more adequate drainage by chiselling off the great trochanter and displacing it upwards.

The sulphonamides were applied locally and given by mouth till superseded by penicillin both for the prevention and treatment of infection. The infected cases were generally very seriously ill, with marked toxaemia and anaemia, and recovery was often a hard and prolonged struggle. Skilled nursing was essential. Blood transfusions and liberal high protein diet were of great value. Adequate doses of parenteral penicillin, given from the time of wounding till all danger of infection had passed, proved the most satisfactory treatment of the hip-joint injuries.

Knee-joint Wounds Invalided from 2 NZEF

associated injuries in group (85 cases)—	
Haemarthrosis joint	3
Excision patella	2
Rupture ant. crucial lig.	1
Simp. dislocation knee	1
Ligature popliteal vein	1
Inj. ext. popliteal nerve	1
complications—	
Suppurative arthritis knee	3
Infection patella	1
Persistent synovitis	1
Partial ankylosis	1
Bony ankylosis (PW)	2

Fibrous ankylosis (PW)	1
missile causing—	
Shell	30
Machine-gun	10
Mortar	8
Gunshot	8
Bomb	6
Mine	4
Other	4
date of medical boarding—	
1941	3
1942	20
1943	9
1944	31
1945	6
PW	6

Hip-joint Injuries Invalided from 2 NZEF

fracture—	BC	AI
With suppurative arthritis	5	
Dislocation with fracture acetabulum	1	2
Dislocation hip		2
Other injuries	4	
	10	4

Pelvic Injuries Invalided from 2 NZEF

fracture—	BC	AI
Ilium	43	2
Ilium involg sacro-iliac joint	3	
Ilium involg hip joint	1	
Ilium acetabulum	1	
Ilium acetabulum involg hip joint	2	
Sacrum	11	3
Sacrum involg sacro-iliac joint	6	
Sacrum and ilium	1	
Sacrum and ischium	4	
Sacrum and pubis	3	
Ischium and pubis	1	

Ischium and dislocation hip	1	
Pelvis	21	22
Pubis involg urethra	1	
Ilium involg urethra	1	
Sacro-iliac subluxation	3	
	100	30

associated injuries—

Rupture bladder intra-peritoneal	1
Rupture bladder extra-peritoneal	1
Rupture prostatic urethra	3
Femoral thrombosis	1

CHAPTER 20 — FOOT DISABILITIES

CHAPTER 20
Foot Disabilities

THE problems associated with the efficiency of the soldier's feet in the army are of the utmost importance.

During the First World War the infantry were essentially foot soldiers and had to march carrying their equipment whenever a change of location was made. In spite of this, there does not seem to have been an undue amount of disability produced by the feet. During the war there was a marked development of orthopaedic surgery as a specialty, and between the wars this specialisation continued. Attention was concentrated on orthopaedic conditions. The different abnormalities of the foot were studied and many operative procedures developed to rectify them. As was to be expected, the enthusiasm often led to over-elaboration of treatment for comparatively minor disabilities. There was also a tendency, especially amongst the less experienced surgeons, to overstress the anatomical as against the functional conditions of the foot.

Second World War

In the code of instructions for medical boards in New Zealand at the beginning of the war it was directed that the grading of persons suffering from deformities of feet and toes should be determined by the degree of disablement occasioned and not by the nature of the deformity.

Conditions causing disability were noted as club foot, hammer toes, hallux valgus and rigidus, and flat feet. Severe cases of club foot were classed as totally unfit for service. Hammer toe was considered only to be a disability if painful corns or bursae were present, and the same applied to hallux valgus, though a man with severe hallux rigidus was considered to be only fit for base service in New Zealand. As regards flat feet, rigidity was held to be of special importance.

In 1942 the Regional Deputies were asked their opinions regarding the desirability of making changes in the code of instructions. There had been criticism from the army of the physical standard of many of the recruits graded I who had subsequently had to be down-graded or discharged either in New Zealand or overseas. Auckland was the only centre in which an orthopaedic board was available, and elsewhere the difficulty in getting an orthopaedic opinion without delay meant that the borderline case was generally rejected. As a result of the opinions received, the National Medical Committee altered the code of instructions.

It pointed out that it was important to investigate any degree of disablement experienced by the man in civilian life and his type of occupation. Consideration had to be given to the possibility of aggravation of the disability by the conditions of military service.

Callosities on the soles of the feet, if not curable, rendered a man unfit for overseas service, as did club foot in the majority of cases. Cases of flat feet were to be graded according to the degree of disablement or anatomical deformity. Cases of hallux rigidus were to be graded as unfit for overseas service. Men with hallux valgus could, in the absence of symptoms, be graded I. No operation was to be recommended for this condition, and no case previously operated on was to be graded I. Hammer toes, on the other hand, could be operated on to improve the grading. No case of pes cavus was to be made Grade I, and severe cases were not to be accepted except for base duties in New Zealand.

This advice was sound in that the grading was to be determined by the degree of disablement occasioned and not by the nature of the deformity. Stress was laid, however, on the anatomy of the foot, and any abnormality of anatomy was held suspect. The boarding was carried out all over New Zealand by very many practitioners, many without army experience, and most without any special orthopaedic or other experience of foot conditions. The functional standard of the feet was difficult to evaluate in a short examination. Without a functional test, it was natural that the anatomical aspect of the problem would be particularly considered.

In Camp

When the test of training took place many soldiers were found to suffer from undue strain and fatigue, and this generally was first shown with regard to the feet. The problem was particularly well studied at Papakura Camp, where a remedial training group was formed and graduated training carried out. This proved successful, and as a result a special remedial training camp was set up at Rotorua at the end of 1940 and functioned for three years with varying success. Foot cases formed the largest single group referred for treatment. Special foot exercises were arranged and physical therapy training given by highly trained instructors. The great importance of the psychological aspect was realised, and it was found that the antagonistic type gained little benefit.

Major (later Colonel) W. B. Fisher made the following comments as RMO to the Maori Battalion at Palmerston North Military Camp from January to May 1940:

A lot of valuable work was done by chiropodists, the feet generally being in a very bad state when the men first came into camp. A routine inspection of all feet at the beginning of the camp revealed about an 80% incidence of ringworm of the toes and a large percentage of corns and callosities.

The shape of the Maori foot caused difficulty in the wearing of boots. It was noticed that most Maoris have flat feet and are very wide across the heads of the metatarsals with a definite tendency to bunion formation of the big toe as well as a similar condition of the little toe, with the result that corns readily formed at these sites.

In my opinion with this Maori Battalion anyway it would be worth spending much more time over the issue of boots by allowing the men to try on their boots first, and getting a pair which was comfortable at the start. They were, of course, allowed to change them, but many men seemed to think they could make their feet fit the boots just as easily as make the boots fit the feet.

Dr D. Macdonald Wilson, who was a Regional Deputy and later medical officer in charge of treatment at the Pensions Department, and who had had active war service, made the following observations based on his experience of seeing men at recruitment and, later, the same men after being referred for boarding at Trentham Camp:

(1) The enthusiast in the Drill Hall with some degree of flat feet had perhaps after a month in camp lost his enthusiasm and tended to trade on his flat feet. This was the psychological element.
(2) Men with definite flat feet who had been shepherds around the hills without trouble were often disabled in camp. The heavy boots and marching with kit on

a route march seemed too much for them. More attention to footwear and more gentle approach to 'foot-slogging' on a hard road would have enabled them to stand up to it. With gradual training and remedial training in the ordinary camp, and not in the equivalent of a special 'hospital' for foot trouble as the Rotorua Training Camp, such men might have made good.

(3) Experience showed that attempts to improve feet by operation were useless to make men Grade I and, with hospitals full and waiting lists of other cases, we did not want these men to undergo surgery at the Army's expense and time if they were only to be discharged later. (Also there had been some unfortunate happenings.)

Therefore we forbade operations for hallux valgus and bunion, feeling the majority would not stand up to training. Minor operations for hammer toes and corns, if the recruit wished it, he could arrange himself and return for re-examination. As 'remedial treatment' had ceased, it was no use taking the man into camp on the understanding he would voluntarily have an operation, as likely as not he would later decline it.

Probably if some of these cases of minor foot disabilities had proceeded overseas their psychology would have changed. Nearer the seat of hostilities, amongst other men with similar disabilities who did not allow them to become disablements and where Army authority was more easily maintained, I think many of them would have carried on. But if they had not, would the Army overseas have complained of poor boarding in New Zealand?

Men graded to a lower category for foot conditions were utilised in the camps in New Zealand and in the Territorials and Home Guard. In the latter, ability to march for five miles was the standard laid down.

The Foot Problem in 2 NZEF

Although movement of troops was generally carried out by motor transport there were occasions where marching was necessary. The GOC 2 NZEF considered that training for long marching was essential, and this was part of the routine of army training overseas. Two long marches were especially noted, the one in England by troops of the Second Echelon and the other in Egypt prior to the embarkation of the Division for Italy. As a result of these marches many men suffered from foot strain which had prolonged aftereffects, necessitating down-grading in several instances. This drew the attention of the Medical Corps to the necessity of graduated training, and the necessity for RMOs to ensure that any men subjected to the strain of long marches were physically fit beforehand and to provide for transport of those falling out during the march. The campaign in Crete made a lasting impression on senior combatant officers with regard to the necessity for only having grade A men in the Division. The long march across the island proved too strenuous for some of the men, especially those more accustomed to mechanical transport. The employment of graded men on the understanding that normally they would not have to march long distances was discountenanced, though conditions similar to those in Crete never arose again during the war. This led to an unnecessary restriction in manpower available for the Division, and would, in the future, quite negative any value of the Pulheems system of evaluation as far as the locomotor system was concerned.

Different Types of Feet

Flat Foot with Free Mobility: This was associated with undue pronation and with some eversion at the ankles, and there was a tendency to a weakening of the transverse arch with widening at the metatarsal heads and a condition of hallux valgus. It was essentially a position of rest or inactivity. With strong musculature the position of activity could be readily attained and the foot function normally. With weak muscles and liability to fatigue, the foot could be the focus of discomfort.

Flat Foot with Rigidity due to the arthritic changes in the tarsal joints and general lack of flexibility in the foot. The position occupied was similar to the above, but the position of activity could not be resumed. If the condition had become stabilised and painless, satisfactory functional activity was possible. If not stabilised there might be definite disability.

Dropped Anterior Arch: This was really only a part of the relaxation of the foot, but often reconstitution of the arch was impossible and callosities formed under the tread and the foot would not stand the normal strain. Remedial exercises to strengthen the musculature were of special value.

Pes Cavus: The high-arched rigid foot with hammer-shaped toes and some restriction in ankle movement denoted a foot which could not stand undue strain, and in the severer forms was not accepted in the army for any branch necessitating marching. No treatment was of any use in the army.

Hammer Toes: These were often a part of pes cavus but, in minor forms, were of little importance, except for the discomfort from corns which formed on the prominent joints. A simple operative procedure brought about relief in the mild cases.

Hallux Valgus: In the milder forms this was of no importance except as an indication of a weaker foot. When there was a pronounced exostosis of the head of the first metatarsal with a bunion over it treatment to remove both bunion and exostosis was useful. In the severer forms where this simple operation was unavailing no treatment was of use and the men were down-graded. (Lieutenant-Colonel J. K. Elliott reported in 1949 that the removal of the exostoses had in many cases resulted in increased lateral deviation due to the weakening of the capsular ligament.)

Hallux Rigidus: This was a genuine disability because of the inability to spring off the big toe. Treatment was of no use in the army and grading down was necessary.

Overlapping Little Toes: This was a congenital deformity often giving rise to symptoms. The removal of the toe was done if there was real disability. A plastic operation with dorsal division of the capsule of the metatarso-phalangeal joint was preferable to amputation and protected the fourth toe.

Exostosis of the fifth metatarsal, generally associated with a broad foot with spreading transverse arch. If a wide-fitting boot was available, no treatment was necessary. The exostosis was removed, with relief in some cases.

Ingrowing Toenails: This was a very frequent condition, being associated with infection, especially in feet prone to sweating. Simple attention cleared up the milder infection, but in the severer forms the removal of the side of the nail with the nail bed was required. A form of operation popular amongst some orthopaedic surgeons of removal of the terminal part of the last phalanx of the big toe with all the nail bed was unnecessarily drastic, and constituted a permanent pensionable disability in many cases. (Like other radical measures it is not suitable for army conditions, though indications for its use may arise in civil surgery in cases of engrained and long-standing infection.)

A similar outlook on operative procedures in the army was shown by an Australian Army Instruction.

Operative Treatment Carried Out in 2 NZEF

From the outset, operations were not encouraged unless they were simple in nature and likely to bring about a rapid and definite improvement in the condition, thus rendering the man of more value in the army. It was felt that any major procedure would entail a long convalescence, and almost certain down-grading, so in cases demanding such measures, down-grading without operation was the more practical procedure.

Hammer Toes: Simple arthrodesis of the prominent knuckle was the type of operation performed.

Hallux Valgus: The removal of a prominent exostosis with the overlying bunion was all that was done in the large majority of the cases. The more radical procedures were discouraged.

Hallux Rigidus: Again, operation was discouraged and down-grading adopted as necessary, the majority of the cases carrying out base duties satisfactorily.

Overlapping Toes: These were removed at the metatarso-phalangeal joint as required.

Ingrowing Toenail, as already stated, simple removal of the affected part of the nail and nail bed.

A review of cases either operated on or regraded in the 2 NZEF was made in December 1941. There had been very few cases dealt with, and it was evident that hallux valgus was not a common disability in the army. Radical operations had proved unnecessary and unsatisfactory. The lesser operations of removal of the exostosis had proved at least temporarily successful.

Remedial Treatment in 2 NZEF

A considerable number of men were down-graded in the 2 NZEF for foot disabilities, most of them for flat feet. The disability was present generally in debilitated individuals prone to fatigue, and was often just part of a general lack of vitality and also part of a psychoneurosis. The man robust physically and mentally could carry on with a very flat foot without complaint, but the weakling not only felt the results of fatigue more often but used the mild disability as a refuge. Efforts were made by special remedial training units to make the men Grade I, but because of the psychological condition of so many it was difficult to improve their condition.

A report written by the DMS 2 NZEF in August 1941 gives a clear idea of the difficulties experienced at that time:

The problem of men who become unfit through flat feet and other foot disabilities is becoming an acute one. A number of men are sent to the bone and joint specialists at the general hospitals and are ordered foot exercises, graduated training, and various matters of attention to boots and socks. In very few cases are the results successful.

It is felt, therefore, that some arrangement must be made to get these men together under supervision so that all these necessary measures may be carried out and decision made as to whether men are fit to resume training for the field, or must be re-graded. The most suitable arrangement would seem to be to form a special group at the Base Reception Depot under the control of a junior officer or senior NCO.

A good surgical bootmaker is desirable, though a certain amount of alterations to boots is carried out by the splint-maker attached to 2 NZ General Hospital. A chiropodist attached at present to 1 Camp Hospital could be transferred and a medical officer could be detailed to check all cases twice a week.

This statement was supported by a report by the Consultant Surgeon 2 NZEF on the problem:

In cases appearing before medical boards for reclassification during the last few months, there has been an increased incidence of cases designated as flat feet, metatarsalgia, or other afflictions of the anterior arch, and a small number of cases of pes cavus. The following observations are made after carefully eliciting the history and symptoms of the cases, and after examination of them, by both general and orthopaedic surgeons:

In only a very small proportion of the cases has there been any real anatomical abnormality that can be readily ascertained on physical examination. In almost all the cases the symptoms complained of are not those pathognomonic of flat feet or metatarsalgia.

Treatment by raising the inner aspect of the sole and heel of the boot has not only been of no benefit in most cases but has aggravated the condition, the men being more comfortable in tennis shoes. In a definite proportion the boots have been found to be illfitting and they are always stiff and rigid. In many cases the first onset of the symptoms has followed very prolonged route marches. It is an almost constant statement that no route marching had been done in New Zealand and often little or none done in Egypt previously.

As a result of these observations it is clear that the symptoms complained of are not those due to flat feet but rather to muscular fatigue, especially and naturally shown as foot fatigue in men undergoing training by route marches or constantly on their feet. This is shown by the symptoms being aggravated rather than relieved by wedging of the boot, and by the relative comfort of sand shoes. These symptoms naturally arise in those soldiers who are unable temperamentally to put up with discomfort of any kind—the feebler type of soldier.

The problem is naturally difficult to solve, but, if looked upon as one of fatigue and lack of energy generally, perhaps something can be done to solve it by arranging a special platoon at the Base for men suffering from foot fatigue and other somewhat similar conditions, such as convalescence from knee and leg injuries. This platoon could be given special graduated training by physical instructors capable of dealing with the position sympathetically yet firmly. Special attention could be paid in the platoon to the fitting of boots, the wearing of satisfactory and clean socks as well as to any alterations in the boots advised by the medical officer. Chiropody could be made available from the camp hospital. An orthopaedic surgeon could carry out regular visits to the platoon to advise on problems connected with the training, and also to examine any special cases.

Finally I consider that observation of these cases shows that massage and physiotherapy is not only useless and a waste of time, but actually aggravates the condition by fixing the disability in the mind of the patient and giving him a sense of invalidism.

Special clinics were set up in Maadi Camp for a short time, but were not successful as was at first hoped.

For the remainder of the war there was no special incidence of foot trouble in the 2 NZEF and no fresh problems encountered. In Italy there were no long marches and no abnormal conditions such as heat and sand likely to aggravate foot disabilities. It was noticeable that there were no fatigue fractures seen. The foot disability had been evaluated in its relation to the army, and all that was necessary was a regular grading of personnel who were unable to stand the stress of front-line service.

The General Problem of the Function of the Foot

It is very difficult to get a proper perspective to evaluate the foot as to its functions in locomotion. It is unfortunate that the physiological outlook has for so long been neglected and that the anatomical shape of the foot has come, in the minds of perhaps the majority of medical men, to be considered of supreme importance. This has led to a classification of foot disabilities under anatomical groups and a false idea of a normal foot has evolved. The position of the foot, in what we may call the mid-position between rest and activity, is treated as the ideal foot, and a relatively high longitudinal arch is considered ideal. If the arch is still more prominent, as it is in pes cavus, the appearance of the foot seems preferable to the pronated flat-looking foot, which is the normal position of rest. If the foot is very mobile, then during rest it will appear very flat, and under the anatomical classification will be a flat foot and disability will be expected. The foot is looked upon as a mechanical means of support and the bones and ligaments are looked upon as the structures that take the strain, and it is natural to expect them to function better if the shape of the foot appears to be mechanically better able to sustain the body weight. This outlook has vitiated the whole management of foot conditions.

It would be of great value if, for a while, the anatomy of the foot were forgotten and the medical student had instead to study the foot in action in athletics, in walking, in standing, and at rest. Perhaps the foot of the ballet dancer is as efficient as any other, yet at rest it is very flat and pronated. The bare foot of the native races also appears to be a flattish foot. If one is observant one will have noticed many of our fellows with just such flat feet who are able to do the most strenuous work. Even rigid flat feet are no bar to strenuous and prolonged work. What it is essential to realise is that the foot is normally a very mobile and pliable structure with constant changes in position. There is a position of activity with the foot adducted, the longitudinal arch raised, the foot extended, the toes flexed, and the muscles of the leg and foot acting strongly. Then there is the position of rest with no muscular action the foot pronated or abducted, and the longitudinal arch flattened. Then there is the mid-position adopted during standing, when the muscles are acting less strongly and the bony ligamentous structures have to take part of the strain.

On muscular activity depends the functional efficiency of the foot. Pliability of the foot is essential to full function, and the real disabilities of the foot are associated with rigidity of the foot structures, especially when this is associated with any inflammatory condition. This is seen in the partially rigid foot due to inflammatory adhesions, which is often relieved by manipulation. The foot with bony rigidity, though awkward, generally gives rise to little trouble. Pes cavus in a marked degree is often a serious disability as regards marching.

When there is marked muscular weakness, often associated with general debility, and so often seen in adolescents, there will be undue strain put on the ligaments of the foot during activity, including standing, and this strain tends to exaggerate and sometimes fix the position of rest and later to bring about some generally slight anatomical changes such as hallux valgus. The causative factor has been the muscular weakness; the anatomical changes are secondary. On the other hand, with strongly developed muscles even a foot weak structurally will be able to act efficiently, always remembering that a freely mobile foot is not a weak foot.

A valuable demonstration of the essential difference between anatomical structure and physiological efficiency was given by an investigation carried out in the British Army to ascertain what number of men in a typical infantry brigade had anatomical deformities of the feet which were symptomless. A thorough examination of the feet of all the men was carried out and the following abnormalities observed: (i) abducted feet, (ii) pes cavus, (iii) deformity of the toes. Rigorous tests were then carried out, including 3-mile runs and 14- and 21-mile route marches. Some 24 per cent of the men had foot deformities, but the feet were supple and they were not foot conscious. There was relatively no more disability recorded in the men with deformities. These conclusions were reached: firstly, in an infantry brigade there were men with anatomical deformities of the feet who were performing normal duties; therefore anatomical deformity of the foot alone was not a sufficient indication for down-grading. Secondly, approximately the same proportion of men with normal and abnormal feet reported sick with foot complaints. This investigation suggested that the deformed foot was no more liable to give rise to disablement than the normal foot.

This was valuable support to the idea that anatomical abnormalities, when unassociated with rigidity, are of no importance as regards the efficiency of the soldier.

The two factors of prime importance in the fitness of the soldier are graduated training and psychological normality.

Graduated Training and Physical Fitness

During the war constant reference was made to the importance of adequate, and especially graduated, training of the soldier in marching. Complaints were made from the 2 NZEF that men were sent overseas without adequate military training and especially without having done any marching. In New Zealand a special remedial training camp was established at Rotorua, where graduated physical training was given to men with weak feet to render them fit for service. The type of man chosen was mainly the underdeveloped and undernourished man who had led a sedentary life and had not taken part in any physical sport. The medical authorities were alive to the importance of the physiological aspect of the problem.

In the 2 NZEF it was quickly realised that foot disability was largely a question of fatigue, and that graduated training would enable many men with abnormal feet to become fully efficient. Radical surgical procedures were discountenanced. Special remedial training groups were formed at the base camp where graduated training was carried out. The treatment by physiotherapy in the hospital was discouraged as likely to make the soldier foot-conscious.

Psychological Efficiency

The psychoneurotics undoubtedly formed the majority of those who complained of foot disability. This may have been due in some measure to the possibly lower physical standard of this type. The main reason, however, was that the foot was used as the means of escape, and the normal symptoms of fatigue were exaggerated into a disability which the individual gave in to. If there was some anatomical abnormality, then it was easier for the man to plead disability and more difficult for the medical officer to deny it.

It was realised very early in the war that the large majority of the men complaining of foot disability were the psychoneurotics and the poorer types in the force, and that as often as not there was no demonstrable abnormality in the feet. The flat foot was not an anatomical defect but could produce an abnormal personality. The undue stress laid on the anatomical factor naturally made the management of these cases at times very difficult. Colonel Spencer, OC 2 NZ General Hospital, stressed this aspect very strongly in a valuable report he submitted on the psychological aspect of hospital treatment early in the war.

Brigadier Ogilvie, Consultant Surgeon MEF, stressed the importance of sizing the man up as a whole, and of referring men without demonstrable signs of disability to the psychiatrist for his opinion. He emphasized that flat foot was merely an abnormality of posture and that in the absence of stiffness was not a sign of disability.

The Military Boot and Other Footwear

It has to be realised that for the large majority of recruits entering camp there is a violent change in footwear and in the work that the foot has to accomplish. The average civilian wears light shoes and light socks, and does little in the way of walking, and certainly not with heavy loads. It is not to be wondered at that he has difficulty in accommodating himself to the heavy rigid boots, the thick socks, the marching in formation with packs. The soldier's feet have to be broken in, and common sense should lead one to do this gradually.

In the provision of boots there is need for great care. The size of the boot required may be, and often is, different from the size of the light civilian shoe usually worn. There must be provision for a thick sock and maybe two pairs of socks, and provision also for some swelling of the feet after long marches.

In the British Army, officers are required to see that boots are fitted in accordance with instructions. Experience has shown that very few soldiers know how to select suitable boots. It must be remembered that the foot spreads out a quarter to a third of an inch in length and one-fifth to one-half of an inch in breadth under the weight of a full marching load. Boots should be fitted indoors in a long room in which men can walk up and down. They should be put on over regulation army socks. If there is any doubt, the larger size should be taken. The soldier should select the boot which gives him greatest comfort. This is a different method from that often seen, where a pair of boots of the size named by the soldier is simply given to him at the same time as he receives other articles of his kit, without any provision for trying the boots on.

There was at times criticism of the army boots and shoes issued to the New Zealand soldier, but in general they were satisfactory if they fitted. Difficulties, however, did arise:

1. There was an insufficient supply of broader boots. This was of considerable importance as the Maori foot is wider than the normal European foot, as his general physique is sturdier. This width is seen whether the foot is short or long. (This peculiarity of the Maori foot was recognised by Dr Thomson, surgeon to the 58th Regiment during the Maori Wars.) There is no special provision made for the Maori soldier in this respect, though frequent complaints were made and recommendations also made by medical officers associated with the Maori Battalion, and by the consultant surgeon. As a consequence of wearing the narrow boots, bunions and callosities developed both over the prominent heads of the first metatarsal and also over the fifth metatarsal. Removal of the prominent bone was often resorted to in consequence, and it seemed as if we were trimming the Maori's feet to fit the boots rather than providing boots to fit the feet. The strong recommendation is made that special lasts be provided to enable adequate provision of broader boots for Maoris and the relatively few Europeans with the same shape of foot.

2. When boots were repaired provision was not always made for the soldier to get back his own boots, and he was issued with some other soldier's second-hand boots. This was at one time the established custom in the MEF, and the records show that the same thing happened in New Zealand. Strong comments naturally were made by medical officers, with sometimes little effect on administration officers. It cannot be too strongly urged that the practice should be condemned and that fuller provision should be made for the repair of boots, so that every soldier can without difficulty get his own boots repaired.
3. Complaint was made that the wearing of rubber shoes on transports was detrimental to the feet and caused disability in subsequent training. Leather-soled sandals were recommended and were supplied later in the war.

The provision of special boots for soldiers with abnormalities of the feet was arranged for both in New Zealand and overseas. In New Zealand the main hospitals agreed to supply special boots and to adjust the boots as required. In several of the hospitals well-equipped departments with skilled personnel were available. Overseas, light boots were supplied by the army when required, and special boots were also made for selected cases on the order of the consultant surgeon. Adjustment to boots was carried out both at the hospitals and in the camps. A special department was developed at Helwan Hospital.

The ordinary adjustments to the boots such as the raising of the inside of the heel and its prolongation forward, and the raising of the inner part of the sole, were useless in the desert, where the boot sank into the sand. The adjustments simply increased the weight and clumsiness of the boot and aggravated the fatigue which generally underlay the real disability.

The need for constant attention to boots was stressed in the army, and many memoranda were issued to this effect. It was recommended that the boots be kept in good repair to prevent the feet getting wet, and that if the boots did get wet they should be dried slowly and then well oiled. The boots should also be softened regularly with vaseline, neatsfoot oil, or dubbin.

Socks: Soldiers were issued with four pairs of socks, and in addition most of them had some hand-knitted pairs. The need for cleanliness, with constant washing of the socks and care to prevent shrinking, was ever present. Thick socks capable of absorbing perspiration were provided.

Foot Cleanliness: Of all matters concerned with the feet this was the most important. The provision of facilities for washing the feet, especially after long marches, was essential. The provision of showers was important to any army. The use of foot powder after thorough drying of the skin was of great value. A useful foot powder was salicylic acid, 3 parts; boric acid, 10 parts; talc, 87 parts.

The Care of the Feet after Illness: The natural sequel to any debilitating disease or to any prolonged rest was an absence of fitness for physical exercise or strain. This was specially noted in regard to the lower limbs, and, in consequence, foot strain was frequently complained of when convalescents resumed their military training.

The necessity for graduated training with physical exercise for the lower limbs became obvious, and the British type of convalescent depot was mainly occupied with this training. The British physical training instructors were invaluable in the training of convalescents, and one of their depots well forward on the North-West European front was one of the most efficient medical units observed during the war.

Skin Diseases of the Feet

These were relatively common in the 2 NZEF and led to much of the real foot disability. The commonest disturbances were, in order of frequency: (1) hyperidrosis, (2) eczema, (3) pyogenic infection, (4) tinea. The prevention of the spread of tinea exercised the minds of medical officers in every theatre of war. The Americans had shallow troughs at the entrance to their shower or bath rooms filled with antiseptic solution. Provision was made for the frequent washing of the floors with antiseptics. The boots and socks of infected men were treated with formalin vapour in a closed container or otherwise sterilised. The infection was difficult to eradicate either in the individual or the group.

General Summary

The problem of foot disability in the army is quite distinct from that in civil life. It has been found that, provided the foot is mobile, minor deformities of any kind are of no significance in function. The grosser deformities and the rigid feet are generally not suitable for full military service, except that fixed bony deformity does not seem to give rise to any marked disability. There are three danger points: on enlistment, at physical training, and on long route marches.

There is profound alteration of the foot habit of the individual when he enters camp. From a sedentary worker wearing light shoes and thin socks, he is transformed into a soldier with heavy boots, thick socks, and then subjected to strenuous physical exercises and long route marches. An ill-fitting boot can play havoc with his feet, and his muscles will need gradual training to enable him to carry out his military duties without foot strain.

The recruit may then come under the control of an over-zealous and exacting physical training instructor who may not realise that the feeble leg musculature cannot at once do all that is asked of it, and as a consequence acute foot strain may develop.

Finally, long route marches may overtax the relatively untrained man, who may feel in honour bound to keep up with his fellows and so subject his feet to severe strain from which he may take a long time to recover.

The provision of well-fitting boots is essential and must be given every attention by combatant officers. The repair of boots, and return to the man of his own boots, is also of great importance. The care of both boots and socks and cleanliness of the feet will guard against most troubles.

Difficulty arose because of the mistaken idea of foot physiology, and the overstress laid on anatomical variations, which were often mere temporary postural attitudes.

With regard to the treatment of foot deformities, it has been amply proved that no major surgical procedures are advisable under army conditions, and only minor procedures to alleviate a few of the lesser marked deformities are of any real value.

Skin diseases demand attention, and of all diseases hyperidrosis is the most common and most disabling. Eczema, pyogenic infections, especially with reference to ingrowing toenails, and tinea are also of importance. Tinea necessitated constant vigilance in preventing the spread of the infection at bath houses, but did not cause much disability.

The association of psychoneurosis with the disabilities of the foot was the most important, and the most difficult, aspect of the whole problem. It was found that the feebler type of soldier complained, often with perfectly shaped feet, whereas the keen, alert men would carry on under the most rigorous conditions with badly deformed feet.

The realisation that the foot is a highly mobile structure depending for its strength on muscular action is necessary to appreciate its function.

Cases Invalided To New Zealand From 2 NZEF, 1940–45

Pes planus	43
Pes cavus	27
Metatarsalgia	11
Hallux valgus	17
Hallux arthritis	24
	122

These disabilities were commonly associated with other conditions affecting the general health of the soldier, especially if he was in the older age group.

The total number of cases diagnosed as flat feet reviewed by the War Pensions Department up to March 1952 was 1009 with overseas service and 444 with service only in New Zealand, but the number of those actually receiving pensions was not available.

WAR SURGERY AND MEDICINE

[SECTION]

THE problems associated with the efficiency of the soldier's feet in the army are of the utmost importance.

During the First World War the infantry were essentially foot soldiers and had to march carrying their equipment whenever a change of location was made. In spite of this, there does not seem to have been an undue amount of disability produced by the feet. During the war there was a marked development of orthopaedic surgery as a specialty, and between the wars this specialisation continued. Attention was concentrated on orthopaedic conditions. The different abnormalities of the foot were studied and many operative procedures developed to rectify them. As was to be expected, the enthusiasm often led to over-elaboration of treatment for comparatively minor disabilities. There was also a tendency, especially amongst the less experienced surgeons, to overstress the anatomical as against the functional conditions of the foot.

Second World War

In the code of instructions for medical boards in New Zealand at the beginning of the war it was directed that the grading of persons suffering from deformities of feet and toes should be determined by the degree of disablement occasioned and not by the nature of the deformity.

Conditions causing disability were noted as club foot, hammer toes, hallux valgus and rigidus, and flat feet. Severe cases of club foot were classed as totally unfit for service. Hammer toe was considered only to be a disability if painful corns or bursae were present, and the same applied to hallux valgus, though a man with severe hallux rigidus was considered to be only fit for base service in New Zealand. As regards flat feet, rigidity was held to be of special importance.

In 1942 the Regional Deputies were asked their opinions regarding the desirability of making changes in the code of instructions. There had been criticism from the army of the physical standard of many of the recruits graded I who had subsequently had to be down-graded or discharged either in New Zealand or overseas. Auckland was the only centre in which an orthopaedic board was available, and elsewhere the difficulty in getting an orthopaedic opinion without delay meant that the borderline case was generally rejected. As a result of the opinions received, the National Medical Committee altered the code of instructions.

It pointed out that it was important to investigate any degree of disablement experienced by the man in civilian life and his type of occupation. Consideration had to be given to the possibility of aggravation of the disability by the conditions of military service.

Callosities on the soles of the feet, if not curable, rendered a man unfit for overseas service, as did club foot in the majority of cases. Cases of flat feet were to be graded according to the degree of disablement or anatomical deformity. Cases of hallux rigidus were to be graded as unfit for overseas service. Men with hallux valgus could, in the absence of symptoms, be graded I. No operation was to be recommended for this condition, and no case previously operated on was to be graded I. Hammer toes, on the other hand, could be operated on to improve the grading. No case of pes cavus was to be made Grade I, and severe cases were not to be accepted except for base duties in New Zealand.

This advice was sound in that the grading was to be determined by the degree of disablement occasioned and not by the nature of the deformity. Stress was laid, however, on the anatomy of the foot, and any abnormality of anatomy was held suspect. The boarding was carried out all over New Zealand by very many practitioners, many without army experience, and most without any special orthopaedic or other experience of foot conditions. The functional standard of the feet was difficult to evaluate in a short examination. Without a functional test, it was natural that the anatomical aspect of the problem would be particularly considered.

WAR SURGERY AND MEDICINE

IN CAMP

In Camp

When the test of training took place many soldiers were found to suffer from undue strain and fatigue, and this generally was first shown with regard to the feet. The problem was particularly well studied at Papakura Camp, where a remedial training group was formed and graduated training carried out. This proved successful, and as a result a special remedial training camp was set up at Rotorua at the end of 1940 and functioned for three years with varying success. Foot cases formed the largest single group referred for treatment. Special foot exercises were arranged and physical therapy training given by highly trained instructors. The great importance of the psychological aspect was realised, and it was found that the antagonistic type gained little benefit.

Major (later Colonel) W. B. Fisher made the following comments as RMO to the Maori Battalion at Palmerston North Military Camp from January to May 1940:

A lot of valuable work was done by chiropodists, the feet generally being in a very bad state when the men first came into camp. A routine inspection of all feet at the beginning of the camp revealed about an 80% incidence of ringworm of the toes and a large percentage of corns and callosities.

The shape of the Maori foot caused difficulty in the wearing of boots. It was noticed that most Maoris have flat feet and are very wide across the heads of the metatarsals with a definite tendency to bunion formation of the big toe as well as a similar condition of the little toe, with the result that corns readily formed at these sites.

In my opinion with this Maori Battalion anyway it would be worth spending much more time over the issue of boots by allowing the men to try on their boots first, and getting a pair which was comfortable at the start. They were, of course, allowed to change them, but many men seemed to think they could make their feet fit the boots just as easily as make the boots fit the feet.

Dr D. Macdonald Wilson, who was a Regional Deputy and later medical officer in charge of treatment at the Pensions Department, and who had had active war service, made the following observations based on his experience of seeing men at recruitment and, later, the same men after being referred for boarding at Trentham Camp:

(1) The enthusiast in the Drill Hall with some degree of flat feet had perhaps after a month in camp lost his enthusiasm and tended to trade on his flat feet. This was the psychological element.
(2) Men with definite flat feet who had been shepherds around the hills without trouble were often disabled in camp. The heavy boots and marching with kit on a route march seemed too much for them. More attention to footwear and more gentle approach to 'foot-slogging' on a hard road would have enabled them to stand up to it. With gradual training and remedial training in the ordinary camp, and not in the equivalent of a special 'hospital' for foot trouble as the Rotorua Training Camp, such men might have made good.
(3) Experience showed that attempts to improve feet by operation were useless to make men Grade I and, with hospitals full and waiting lists of other cases, we did not want these men to undergo surgery at the Army's expense and time if they were only to be discharged later. (Also there had been some unfortunate happenings.)

Therefore we forbade operations for hallux valgus and bunion, feeling the majority would not stand up to training. Minor operations for hammer toes and corns, if the recruit wished it, he could arrange himself and return for re-examination. As 'remedial treatment' had ceased, it was no use taking the man into camp on the understanding he would voluntarily have an operation, as likely as not he would later decline it.

Probably if some of these cases of minor foot disabilities had proceeded overseas their psychology would have changed. Nearer the seat of hostilities, amongst other men with similar disabilities who did not allow them to become disablements and where Army authority was more easily maintained, I think many of them would have carried on. But if they had not, would the Army overseas have complained of poor boarding in New Zealand?

Men graded to a lower category for foot conditions were utilised in the camps in New Zealand and in the Territorials and Home Guard. In the latter, ability to march for five miles was the standard laid down.

THE FOOT PROBLEM IN 2 NZEF

The Foot Problem in 2 NZEF

Although movement of troops was generally carried out by motor transport there were occasions where marching was necessary. The GOC 2 NZEF considered that training for long marching was essential, and this was part of the routine of army training overseas. Two long marches were especially noted, the one in England by troops of the Second Echelon and the other in Egypt prior to the embarkation of the Division for Italy. As a result of these marches many men suffered from foot strain which had prolonged aftereffects, necessitating down-grading in several instances. This drew the attention of the Medical Corps to the necessity of graduated training, and the necessity for RMOs to ensure that any men subjected to the strain of long marches were physically fit beforehand and to provide for transport of those falling out during the march. The campaign in Crete made a lasting impression on senior combatant officers with regard to the necessity for only having grade A men in the Division. The long march across the island proved too strenuous for some of the men, especially those more accustomed to mechanical transport. The employment of graded men on the understanding that normally they would not have to march long distances was discountenanced, though conditions similar to those in Crete never arose again during the war. This led to an unnecessary restriction in manpower available for the Division, and would, in the future, quite negative any value of the Pulheems system of evaluation as far as the locomotor system was concerned.

DIFFERENT TYPES OF FEET

Different Types of Feet

Flat Foot with Free Mobility: This was associated with undue pronation and with some eversion at the ankles, and there was a tendency to a weakening of the transverse arch with widening at the metatarsal heads and a condition of hallux valgus. It was essentially a position of rest or inactivity. With strong musculature the position of activity could be readily attained and the foot function normally. With weak muscles and liability to fatigue, the foot could be the focus of discomfort.

Flat Foot with Rigidity due to the arthritic changes in the tarsal joints and general lack of flexibility in the foot. The position occupied was similar to the above, but the position of activity could not be resumed. If the condition had become stabilised and painless, satisfactory functional activity was possible. If not stabilised there might be definite disability.

Dropped Anterior Arch: This was really only a part of the relaxation of the foot, but often reconstitution of the arch was impossible and callosities formed under the tread and the foot would not stand the normal strain. Remedial exercises to strengthen the musculature were of special value.

Pes Cavus: The high-arched rigid foot with hammer-shaped toes and some restriction in ankle movement denoted a foot which could not stand undue strain, and in the severer forms was not accepted in the army for any branch necessitating marching. No treatment was of any use in the army.

Hammer Toes: These were often a part of pes cavus but, in minor forms, were of little importance, except for the discomfort from corns which formed on the prominent joints. A simple operative procedure brought about relief in the mild cases.

Hallux Valgus: In the milder forms this was of no importance except as an indication of a weaker foot. When there was a pronounced exostosis of the head of the first metatarsal with a bunion over it treatment to remove both bunion and exostosis was useful. In the severer forms where this simple operation was unavailing no treatment was of use and the men were down-graded. (Lieutenant-Colonel J. K. Elliott reported in 1949 that the removal of the exostoses had in many cases resulted in increased lateral deviation due to the weakening of the capsular ligament.)

Hallux Rigidus: This was a genuine disability because of the inability to spring off the big toe. Treatment was of no use in the army and grading down was necessary.

Overlapping Little Toes: This was a congenital deformity often giving rise to symptoms. The removal of the toe was done if there was real disability. A plastic operation with dorsal division of the capsule of the metatarso-phalangeal joint was preferable to amputation and protected the fourth toe.

Exostosis of the fifth metatarsal, generally associated with a broad foot with spreading transverse arch. If a wide-fitting boot was available, no treatment was necessary. The exostosis was removed, with relief in some cases.

Ingrowing Toenails: This was a very frequent condition, being associated with infection, especially in feet prone to sweating. Simple attention cleared up the milder infection, but in the severer forms the removal of the side of the nail with the nail bed was required. A form of operation popular amongst some orthopaedic surgeons of removal of the terminal part of the last phalanx of the big toe with all the nail bed was unnecessarily drastic, and constituted a permanent pensionable disability in many cases. (Like other radical measures it is not suitable for army conditions, though indications for its use may arise in civil surgery in cases of engrained and long-standing infection.)

A similar outlook on operative procedures in the army was shown by an Australian Army Instruction.

Operative Treatment Carried Out in 2 NZEF

From the outset, operations were not encouraged unless they were simple in nature and likely to bring about a rapid and definite improvement in the condition, thus rendering the man of more value in the army. It was felt that any major procedure would entail a long convalescence, and almost certain down-grading, so in cases demanding such measures, down-grading without operation was the more practical procedure.

Hammer Toes: Simple arthrodesis of the prominent knuckle was the type of operation performed.

Hallux Valgus: The removal of a prominent exostosis with the overlying bunion was all that was done in the large majority of the cases. The more radical procedures were discouraged.

Hallux Rigidus: Again, operation was discouraged and down-grading adopted as necessary, the majority of the cases carrying out base duties satisfactorily.

Overlapping Toes: These were removed at the metatarso-phalangeal joint as required.

Ingrowing Toenail, as already stated, simple removal of the affected part of the nail and nail bed.

A review of cases either operated on or regraded in the 2 NZEF was made in December 1941. There had been very few cases dealt with, and it was evident that hallux valgus was not a common disability in the army. Radical operations had proved unnecessary and unsatisfactory. The lesser operations of removal of the exostosis had proved at least temporarily successful.

REMEDIAL TREATMENT IN 2 NZEF

Remedial Treatment in 2 NZEF

A considerable number of men were down-graded in the 2 NZEF for foot disabilities, most of them for flat feet. The disability was present generally in debilitated individuals prone to fatigue, and was often just part of a general lack of vitality and also part of a psychoneurosis. The man robust physically and mentally could carry on with a very flat foot without complaint, but the weakling not only felt the results of fatigue more often but used the mild disability as a refuge. Efforts were made by special remedial training units to make the men Grade I, but because of the psychological condition of so many it was difficult to improve their condition.

A report written by the DMS 2 NZEF in August 1941 gives a clear idea of the difficulties experienced at that time:

The problem of men who become unfit through flat feet and other foot disabilities is becoming an acute one. A number of men are sent to the bone and joint specialists at the general hospitals and are ordered foot exercises, graduated training, and various matters of attention to boots and socks. In very few cases are the results successful.

It is felt, therefore, that some arrangement must be made to get these men together under supervision so that all these necessary measures may be carried out and decision made as to whether men are fit to resume training for the field, or must be re-graded. The most suitable arrangement would seem to be to form a special group at the Base Reception Depot under the control of a junior officer or senior NCO.

A good surgical bootmaker is desirable, though a certain amount of alterations to boots is carried out by the splint-maker attached to 2 NZ General Hospital. A chiropodist attached at present to 1 Camp Hospital could be transferred and a medical officer could be detailed to check all cases twice a week.

This statement was supported by a report by the Consultant Surgeon 2 NZEF on the problem:

In cases appearing before medical boards for reclassification during the last few months, there has been an increased incidence of cases designated as flat feet, metatarsalgia, or other afflictions of the anterior arch, and a small number of cases of pes cavus. The following observations are made after carefully eliciting the history and symptoms of the cases, and after examination of them, by both general and orthopaedic surgeons:

In only a very small proportion of the cases has there been any real anatomical abnormality that can be readily ascertained on physical examination. In almost all the cases the symptoms complained of are not those pathognomonic of flat feet or metatarsalgia.

Treatment by raising the inner aspect of the sole and heel of the boot has not only been of no benefit in most cases but has aggravated the condition, the men being more comfortable in tennis shoes. In a definite proportion the boots have been found to be illfitting and they are always stiff and rigid. In many cases the first onset of the symptoms has followed very prolonged route marches. It is an almost constant statement that no route marching had been done in New Zealand and often little or none done in Egypt previously.

As a result of these observations it is clear that the symptoms complained of are not those due to flat feet but rather to muscular fatigue, especially and naturally shown as foot fatigue in men undergoing training by route marches or constantly on their feet. This is shown by the symptoms being aggravated rather than relieved by wedging of the boot, and by the relative comfort of sand shoes. These symptoms naturally arise in those soldiers who are unable temperamentally to put up with discomfort of any kind—the feebler type of soldier.

The problem is naturally difficult to solve, but, if looked upon as one of fatigue and lack of energy generally, perhaps something can be done to solve it by arranging a special platoon at the Base for men suffering from foot fatigue and other somewhat similar conditions, such as convalescence from knee and leg injuries. This platoon could be given special graduated training by physical instructors capable of dealing with the position sympathetically yet firmly. Special attention could be paid in the platoon to the fitting of boots, the wearing of satisfactory and clean socks as well as to any alterations in the boots advised by the medical officer. Chiropody could be made available from the camp hospital. An orthopaedic surgeon could carry out regular visits to the platoon to advise on problems connected with the training, and also to examine any special cases.

Finally I consider that observation of these cases shows that massage and physiotherapy is not only useless and a waste of time, but actually aggravates the condition by fixing the disability in the mind of the patient and giving him a sense of invalidism.

Special clinics were set up in Maadi Camp for a short time, but were not successful as was at first hoped.

For the remainder of the war there was no special incidence of foot trouble in the 2 NZEF and no fresh problems encountered. In Italy there were no long marches and no abnormal conditions such as heat and sand likely to aggravate foot disabilities. It was noticeable that there were no fatigue fractures seen. The foot disability had been evaluated in its relation to the army, and all that was necessary was a regular grading of personnel who were unable to stand the stress of front-line service.

THE GENERAL PROBLEM OF THE FUNCTION OF THE FOOT

The General Problem of the Function of the Foot

It is very difficult to get a proper perspective to evaluate the foot as to its functions in locomotion. It is unfortunate that the physiological outlook has for so long been neglected and that the anatomical shape of the foot has come, in the minds of perhaps the majority of medical men, to be considered of supreme importance. This has led to a classification of foot disabilities under anatomical groups and a false idea of a normal foot has evolved. The position of the foot, in what we may call the mid-position between rest and activity, is treated as the ideal foot, and a relatively high longitudinal arch is considered ideal. If the arch is still more prominent, as it is in pes cavus, the appearance of the foot seems preferable to the pronated flat-looking foot, which is the normal position of rest. If the foot is very mobile, then during rest it will appear very flat, and under the anatomical classification will be a flat foot and disability will be expected. The foot is looked upon as a mechanical means of support and the bones and ligaments are looked upon as the structures that take the strain, and it is natural to expect them to function better if the shape of the foot appears to be mechanically better able to sustain the body weight. This outlook has vitiated the whole management of foot conditions.

It would be of great value if, for a while, the anatomy of the foot were forgotten and the medical student had instead to study the foot in action in athletics, in walking, in standing, and at rest. Perhaps the foot of the ballet dancer is as efficient as any other, yet at rest it is very flat and pronated. The bare foot of the native races also appears to be a flattish foot. If one is observant one will have noticed many of our fellows with just such flat feet who are able to do the most strenuous work. Even rigid flat feet are no bar to strenuous and prolonged work. What it is essential to realise is that the foot is normally a very mobile and pliable structure with constant changes in position. There is a position of activity with the foot adducted, the longitudinal arch raised, the foot extended, the toes flexed, and the muscles of the leg and foot acting strongly. Then there is the position of rest with no muscular action the foot pronated or abducted, and the longitudinal arch flattened. Then there is the mid-position adopted during standing, when the muscles are acting less strongly and the bony ligamentous structures have to take part of the strain.

On muscular activity depends the functional efficiency of the foot. Pliability of the foot is essential to full function, and the real disabilities of the foot are associated with rigidity of the foot structures, especially when this is associated with any inflammatory condition. This is seen in the partially rigid foot due to inflammatory adhesions, which is often relieved by manipulation. The foot with bony rigidity, though awkward, generally gives rise to little trouble. Pes cavus in a marked degree is often a serious disability as regards marching.

When there is marked muscular weakness, often associated with general debility, and so often seen in adolescents, there will be undue strain put on the ligaments of the foot during activity, including standing, and this strain tends to exaggerate and sometimes fix the position of rest and later to bring about some generally slight anatomical changes such as hallux valgus. The causative factor has been the muscular weakness; the anatomical changes are secondary. On the other hand, with strongly developed muscles even a foot weak structurally will be able to act efficiently, always remembering that a freely mobile foot is not a weak foot.

A valuable demonstration of the essential difference between anatomical structure and physiological efficiency was given by an investigation carried out in the British Army to ascertain what number of men in a typical infantry brigade had anatomical deformities of the feet which were symptomless. A thorough examination of the feet of all the men was carried out and the following abnormalities observed: (i) abducted feet, (ii) pes cavus, (iii) deformity of the toes. Rigorous tests were then carried out, including 3-mile runs and 14- and 21-mile route marches. Some 24 per cent of the men had foot deformities, but the feet were supple and they were not foot conscious. There was relatively no more disability recorded in the men with deformities. These conclusions were reached: firstly, in an infantry brigade there were men with anatomical deformities of the feet who were performing normal duties; therefore anatomical deformity of the foot alone was not a sufficient indication for down-grading. Secondly, approximately the same proportion of men with normal and abnormal feet reported sick with foot complaints. This investigation suggested that the deformed foot was no more liable to give rise to disablement than the normal foot.

This was valuable support to the idea that anatomical abnormalities, when unassociated with rigidity, are of no importance as regards the efficiency of the soldier.

The two factors of prime importance in the fitness of the soldier are graduated training and psychological normality.

GRADUATED TRAINING AND PHYSICAL FITNESS

Graduated Training and Physical Fitness

During the war constant reference was made to the importance of adequate, and especially graduated, training of the soldier in marching. Complaints were made from the 2 NZEF that men were sent overseas without adequate military training and especially without having done any marching. In New Zealand a special remedial training camp was established at Rotorua, where graduated physical training was given to men with weak feet to render them fit for service. The type of man chosen was mainly the underdeveloped and undernourished man who had led a sedentary life and had not taken part in any physical sport. The medical authorities were alive to the importance of the physiological aspect of the problem.

In the 2 NZEF it was quickly realised that foot disability was largely a question of fatigue, and that graduated training would enable many men with abnormal feet to become fully efficient. Radical surgical procedures were discountenanced. Special remedial training groups were formed at the base camp where graduated training was carried out. The treatment by physiotherapy in the hospital was discouraged as likely to make the soldier foot-conscious.

Psychological Efficiency

The psychoneurotics undoubtedly formed the majority of those who complained of foot disability. This may have been due in some measure to the possibly lower physical standard of this type. The main reason, however, was that the foot was used as the means of escape, and the normal symptoms of fatigue were exaggerated into a disability which the individual gave in to. If there was some anatomical abnormality, then it was easier for the man to plead disability and more difficult for the medical officer to deny it.

It was realised very early in the war that the large majority of the men complaining of foot disability were the psychoneurotics and the poorer types in the force, and that as often as not there was no demonstrable abnormality in the feet. The flat foot was not an anatomical defect but could produce an abnormal personality. The undue stress laid on the anatomical factor naturally made the management of these cases at times very difficult. Colonel Spencer, OC 2 NZ General Hospital, stressed this aspect very strongly in a valuable report he submitted on the psychological aspect of hospital treatment early in the war.

Brigadier Ogilvie, Consultant Surgeon MEF, stressed the importance of sizing the man up as a whole, and of referring men without demonstrable signs of disability to the psychiatrist for his opinion. He emphasized that flat foot was merely an abnormality of posture and that in the absence of stiffness was not a sign of disability.

THE MILITARY BOOT AND OTHER FOOTWEAR

The Military Boot and Other Footwear

It has to be realised that for the large majority of recruits entering camp there is a violent change in footwear and in the work that the foot has to accomplish. The average civilian wears light shoes and light socks, and does little in the way of walking, and certainly not with heavy loads. It is not to be wondered at that he has difficulty in accommodating himself to the heavy rigid boots, the thick socks, the marching in formation with packs. The soldier's feet have to be broken in, and common sense should lead one to do this gradually.

In the provision of boots there is need for great care. The size of the boot required may be, and often is, different from the size of the light civilian shoe usually worn. There must be provision for a thick sock and maybe two pairs of socks, and provision also for some swelling of the feet after long marches.

In the British Army, officers are required to see that boots are fitted in accordance with instructions. Experience has shown that very few soldiers know how to select suitable boots. It must be remembered that the foot spreads out a quarter to a third of an inch in length and one-fifth to one-half of an inch in breadth under the weight of a full marching load. Boots should be fitted indoors in a long room in which men can walk up and down. They should be put on over regulation army socks. If there is any doubt, the larger size should be taken. The soldier should select the boot which gives him greatest comfort. This is a different method from that often seen, where a pair of boots of the size named by the soldier is simply given to him at the same time as he receives other articles of his kit, without any provision for trying the boots on.

There was at times criticism of the army boots and shoes issued to the New Zealand soldier, but in general they were satisfactory if they fitted. Difficulties, however, did arise:

1. There was an insufficient supply of broader boots. This was of considerable

importance as the Maori foot is wider than the normal European foot, as his general physique is sturdier. This width is seen whether the foot is short or long. (This peculiarity of the Maori foot was recognised by Dr Thomson, surgeon to the 58th Regiment during the Maori Wars.) There is no special provision made for the Maori soldier in this respect, though frequent complaints were made and recommendations also made by medical officers associated with the Maori Battalion, and by the consultant surgeon. As a consequence of wearing the narrow boots, bunions and callosities developed both over the prominent heads of the first metatarsal and also over the fifth metatarsal. Removal of the prominent bone was often resorted to in consequence, and it seemed as if we were trimming the Maori's feet to fit the boots rather than providing boots to fit the feet. The strong recommendation is made that special lasts be provided to enable adequate provision of broader boots for Maoris and the relatively few Europeans with the same shape of foot.

2. When boots were repaired provision was not always made for the soldier to get back his own boots, and he was issued with some other soldier's second-hand boots. This was at one time the established custom in the MEF, and the records show that the same thing happened in New Zealand. Strong comments naturally were made by medical officers, with sometimes little effect on administration officers. It cannot be too strongly urged that the practice should be condemned and that fuller provision should be made for the repair of boots, so that every soldier can without difficulty get his own boots repaired.
3. Complaint was made that the wearing of rubber shoes on transports was detrimental to the feet and caused disability in subsequent training. Leather-soled sandals were recommended and were supplied later in the war.

The provision of special boots for soldiers with abnormalities of the feet was arranged for both in New Zealand and overseas. In New Zealand the main hospitals agreed to supply special boots and to adjust the boots as required. In several of the hospitals well-equipped departments with skilled personnel were available. Overseas, light boots were supplied by the army when required, and special boots were also made for selected cases on the order of the consultant surgeon. Adjustment to boots was carried out both at the hospitals and in the camps. A special department was developed at Helwan Hospital.

The ordinary adjustments to the boots such as the raising of the inside of the heel and its prolongation forward, and the raising of the inner part of the sole, were useless in the desert, where the boot sank into the sand. The adjustments simply increased the weight and clumsiness of the boot and aggravated the fatigue which generally underlay the real disability.

The need for constant attention to boots was stressed in the army, and many memoranda were issued to this effect. It was recommended that the boots be kept in good repair to prevent the feet getting wet, and that if the boots did get wet they should be dried slowly and then well oiled. The boots should also be softened regularly with vaseline, neatsfoot oil, or dubbin.

Socks: Soldiers were issued with four pairs of socks, and in addition most of them had some hand-knitted pairs. The need for cleanliness, with constant washing of the socks and care to prevent shrinking, was ever present. Thick socks capable of absorbing perspiration were provided.

Foot Cleanliness: Of all matters concerned with the feet this was the most important. The provision of facilities for washing the feet, especially after long marches, was essential. The provision of showers was important to any army. The use of foot powder after thorough drying of the skin was of great value. A useful foot powder was salicylic acid, 3 parts; boric acid, 10 parts; talc, 87 parts.

The Care of the Feet after Illness: The natural sequel to any debilitating disease or to any prolonged rest was an absence of fitness for physical exercise or strain. This was specially noted in regard to the lower limbs, and, in consequence, foot strain was frequently complained of when convalescents resumed their military training.

The necessity for graduated training with physical exercise for the lower limbs became obvious, and the British type of convalescent depot was mainly occupied with this training. The British physical training instructors were invaluable in the training of convalescents, and one of their depots well forward on the North-West European front was one of the most efficient medical units observed during the war.

SKIN DISEASES OF THE FEET

Skin Diseases of the Feet

These were relatively common in the 2 NZEF and led to much of the real foot disability. The commonest disturbances were, in order of frequency: (1) hyperidrosis, (2) eczema, (3) pyogenic infection, (4) tinea. The prevention of the spread of tinea exercised the minds of medical officers in every theatre of war. The Americans had shallow troughs at the entrance to their shower or bath rooms filled with antiseptic solution. Provision was made for the frequent washing of the floors with antiseptics. The boots and socks of infected men were treated with formalin vapour in a closed container or otherwise sterilised. The infection was difficult to eradicate either in the individual or the group.

GENERAL SUMMARY

General Summary

The problem of foot disability in the army is quite distinct from that in civil life. It has been found that, provided the foot is mobile, minor deformities of any kind are of no significance in function. The grosser deformities and the rigid feet are generally not suitable for full military service, except that fixed bony deformity does not seem to give rise to any marked disability. There are three danger points: on enlistment, at physical training, and on long route marches.

There is profound alteration of the foot habit of the individual when he enters camp. From a sedentary worker wearing light shoes and thin socks, he is transformed into a soldier with heavy boots, thick socks, and then subjected to strenuous physical exercises and long route marches. An ill-fitting boot can play havoc with his feet, and his muscles will need gradual training to enable him to carry out his military duties without foot strain.

The recruit may then come under the control of an over-zealous and exacting physical training instructor who may not realise that the feeble leg musculature cannot at once do all that is asked of it, and as a consequence acute foot strain may develop.

Finally, long route marches may overtax the relatively untrained man, who may feel in honour bound to keep up with his fellows and so subject his feet to severe strain from which he may take a long time to recover.

The provision of well-fitting boots is essential and must be given every attention by combatant officers. The repair of boots, and return to the man of his own boots, is also of great importance. The care of both boots and socks and cleanliness of the feet will guard against most troubles.

Difficulty arose because of the mistaken idea of foot physiology, and the overstress laid on anatomical variations, which were often mere temporary postural attitudes.

With regard to the treatment of foot deformities, it has been amply proved that no major surgical procedures are advisable under army conditions, and only minor procedures to alleviate a few of the lesser marked deformities are of any real value.

Skin diseases demand attention, and of all diseases hyperidrosis is the most common and most disabling. Eczema, pyogenic infections, especially with reference to ingrowing toenails, and tinea are also of importance. Tinea necessitated constant vigilance in preventing the spread of the infection at bath houses, but did not cause much disability.

The association of psychoneurosis with the disabilities of the foot was the most important, and the most difficult, aspect of the whole problem. It was found that the feebler type of soldier complained, often with perfectly shaped feet, whereas the keen, alert men would carry on under the most rigorous conditions with badly deformed feet.

The realisation that the foot is a highly mobile structure depending for its strength on muscular action is necessary to appreciate its function.

Cases Invalided To New Zealand From 2 NZEF, 1940–45	
Pes planus	43
Pes cavus	27
Metatarsalgia	11
Hallux valgus	17
Hallux arthritis	24
	122

These disabilities were commonly associated with other conditions affecting the general health of the soldier, especially if he was in the older age group.

The total number of cases diagnosed as flat feet reviewed by the War Pensions Department up to March 1952 was 1009 with overseas service and 444 with service only in New Zealand, but the number of those actually receiving pensions was not available.

CHAPTER 21 — HERNIA

CHAPTER 21
Hernia

HERNIA is a common condition, and it is inevitable that men develop hernia during service.

In 1 NZEF operation for repair of hernia was carried out in the base hospitals overseas, and cases deemed unsuitable for operation were graded for base duty or sent back to New Zealand. The large majority of cases dealt with overseas carried on their service satisfactorily.

Second World War

The original code of instructions for medical boards laid down the following regarding the acceptance of recruits:

Hernia (Inguinal): No case however slight, should be accepted for Grade I, even if well retained by a truss; if bilateral and not large and controlled by a truss, the man may be put in Grade II. If the hernia, either single or double, is large with patulous rings, but is retained by a truss, the man must be placed in a grade below the first, the precise grade being determined by a consideration of his general physical condition. If the hernia is irreducible, the man must be placed in Grade IV. Four months is the minimum interval after operation before a man may be placed in Grade I.

Hernia was the fifth most common disability (5 per cent) in all men graded II, III, or IV at their initial medical examinations in 1942 and 1943, when older men were in the majority among those examined. Of those called up for service, 1·62 per cent could not be placed in Grade I because of hernia.

When remedial treatment for minor surgical conditions was arranged in September 1940, hernia was definitely excluded from the list of conditions for which operation was authorised. Remedial treatment could only be given to cases which could be rendered fit for training in one month. The period of four months had been laid down as the minimum between operation for hernia and full duty. Suggestions were made by regional deputies that the period of one month be extended and that treatment for hernia should be included in the list, but the DGMS firmly adhered to his opinion that men with hernia should not be given remedial treatment to fit them for service.

In June 1943 all the Regional Deputies were asked their opinion with regard to the fitness of men with hernia for duty in camp or in the Home Guard. Nearly all the replies were to the effect that men who carried out their civil occupations without any trouble, particularly if this entailed physical work, were fit for duty both in camp and in the Home Guard. It was only the sedentary workers with particularly large hernias who would be unsuitable for these duties. It was pointed out that the number of otherwise fit and healthy men with hernia was surprisingly great, and many of them did strenuous labouring work without complaint.

The necessity for regulating the physical work required in the Home Guard was stressed, and it was pointed out that many men not fit for any strenuous physical work would be employed on lighter duties and they could be so graded by the Regional Deputies. The army authorities, however, for some inexplicable reason, had instructed that no differentiation was allowable.

It would seem that the ideal solution would have been to have given the Regional Deputies the power to determine whether these men were fit for duty in camp and in the Home Guard, and in certain cases sedentary work could have been stipulated. The Pulheems system, properly applied, would readily solve all difficulties.

Hernia is a common disability, and if all men, otherwise young and fit, are automatically excluded from the army, except as graded men, it means a definite limitation of manpower for the army. The three months' treatment needed to make a hernia case fit for active service would seem to be justified in a prolonged war, provided the operation is restricted to cases likely to be Grade I and not likely to recur. There would seem to be no justification for operation on men in the older age groups or on those with feeble abdominal musculature.

Wearing of Trusses

The Regional Deputies in 1943 pointed out that very few men with hernia wore trusses, no matter what their occupation, and in spite of this they seemed to have no disability. This finding has been confirmed by Dr D. Macdonald Wilson, supervisor of medical treatments, War Pensions Department. In a survey of the 562 cases coming before War Pensions Boards up to 1952, he found that there were 232 men with unrelieved hernia, but only 18 of them stated that they wore a truss. The Department was prepared to supply trusses, but the only requests came from First World War pensioners who had worn them for twenty to thirty years, dating back to the time when doctors regularly recommended a truss if operation was not undertaken.

Overseas Experience of 2 NZEF

Some 700 men developed hernia during service overseas with 2 NZEF. The great majority were young men in whom operative repair was eminently suitable, and comparatively few were of an age at which permanent success could not be hoped for. However, all cases in the older group were carefully evaluated with regard to the prospects of future satisfactory military service. They were graded for base duties, or sent back to New Zealand without operation, if full operative success was not expected.

The practice of discouraging operation for the older group of men (those in their late thirties and forties) proved satisfactory. It was felt that these men could carry on at the Base if suited for light employment, and, if not, it was better policy for them to be employed in New Zealand.

Even if operation were successful in these cases they were unsuited for front-line duty, and the period of six months on light duty following operation was not warranted for a man fit to be employed only in Base Camp. The younger men, on the other hand, could in three months be made fit for front-line service with a very slight liability to recurrence, so operation was well justified.

In December 1943 recommendations were made by the Consultant Surgeon 2 NZEF that ‘cases with definite herniation should be referred to hospital for operation. Cases with weakness of abdominal musculature, producing some indefinite bulging of the inguinal region, should carry on. After operation care should be taken to prevent undue strain for a period of three months, after primary operation, and at least six months after operation for recurrence. The cases will automatically be graded for this period, but even so care must be taken to see that strain is eliminated as the reason for the grading is apt to be forgotten.'

Grading: Cases were graded following operation in difficult cases, in the older men, and because of recurrence. At May 1942 only nine cases of an average age of thirty-seven years were graded for base duty.

By March 1943 seven graded men had been sent back to New Zealand for non-medical reasons and seven of an average age of thirty-five were at that time graded for base duties. Two had refused operation, for one an operation was not advised, one was awaiting operation, one was a recurrence, and two were graded as a precaution. Details were as follows:

(1) Umbilical Hernia and small R. Bubonocele. Refused operation. Age, 38 years.
(2) Operation Bilateral in New Zealand, 1940. Recurrence of small bulge, one just outside ring, other in ring. Refused operation. Age, 42 years.
(3) Large Indirect Hernia. Operation September 1942. Temporarily graded for rest. Age, 23 years.
(4) Bubonoceles bilateral, also osteoarthritis knees, fat, poor subject. No operation advised. Age, 40 years.
(5) Bilateral operation in New Zealand. Operation NZEF November 1941. R. side. In November 1942 recurrence noted size of pigeon's egg. Sac small and difficult to find. Cord displaced in front of aponeurosis. Also has syphilis. Age, 41 years.
(6) L.I.H. Operation advised recently. Not yet performed. Age, 37 years.
(7) Operation in New Zealand (1932 R.I.H., 1935 R. & L.I.H.). Operation in NZEF, R.I.H. September 1941. Silk repair, satisfactory result but graded as a precaution. Age, 26 years.

The conclusions reached in May 1942 after a review of the cases sum up the position satisfactorily: 'The results show clearly that inguinal hernia, except for the period of disability consequent on the performance of the operation and the convalescence therefrom, is not of any serious importance in 2 NZEF'.

There were about 10 men graded for hernia every month, including cases graded temporarily following operation. There were normally about 30 men on the graded list at one time, 23 actually in the last list of men graded for all conditions, a very small proportion of the whole.

Invaliding: Older patients were often sent back to New Zealand, especially if they had some added disability. Up till March 1943 only seven cases had been sent back to New Zealand, their ages being 29, 39, 42, 49, 50, 52, 52. During the rest of the war in the MEF and CMF another 24 cases were invalided back to New Zealand—a total of only 31 in 2 NZEF for the whole period of the war.

Operative Procedure

The conditions present in hernia may be:

(1) A congenital indirect sac starting at the internal abdominal ring and passing down the canal for a variable length, the maximum extending to the scrotum and being continuous with the tunica vaginalis.
(2) Weakness in the musculature of the abdominal wall, especially in the region of the inguinal canal.
(3) Attenuation of the structures of the inguinal canal with consequent stretching and bulging of the abdominal wall in this region.
(4) Direct herniation due to the bulging of the peritoneum through weakened areas of the inguinal canal.

It is obvious that the operative measures to be adopted must vary with the conditions present in the individual case. In the simple indirect hernia the removal of the sac should bring about cure.

When the musculature is much weakened and, in consequence, stretching and bulging of the inguinal region has taken place, with eventually the formation of a direct hernial sac, the simple removal of this sac cannot be expected to bring about permanent repair. Some tautening and strengthening is essential. It is well known that this function is carried out in the body by the fascial layers, so it is natural to employ methods which utilise the fascial tissues available. Unfortunately the transversalis fascia is often fragmentary, especially in the worst cases.

Overlapping of the external oblique aponeurosis is simple and of considerable value. The rectus sheath can often be utilised to strengthen the weak inner part of the canal, either by turning back a flap or by splitting the sheath and suturing the lower part to Poupart's ligament. A combination of methods is frequently available and useful.

The utilisation of muscle in the repair is against surgical principles except in so far as the alteration in insertion may make the muscular action more efficient. This would be brought about by the alteration in the insertion of the conjoint tendon, bringing the tendon lower to cover over the weak internal portion of the canal. The tendon may be partly split to enable this to be done or simply stitched lower down to the pubis.

The stitching of the muscular part of the conjoint tendon to Poupart's ligament as in Bassini's operation damages the muscles and interferes with their action, and can only be effective by the formation of fibrous tissue at the site of suture and the production of a new fascial layer.

The use of fascial strips provides support by the incorporation of the strips in the tissues and the formation of fresh fibrous tissue around them, and the silk lacing produces the same kind of result, encouraging the production of much fibrous tissue.

Essentially, operation in all but the simplest cases entails a plastic repair of the inguinal part of the abdominal wall, if possible brought about without interference with muscular action. Fortunately the proportion of simple cases is high. There are many types of herniation and many degrees of severity and no one technique can deal with them all. It is essential to suit the technique to the individual case and apply sound general surgical principles. One must occasionally admit that no surgical repair is possible and that other methods of partial relief are all that can be offered the patient.

Operative Treatment in 2 NZEF

This was carried out in the New Zealand base hospitals by any of the surgeons available. When the hospitals were fully occupied with battle casualties, the hernia cases were deferred, both from the point of view of space, and also of possible infection. With the large numbers of surgeons concerned there was no uniformity of operative technique, but the following four main types of operation were carried out:

Simple removal of the sac without any alteration in the ordinary anatomy of the inguinal canal. This technique was favoured in the early case of indirect hernia in young men, where no undue weakening of the musculature and fascial layers had taken place.

Removal of the sac and in addition some reinforcement, its form depending on the case and on the surgeon, by repairs of the Bassini type, by suturing of the transversalis fascia, especially round the internal ring, by suturing the conjoint tendon to Cooper's ligament, by overlapping the external oblique aponeurosis, by utilising a flap from the rectus sheath to suture to Poupart's ligament, all methods to strengthen the wall of the inguinal canal, either with or without displacement of the cord.

Silk Repair: The utilisation of strong silk to lace up the posterior wall of the inguinal canal, and especially the region of the internal abdominal ring, was much in vogue at the beginning of the war, as a simpler and just as efficient method as that of the utilisation of fascial strips. The method was recommended by Major-General Ogilvie, Consultant Surgeon MEF, who kindly demonstrated it on two cases in the New Zealand base hospital in Helwan. Unfortunately, under the conditions sepsis was found to occur in a sufficient number of cases to make the employment of silk undesirable, and the operation was later prohibited in the British Army. When sepsis did arise the deeply embedded silk caused severe local disturbance and was very difficult to remove.

Fascial Repair: This was not often carried out except by the utilisation of viable fascia in the canal itself, such as a flap from the rectus sheath. Cases requiring this type of operation would generally be in the older age group. In this group, operation in the army overseas was deemed inadvisable for the more severe cases, who were graded or sent back to New Zealand.

Physical Exercises

Arrangements were made to have men suffering from hernia undergo a course of physical exercises to strengthen the abdominal musculature, both before and after operation. This was found to shorten the period of convalescence, and was thought to make recurrence less likely.

Recurrence

In the Middle East Force the question of the frequency of recurrence caused much comment at one time, and investigations were carried out to find the cause. It was considered that unsatisfactory operative technique had been responsible for some of the recurrences.

It was ascertained that many of the recurrences were due to the inability to remove the sac satisfactorily, and in some cases the original sac was intact, and there was dissatisfaction with the Bassini and similar techniques.

There was a tendency to rely on the simple removal of the sac and not to interfere with the normal functioning of the musculature of the inguinal canal. It was emphasized, however, that operative repair of inguinal hernia was not always an easy matter to be delegated to the young untrained surgeon, but that it was highly important that the first operation performed be carried out with great care by a surgeon of experience who could add, as necessary for the individual case, some extra form of plastic repair, as little damaging as possible to the functioning musculature of the inguinal canal. The problem, fortunately, did not apply so much to 2 NZEF, in which there were comparatively few recurrences. Two reviews of the cases in the 2 NZEF were made by the consultant surgeon, one in May 1942 and the other in March 1943.

By May 1942 there had been 228 operations for primary hernia with two recurrences, one a sliding hernia on the right side and the other following a post-operative chest complication associated with a cough. There were five recurrences following pre-war operations performed in New Zealand. Six cases had had one recurrence and one case had had two recurrences on one side.

By March 1943 there had been a total of 361 operations for inguinal hernia in the following categories:

Inguinal Hernia: Indirect or unspecified	330
Inguinal Hernia: Direct	10
Inguinal Hernia: Fascial repair	2
Inguinal Hernia: Recurrent	19

It was noted that cases operated on for recurrence were very liable to break down again, thus denoting a marked weakness of the abdominal musculature. For instance, one case had an operation for bilateral hernia in 2 NZEF with a history of Battle's incision eighteen years previously and a right hernia operation eleven years previously. Operation on the right side for recurrence took place in April and September 1942, the last being a repair by silk which was effective; there was still a slight recurrence on the left side.

Number of Operations

While an exact record is not available of the number of operations for hernia performed in 2 NZEF it has been possible to compute an approximate total, using the survey made in March 1943 showing 361 operations and the record of hernia patients admitted to hospital for hernia subsequent to that date. It seems that there were about 725 operations altogether, as shown in the following table (the recurrence rate for the second period is estimated):

	Primary	Recurrence	Total
Operated on to March 1943	342	19	361
Admitted to hospital Mar 43–Dec 45	344	20	364
	—	—	—
	686	39	725

Experiences in British Army in United Kingdom [1]

A statistical review of cases of hernia in the British Army in the United Kingdom from mid-1943 to mid-1944 has disclosed much of interest which is partly comparable to 2 NZEF experience. In terms of man wastage among males, hernia contributed more to hospitalisation in the army in the United Kingdom than any other single diagnostic category, and indeed more than the entire class of psychiatric disorders. In addition, refusal of operation entailed wastage of manpower in the higher categories as these men had to be down-graded. In the one year there were 6874 first hernia operations and 846 operations for recurrence, an annual rate of 5 per 1000 strength. The period in hospital was protracted, the mean stay in hospital and convalescent depot being three months. Practically all cases were returned to full duty. The relative incidence of operation at different ages varied little, but the incidence of discharge increased with advancing age and very steeply in the terminal age groups.

The relative incidence of the different types of hernia was indirect 86; direct 10; femoral 4.

Recurrences were much more common following simple removal of the sac and less frequent following repair by fascia. A majority of the recurrences following indirect hernia were still indirect and resulted from failure to excise the sac, and more commonly followed the simpler form of operation. The majority of the recurrences occurred within one year.

The final conclusion arrived at by the reviewers was that '(a) after about one out of every eight primary operations the original condition reappears within twelve months; (b) the overwhelming majority of such recurrent cases are the result of an operation for the performance of which a relatively modest level of professional skill is perhaps too commonly deemed to suffice.'

The review throws valuable light on the problem. It confirms our New Zealand experience in the Middle East that operation in suitable cases can be relied on to make a man fit for front-line duty. The opinion is also given that many recurrences are due to inability to find, or satisfactorily deal with, the sac—a sign of poor and inexpert surgery.

The 2 NZEF period of three months before return to full duty following operation is also shown to have been the standard in the United Kingdom. Multiple recurrences were shown to be fairly common. This upholds the 2 NZEF routine of grading and invaliding such men, generally in the older age group, instead of subjecting them to operation, thus enabling their manpower to be better utilised and saving hospital accommodation overseas.

War Pensions Survey

A survey was made in May 1952 of the records of all ex-servicemen who had applied for pension or had been graded below Grade I on discharge, and including those in whom hernia was diagnosed at discharge, although the man himself may have had no prior knowledge of any abnormality and certainly of no disability. In all there were 562 cases, including those whose hernia had been repaired but who complained of minor symptoms. The records available for these cases revealed that there were 666 herniations in men whose theatres of service were:

	Overseas	New Zealand
Army—2NZEF MEF and CMF	261	186
2 NZEF IP	84	
Navy	22	4
Air Force	46	63
	——	——
	413	253

Of the 261 men with service in 2 NZEF MEF the herniations were: (a) present before going overseas, 14; (b) operated on prior to enlistment with recurrence overseas, 18; (c) originated overseas, 154; (d) discovered on discharge in New Zealand, 65; (e) occurred after discharge, 10. An actual herniation was not present in all the cases in groups (a), (b), and (c)—some men who had been operated on successfully complained of minor symptoms.

The types of hernia noted in these men were: inguinal hernia—right, 85; left, 64; bilateral, 78 (i.e., 39 men); femoral, 8; incisional, 12; umbilical, 6; epigastric, 7; diaphragmatic, 1.

The 227 cases of inguinal hernia were dealt with as follows:

		Recurrences
No operation (hernia persists)	60	
Operated in MEF	41	25
Operated in UK	8	4
Operated in Germany	11	7
Operated in NZ	107	17
	—	—
	227	53

Of the recurrences 35 were repaired satisfactorily, mostly with one operation, but 18 were unrelieved, four of whom had one further operation, and one had four further operations.

Of the 25 recurrences from MEF, 2 were repaired satisfactorily in the Middle East and the majority of the remaining 23 in New Zealand. The 23 cases represented about 3 per cent of the 725 cases dealt with in 2 NZEF in the Middle East, a very satisfactory result which can be attributed to a wise selection of cases for operation, and also to adequate surgery. Of the 725 cases, only 41 were graded below Grade I on discharge.

A total of 84 cases was recorded from the Pacific Force, to which some Grade II men were sent and from which relatively more men were invalided to New Zealand.

A total of 186 hernias were recorded in homeservicemen, and of these 49 were present on enlistment; 14 recurred after a pre-service operation; 110 developed during service; 12 were discovered at discharge; and 1 developed after discharge. Some 104 were operated on, with 32 recurrences, of which 12 remained unrepaired, 7 after one, 3 after two, and 2 after three operations. The recurrence rate was thus 30 per cent, and 11 per cent of the total cases were eventually unrelieved. The poorer results naturally arose from the higher age groups and lower-graded men who composed the Home Service force. The 135 men who had served overseas, but who had their only operative treatment subsequently in New Zealand, had 26 recurrences (only 20 per cent), and only 7 (5 per cent) were finally unrelieved. Altogether the results appear satisfactory, though in some cases several operations were required, with a consequently long period of recovery from disability. The overall picture is, firstly, of the rejection by the army of nearly 2 per cent of recruits because of the presence of hernia; secondly, that of the men sent overseas 1 per cent developed hernia, of whom the majority were operated on with success so that they continued to serve overseas, as also did many who were graded without receiving any operative treatment. Only a very small number were invalided back to New Zealand because of hernia, and most of these had other disabilities or were in the oldest age group. Operation overseas was largely restricted to younger men with good musculature, the older men being graded for lighter work, generally at the Base. This resulted finally in only 3 per cent of the operated cases showing up as recurrences on arrival back in New Zealand. This was in contrast to overseas cases first operated on after their return to New Zealand when 20 per cent had an initial recurrence, but of whom only 5 per cent remained unsatisfactory after further operation. In all primary operations in New Zealand (201 cases) the recurrence rate was 19 per cent, while in the 342 cases operated on in 2 NZEF MEF to March 1943 the recurrence rate was under 6 per cent.

Of the 163 hernias occurring in all services where the interval times between operation and recurrence were given, 77 recurred within one year, 31 within two years, 13 within three years, and 42 after three years. There was only an odd case of recurrence after eight years.

The position in 1952 with the 531 herniations in army cases coming in the purview of the War Pensions Boards was that 351 had been operated on, and of these, 104 had had recurrences, which were all repaired except for 33. Many of the 33 declined further surgery after the first operation. Hernia was still present in 180 cases which had not been operated on.

Of all cases, relieved and unrelieved, only 46 (18 from the Middle East and 21 homeservicemen among them) were receiving a pension in 1952, and of these, 36 were receiving 20 per cent or under. Some of the pensions were for weak or painful scars, and only one was for atrophied testis. The final pension liability is remarkably low, and shows that the army can use men with the abnormality of hernia without the State eventually being required to pay any large amount in pensions.

Recommendations for the Future

In the light of New Zealand's experience in the 1939–45 War one would recommend:

1. All young and otherwise fit recruits with primary hernia conditions should be operated on by a competent surgeon as they will be rendered fit for front-line service.
2. All patients should have physical exercises to improve the abdominal musculature both before and after operation.
3. A period of three months should be laid down as necessary for convalescence following operation before posting to the army or return to full duty.
4. In the older age groups all men with good abdominal musculature in whom satisfactory repair can be carried out should be operated on and given an extra period of three months on light duty before posting or return to full duty.
5. Cases with feeble abdominal musculature, especially in the older group, and recurrent cases, should not be accepted in the army. If already in the army they should not be operated on but graded for base duties or discharged according to their usefulness to the army.
6. In the young men with good abdominal musculature the adequate removal of the sac should give a satisfactory result.

7. There are no data available to show that any of the numerous methods of strengthening the inguinal canal can be deemed to be superior to others or able to give assurance against recurrence. However, many of the methods are of value when used intelligently.
8. Repair by fascial grafts is satisfactory in the more severe types of hernia, but is liable to more severe disturbance in the presence of sepsis, and again, does not give a guarantee against recurrence.
9. Repair by silk darning was found unsuitable for use in the army owing to the severe disturbance associated with infection when that did occur.
10. The operation for hernia is one of considerable importance in the saving of manpower in the army. It demands ability and experience in the operator and should be looked upon as an operation calling for the employment of differing techniques according to the variation in the condition of the individual hernia, and not for a stereotyped routine procedure.

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[1] From Statistical Report on the Health of the Army, 1943-45.

WAR SURGERY AND MEDICINE

[SECTION]

HERNIA is a common condition, and it is inevitable that men develop hernia during service.

In 1 NZEF operation for repair of hernia was carried out in the base hospitals overseas, and cases deemed unsuitable for operation were graded for base duty or sent back to New Zealand. The large majority of cases dealt with overseas carried on their service satisfactorily.

Second World War

The original code of instructions for medical boards laid down the following regarding the acceptance of recruits:

Hernia (Inguinal): No case however slight, should be accepted for Grade I, even if well retained by a truss; if bilateral and not large and controlled by a truss, the man may be put in Grade II. If the hernia, either single or double, is large with patulous rings, but is retained by a truss, the man must be placed in a grade below the first, the precise grade being determined by a consideration of his general physical condition. If the hernia is irreducible, the man must be placed in Grade IV. Four months is the minimum interval after operation before a man may be placed in Grade I.

Hernia was the fifth most common disability (5 per cent) in all men graded II, III, or IV at their initial medical examinations in 1942 and 1943, when older men were in the majority among those examined. Of those called up for service, 1·62 per cent could not be placed in Grade I because of hernia.

When remedial treatment for minor surgical conditions was arranged in September 1940, hernia was definitely excluded from the list of conditions for which operation was authorised. Remedial treatment could only be given to cases which could be rendered fit for training in one month. The period of four months had been laid down as the minimum between operation for hernia and full duty. Suggestions were made by regional deputies that the period of one month be extended and that treatment for hernia should be included in the list, but the DGMS firmly adhered to his opinion that men with hernia should not be given remedial treatment to fit them for service.

In June 1943 all the Regional Deputies were asked their opinion with regard to the fitness of men with hernia for duty in camp or in the Home Guard. Nearly all the replies were to the effect that men who carried out their civil occupations without any trouble, particularly if this entailed physical work, were fit for duty both in camp and in the Home Guard. It was only the sedentary workers with particularly large hernias who would be unsuitable for these duties. It was pointed out that the number of otherwise fit and healthy men with hernia was surprisingly great, and many of them did strenuous labouring work without complaint.

The necessity for regulating the physical work required in the Home Guard was stressed, and it was pointed out that many men not fit for any strenuous physical work would be employed on lighter duties and they could be so graded by the Regional Deputies. The army authorities, however, for some inexplicable reason, had instructed that no differentiation was allowable.

It would seem that the ideal solution would have been to have given the Regional Deputies the power to determine whether these men were fit for duty in camp and in the Home Guard, and in certain cases sedentary work could have been stipulated. The Pulheems system, properly applied, would readily solve all difficulties.

Hernia is a common disability, and if all men, otherwise young and fit, are automatically excluded from the army, except as graded men, it means a definite limitation of manpower for the army. The three months' treatment needed to make a hernia case fit for active service would seem to be justified in a prolonged war, provided the operation is restricted to cases likely to be Grade I and not likely to recur. There would seem to be no justification for operation on men in the older age groups or on those with feeble abdominal musculature.

WEARING OF TRUSSES

Wearing of Trusses

The Regional Deputies in 1943 pointed out that very few men with hernia wore trusses, no matter what their occupation, and in spite of this they seemed to have no disability. This finding has been confirmed by Dr D. Macdonald Wilson, supervisor of medical treatments, War Pensions Department. In a survey of the 562 cases coming before War Pensions Boards up to 1952, he found that there were 232 men with unrelieved hernia, but only 18 of them stated that they wore a truss. The Department was prepared to supply trusses, but the only requests came from First World War pensioners who had worn them for twenty to thirty years, dating back to the time when doctors regularly recommended a truss if operation was not undertaken.

Overseas Experience of 2 NZEF

Some 700 men developed hernia during service overseas with 2 NZEF. The great majority were young men in whom operative repair was eminently suitable, and comparatively few were of an age at which permanent success could not be hoped for. However, all cases in the older group were carefully evaluated with regard to the prospects of future satisfactory military service. They were graded for base duties, or sent back to New Zealand without operation, if full operative success was not expected.

The practice of discouraging operation for the older group of men (those in their late thirties and forties) proved satisfactory. It was felt that these men could carry on at the Base if suited for light employment, and, if not, it was better policy for them to be employed in New Zealand.

Even if operation were successful in these cases they were unsuited for front-line duty, and the period of six months on light duty following operation was not warranted for a man fit to be employed only in Base Camp. The younger men, on the other hand, could in three months be made fit for front-line service with a very slight liability to recurrence, so operation was well justified.

In December 1943 recommendations were made by the Consultant Surgeon 2 NZEF that 'cases with definite herniation should be referred to hospital for operation. Cases with weakness of abdominal musculature, producing some indefinite bulging of the inguinal region, should carry on. After operation care should be taken to prevent undue strain for a period of three months, after primary operation, and at least six months after operation for recurrence. The cases will automatically be graded for this period, but even so care must be taken to see that strain is eliminated as the reason for the grading is apt to be forgotten.'

Grading: Cases were graded following operation in difficult cases, in the older men, and because of recurrence. At May 1942 only nine cases of an average age of thirty-seven years were graded for base duty.

By March 1943 seven graded men had been sent back to New Zealand for non-medical reasons and seven of an average age of thirty-five were at that time graded for base duties. Two had refused operation, for one an operation was not advised, one was awaiting operation, one was a recurrence, and two were graded as a precaution. Details were as follows:

(1) Umbilical Hernia and small R. Bubonocele. Refused operation. Age, 38 years.
(2) Operation Bilateral in New Zealand, 1940. Recurrence of small bulge, one just outside ring, other in ring. Refused operation. Age, 42 years.
(3) Large Indirect Hernia. Operation September 1942. Temporarily graded for rest. Age, 23 years.
(4) Bubonoceles bilateral, also osteoarthritis knees, fat, poor subject. No operation advised. Age, 40 years.
(5) Bilateral operation in New Zealand. Operation NZEF November 1941. R. side. In November 1942 recurrence noted size of pigeon's egg. Sac small and difficult to find. Cord displaced in front of aponeurosis. Also has syphilis. Age, 41 years.
(6) L.I.H. Operation advised recently. Not yet performed. Age, 37 years.
(7) Operation in New Zealand (1932 R.I.H., 1935 R. & L.I.H.). Operation in NZEF, R.I.H. September 1941. Silk repair, satisfactory result but graded as a precaution. Age, 26 years.

The conclusions reached in May 1942 after a review of the cases sum up the position satisfactorily: 'The results show clearly that inguinal hernia, except for the period of disability consequent on the performance of the operation and the convalescence therefrom, is not of any serious importance in 2 NZEF'.

There were about 10 men graded for hernia every month, including cases graded temporarily following operation. There were normally about 30 men on the graded list at one time, 23 actually in the last list of men graded for all conditions, a very small proportion of the whole.

Invaliding: Older patients were often sent back to New Zealand, especially if they had some added disability. Up till March 1943 only seven cases had been sent back to New Zealand, their ages being 29, 39, 42, 49, 50, 52, 52. During the rest of the war in the MEF and CMF another 24 cases were invalided back to New Zealand—a total of only 31 in 2 NZEF for the whole period of the war.

Operative Procedure

The conditions present in hernia may be:

(1) A congenital indirect sac starting at the internal abdominal ring and passing down the canal for a variable length, the maximum extending to the scrotum and being continuous with the tunica vaginalis.
(2) Weakness in the musculature of the abdominal wall, especially in the region of the inguinal canal.
(3) Attenuation of the structures of the inguinal canal with consequent stretching and bulging of the abdominal wall in this region.
(4) Direct herniation due to the bulging of the peritoneum through weakened areas of the inguinal canal.

It is obvious that the operative measures to be adopted must vary with the conditions present in the individual case. In the simple indirect hernia the removal of the sac should bring about cure.

When the musculature is much weakened and, in consequence, stretching and bulging of the inguinal region has taken place, with eventually the formation of a direct hernial sac, the simple removal of this sac cannot be expected to bring about permanent repair. Some tautening and strengthening is essential. It is well known that this function is carried out in the body by the fascial layers, so it is natural to employ methods which utilise the fascial tissues available. Unfortunately the transversalis fascia is often fragmentary, especially in the worst cases.

Overlapping of the external oblique aponeurosis is simple and of considerable value. The rectus sheath can often be utilised to strengthen the weak inner part of the canal, either by turning back a flap or by splitting the sheath and suturing the lower part to Poupart's ligament. A combination of methods is frequently available and useful.

The utilisation of muscle in the repair is against surgical principles except in so far as the alteration in insertion may make the muscular action more efficient. This would be brought about by the alteration in the insertion of the conjoint tendon, bringing the tendon lower to cover over the weak internal portion of the canal. The tendon may be partly split to enable this to be done or simply stitched lower down to the pubis.

The stitching of the muscular part of the conjoint tendon to Poupart's ligament as in Bassini's operation damages the muscles and interferes with their action, and can only be effective by the formation of fibrous tissue at the site of suture and the production of a new fascial layer.

The use of fascial strips provides support by the incorporation of the strips in the tissues and the formation of fresh fibrous tissue around them, and the silk lacing produces the same kind of result, encouraging the production of much fibrous tissue.

Essentially, operation in all but the simplest cases entails a plastic repair of the inguinal part of the abdominal wall, if possible brought about without interference with muscular action. Fortunately the proportion of simple cases is high. There are many types of herniation and many degrees of severity and no one technique can deal with them all. It is essential to suit the technique to the individual case and apply sound general surgical principles. One must occasionally admit that no surgical repair is possible and that other methods of partial relief are all that can be offered the patient.

Operative Treatment in 2 NZEF

This was carried out in the New Zealand base hospitals by any of the surgeons available. When the hospitals were fully occupied with battle casualties, the hernia cases were deferred, both from the point of view of space, and also of possible infection. With the large numbers of surgeons concerned there was no uniformity of operative technique, but the following four main types of operation were carried out:

Simple removal of the sac without any alteration in the ordinary anatomy of the inguinal canal. This technique was favoured in the early case of indirect hernia in young men, where no undue weakening of the musculature and fascial layers had taken place.

Removal of the sac and in addition some reinforcement, its form depending on the case and on the surgeon, by repairs of the Bassini type, by suturing of the transversalis fascia, especially round the internal ring, by suturing the conjoint tendon to Cooper's ligament, by overlapping the external oblique aponeurosis, by utilising a flap from the rectus sheath to suture to Poupart's ligament, all methods to strengthen the wall of the inguinal canal, either with or without displacement of the cord.

Silk Repair: The utilisation of strong silk to lace up the posterior wall of the inguinal canal, and especially the region of the internal abdominal ring, was much in vogue at the beginning of the war, as a simpler and just as efficient method as that of the utilisation of fascial strips. The method was recommended by Major-General Ogilvie, Consultant Surgeon MEF, who kindly demonstrated it on two cases in the New Zealand base hospital in Helwan. Unfortunately, under the conditions sepsis was found to occur in a sufficient number of cases to make the employment of silk undesirable, and the operation was later prohibited in the British Army. When sepsis did arise the deeply embedded silk caused severe local disturbance and was very difficult to remove.

Fascial Repair: This was not often carried out except by the utilisation of viable fascia in the canal itself, such as a flap from the rectus sheath. Cases requiring this type of operation would generally be in the older age group. In this group, operation in the army overseas was deemed inadvisable for the more severe cases, who were graded or sent back to New Zealand.

PHYSICAL EXERCISES

Physical Exercises

Arrangements were made to have men suffering from hernia undergo a course of physical exercises to strengthen the abdominal musculature, both before and after operation. This was found to shorten the period of convalescence, and was thought to make recurrence less likely.

Recurrence

In the Middle East Force the question of the frequency of recurrence caused much comment at one time, and investigations were carried out to find the cause. It was considered that unsatisfactory operative technique had been responsible for some of the recurrences.

It was ascertained that many of the recurrences were due to the inability to remove the sac satisfactorily, and in some cases the original sac was intact, and there was dissatisfaction with the Bassini and similar techniques.

There was a tendency to rely on the simple removal of the sac and not to interfere with the normal functioning of the musculature of the inguinal canal. It was emphasized, however, that operative repair of inguinal hernia was not always an easy matter to be delegated to the young untrained surgeon, but that it was highly important that the first operation performed be carried out with great care by a surgeon of experience who could add, as necessary for the individual case, some extra form of plastic repair, as little damaging as possible to the functioning musculature of the inguinal canal. The problem, fortunately, did not apply so much to 2 NZEF, in which there were comparatively few recurrences. Two reviews of the cases in the 2 NZEF were made by the consultant surgeon, one in May 1942 and the other in March 1943.

By May 1942 there had been 228 operations for primary hernia with two recurrences, one a sliding hernia on the right side and the other following a post-operative chest complication associated with a cough. There were five recurrences following pre-war operations performed in New Zealand. Six cases had had one recurrence and one case had had two recurrences on one side.

By March 1943 there had been a total of 361 operations for inguinal hernia in the following categories:

Inguinal Hernia: Indirect or unspecified	330

Inguinal Hernia: Direct	10
Inguinal Hernia: Fascial repair	2
Inguinal Hernia: Recurrent	19

It was noted that cases operated on for recurrence were very liable to break down again, thus denoting a marked weakness of the abdominal musculature. For instance, one case had an operation for bilateral hernia in 2 NZEF with a history of Battle's incision eighteen years previously and a right hernia operation eleven years previously. Operation on the right side for recurrence took place in April and September 1942, the last being a repair by silk which was effective; there was still a slight recurrence on the left side.

NUMBER OF OPERATIONS

Number of Operations

While an exact record is not available of the number of operations for hernia performed in 2 NZEF it has been possible to compute an approximate total, using the survey made in March 1943 showing 361 operations and the record of hernia patients admitted to hospital for hernia subsequent to that date. It seems that there were about 725 operations altogether, as shown in the following table (the recurrence rate for the second period is estimated):

	Primary	Recurrence	Total
Operated on to March 1943	342	19	361
Admitted to hospital Mar 43–Dec 45	344	20	364
	—	—	—
	686	39	725

EXPERIENCES IN BRITISH ARMY IN UNITED KINGDOM 1

Experiences in British Army in United Kingdom [1]

A statistical review of cases of hernia in the British Army in the United Kingdom from mid-1943 to mid-1944 has disclosed much of interest which is partly comparable to 2 NZEF experience. In terms of man wastage among males, hernia contributed more to hospitalisation in the army in the United Kingdom than any other single diagnostic category, and indeed more than the entire class of psychiatric disorders. In addition, refusal of operation entailed wastage of manpower in the higher categories as these men had to be down-graded. In the one year there were 6874 first hernia operations and 846 operations for recurrence, an annual rate of 5 per 1000 strength. The period in hospital was protracted, the mean stay in hospital and convalescent depot being three months. Practically all cases were returned to full duty. The relative incidence of operation at different ages varied little, but the incidence of discharge increased with advancing age and very steeply in the terminal age groups.

The relative incidence of the different types of hernia was indirect 86; direct 10; femoral 4.

Recurrences were much more common following simple removal of the sac and less frequent following repair by fascia. A majority of the recurrences following indirect hernia were still indirect and resulted from failure to excise the sac, and more commonly followed the simpler form of operation. The majority of the recurrences occurred within one year.

The final conclusion arrived at by the reviewers was that '(a) after about one out of every eight primary operations the original condition reappears within twelve months; (b) the overwhelming majority of such recurrent cases are the result of an operation for the performance of which a relatively modest level of professional skill is perhaps too commonly deemed to suffice.'

The review throws valuable light on the problem. It confirms our New Zealand experience in the Middle East that operation in suitable cases can be relied on to make a man fit for front-line duty. The opinion is also given that many recurrences are due to inability to find, or satisfactorily deal with, the sac—a sign of poor and inexpert surgery.

The 2 NZEF period of three months before return to full duty following operation is also shown to have been the standard in the United Kingdom. Multiple recurrences were shown to be fairly common. This upholds the 2 NZEF routine of grading and invaliding such men, generally in the older age group, instead of subjecting them to operation, thus enabling their manpower to be better utilised and saving hospital accommodation overseas.

War Pensions Survey

A survey was made in May 1952 of the records of all ex-servicemen who had applied for pension or had been graded below Grade I on discharge, and including those in whom hernia was diagnosed at discharge, although the man himself may have had no prior knowledge of any abnormality and certainly of no disability. In all there were 562 cases, including those whose hernia had been repaired but who complained of minor symptoms. The records available for these cases revealed that there were 666 herniations in men whose theatres of service were:

	Overseas	New Zealand
Army—2NZEF MEF and CMF	261	186
2 NZEF IP	84	
Navy	22	4
Air Force	46	63
	413	253

Of the 261 men with service in 2 NZEF MEF the herniations were: (a) present before going overseas, 14; (b) operated on prior to enlistment with recurrence overseas, 18; (c) originated overseas, 154; (d) discovered on discharge in New Zealand, 65; (e) occurred after discharge, 10. An actual herniation was not present in all the cases in groups (a), (b), and (c)—some men who had been operated on successfully complained of minor symptoms.

The types of hernia noted in these men were: inguinal hernia—right, 85; left, 64; bilateral, 78 (i.e., 39 men); femoral, 8; incisional, 12; umbilical, 6; epigastric, 7; diaphragmatic, 1.

The 227 cases of inguinal hernia were dealt with as follows:

		Recurrences
No operation (hernia persists)	60	
Operated in MEF	41	25

Operated in UK	8	4
Operated in Germany	11	7
Operated in NZ	107	17
	—	—
	227	53

Of the recurrences 35 were repaired satisfactorily, mostly with one operation, but 18 were unrelieved, four of whom had one further operation, and one had four further operations.

Of the 25 recurrences from MEF, 2 were repaired satisfactorily in the Middle East and the majority of the remaining 23 in New Zealand. The 23 cases represented about 3 per cent of the 725 cases dealt with in 2 NZEF in the Middle East, a very satisfactory result which can be attributed to a wise selection of cases for operation, and also to adequate surgery. Of the 725 cases, only 41 were graded below Grade I on discharge.

A total of 84 cases was recorded from the Pacific Force, to which some Grade II men were sent and from which relatively more men were invalided to New Zealand.

A total of 186 hernias were recorded in homeservicemen, and of these 49 were present on enlistment; 14 recurred after a pre-service operation; 110 developed during service; 12 were discovered at discharge; and 1 developed after discharge. Some 104 were operated on, with 32 recurrences, of which 12 remained unrepaired, 7 after one, 3 after two, and 2 after three operations. The recurrence rate was thus 30 per cent, and 11 per cent of the total cases were eventually unrelieved. The poorer results naturally arose from the higher age groups and lower-graded men who composed the Home Service force. The 135 men who had served overseas, but who had their only operative treatment subsequently in New Zealand, had 26 recurrences (only 20 per cent), and only 7 (5 per cent) were finally unrelieved. Altogether the results appear satisfactory, though in some cases several operations were required, with a consequently long period of recovery from disability. The overall picture is, firstly, of the rejection by the army of nearly 2 per cent of recruits because of the presence of hernia; secondly, that of the men sent overseas 1 per cent developed hernia, of whom the majority were operated on with success so that they continued to serve overseas, as also did many who were graded without receiving any operative treatment. Only a very small number were invalided back to

New Zealand because of hernia, and most of these had other disabilities or were in the oldest age group. Operation overseas was largely restricted to younger men with good musculature, the older men being graded for lighter work, generally at the Base. This resulted finally in only 3 per cent of the operated cases showing up as recurrences on arrival back in New Zealand. This was in contrast to overseas cases first operated on after their return to New Zealand when 20 per cent had an initial recurrence, but of whom only 5 per cent remained unsatisfactory after further operation. In all primary operations in New Zealand (201 cases) the recurrence rate was 19 per cent, while in the 342 cases operated on in 2 NZEF MEF to March 1943 the recurrence rate was under 6 per cent.

Of the 163 hernias occurring in all services where the interval times between operation and recurrence were given, 77 recurred within one year, 31 within two years, 13 within three years, and 42 after three years. There was only an odd case of recurrence after eight years.

The position in 1952 with the 531 herniations in army cases coming in the purview of the War Pensions Boards was that 351 had been operated on, and of these, 104 had had recurrences, which were all repaired except for 33. Many of the 33 declined further surgery after the first operation. Hernia was still present in 180 cases which had not been operated on.

Of all cases, relieved and unrelieved, only 46 (18 from the Middle East and 21 homeservicemen among them) were receiving a pension in 1952, and of these, 36 were receiving 20 per cent or under. Some of the pensions were for weak or painful scars, and only one was for atrophied testis. The final pension liability is remarkably low, and shows that the army can use men with the abnormality of hernia without the State eventually being required to pay any large amount in pensions.

RECOMMENDATIONS FOR THE FUTURE

Recommendations for the Future

In the light of New Zealand's experience in the 1939–45 War one would recommend:

1. All young and otherwise fit recruits with primary hernia conditions should be operated on by a competent surgeon as they will be rendered fit for front-line service.
2. All patients should have physical exercises to improve the abdominal musculature both before and after operation.
3. A period of three months should be laid down as necessary for convalescence following operation before posting to the army or return to full duty.
4. In the older age groups all men with good abdominal musculature in whom satisfactory repair can be carried out should be operated on and given an extra period of three months on light duty before posting or return to full duty.
5. Cases with feeble abdominal musculature, especially in the older group, and recurrent cases, should not be accepted in the army. If already in the army they should not be operated on but graded for base duties or discharged according to their usefulness to the army.
6. In the young men with good abdominal musculature the adequate removal of the sac should give a satisfactory result.
7. There are no data available to show that any of the numerous methods of strengthening the inguinal canal can be deemed to be superior to others or able to give assurance against recurrence. However, many of the methods are of value when used intelligently.
8. Repair by fascial grafts is satisfactory in the more severe types of hernia, but is liable to more severe disturbance in the presence of sepsis, and again, does not give a guarantee against recurrence.
9. Repair by silk darning was found unsuitable for use in the army owing to the severe disturbance associated with infection when that did occur.
10. The operation for hernia is one of considerable importance in the saving of manpower in the army. It demands ability and experience in the operator and should be looked upon as an operation calling for the employment of differing techniques according to the variation in the condition of the individual hernia, and not for a stereotyped routine procedure.

CHAPTER 22 — VARICOSE VEINS

CHAPTER 22
Varicose Veins

FIRST WORLD WAR

DURING the First World War varicose veins did not loom largely as a disability in 1 NZEF, in spite of the fact that the soldier at that period was a 'foot-slogger', having to march whenever his unit changed its position. The prolonged periods in trenches, and very often wet and muddy trenches, contributed to any leg disability. Treatment at that time consisted in operative removal of the affected veins with ligature of the internal saphenous vein at the saphenous opening. Often the main vein was removed by a stripper or pulled out by means of a probe. The operations were prolonged and tedious. The results were, on the whole, satisfactory, but some recurrences inevitably occurred. The severe cases, with involvement of the deep veins, ulceration and eczema, were uncommon in the soldier.

Between the wars intravenous injections of various sclerosing agents were introduced in the treatment of varicosities and, largely because of their simplicity and relative non-interference with the normal activity of the patient, became very popular. They were specially suitable for the smaller localised bunches of dilated veins in the leg. The tedious operative procedures were to a great extent discarded in favour of the injections. The simplicity of the injections tended to encourage patients to have small symptomless varicosities dealt with, partly for the mere sake of appearance. Repeated injections became quite common, and at times the deep veins were damaged. It became clear, however, that in the case of incompetence of the main valves with dilatation of the main saphenous trunk injections were of no avail. The Trendelenberg operation became the standard method of treatment of these cases, with injections as an adjunct to deal with the localised varicosities, and also to sclerose the main vein after ligature had been carried out.

There was a tendency to simplify the Trendelenberg technique and to employ local anaesthesia for its performance. The treatment in the main was looked upon as a minor matter to be carried out as an ambulatory measure in the consulting room.

In the code of instructions issued to medical boards, regulations with regard to varicose veins were drawn up as follows:

No varix, unless very slight, should be placed in Grade I until cured. More serious cases will be placed in Grade II or III, according to the disability entailed. Cases of chronic ulceration or thin scars of healed ulcers associated with varicose veins should not be placed higher than Grade III. Cases with evidence of recurrent phlebitis should be placed in Grade IV.

The regulation that 'No varix, unless very slight, should be placed in Grade I until cured', must be taken to mean that every prominent vein had to be looked upon as a disability and that till treatment had been carried out the man had to be down-graded. Refusal of treatment necessarily meant escape from overseas service. Boards were encouraged to look for enlarged veins, and it can readily be understood that busy practitioners, with possibly little experience of the problems, were inclined to pay too much attention to the veins. The recruit naturally had his attention drawn to the slight enlargement of the veins and thereby incalculable psychological harm was done. A mountain was made out of a molehill.

The only reviews of gradings carried out after the original board were of the Grade IV cases, so that if a recruit had been placed as Grade III because of varicose veins he was lost to the army forever, and many men of fine physique were undoubtedly in this category.

The degree of disability brought about by varicose veins was difficult to assess, and the presence of dilated veins might denote no disability whatever. The practitioner, accustomed to treating minor degrees of varicosity, and often merely for beautifying purposes, would tend to lay too much stress on the condition. It was common knowledge that vigorous men, showing prowess in athletics of all kinds, were turned down on enlistment because of varicose veins. There was undue stress laid on minor anatomical abnormalities and insufficient attention paid to the all-important question of function. It was impossible for the large number of boards, operating throughout the length and breadth of New Zealand, to develop suddenly a military outlook and to shed their outlook as civilian practitioners. There was also little elasticity permissible, as is rendered possible under the Pulheems system.

Cases with moderate degrees of varicose veins were graded as temporarily unfit and referred to hospitals or their own practitioners for treatment so as to bring them up to Grade I.

It was clearly laid down, however, that remedial treatment should only be given to recruits who could be made fit for full duty in one month. Two injections only were to be given, and those below the knee, and operation was not to be carried out. In spite of recommendations to lengthen the period of treatment and enlarge its scope, particularly by operation, the original regulations were adhered to. The whole question was thereby given a wrong bias, one quite contrary to army experience. Dr D. Macdonald Wilson stated that many keen territorials graded II for varicose veins were mobilised when Japan entered the war, underwent rigorous training, and having had no symptoms were up-graded and sent overseas.

Middle East Force

The heat and debilitating conditions associated with camp life in Egypt tended to aggravate any disability due to varicose veins, especially if there was any tendency to the development of eczema.

Treatment: Men were referred to the New Zealand hospitals for both in-patient and out-patient treatment. From Base cases were referred to the hospital at Helwan. The more marked cases were admitted, but the minor cases were treated by injection as out-patients, and the injections repeated till satisfactory relief had been obtained.

Operation: The operative treatment almost universally carried out was the Trendelenberg operation, consisting of ligature of the internal saphenous and its branches at the saphenous opening, or occasionally, ligature of the external saphenous, at the lower part of the popliteal space.

There was a tendency to carry out this seemingly minor operation under local anaesthesia, and articles had been written describing this procedure. The result, perhaps inevitable, of this seeming simplification was frequently an incomplete and unsatisfactory operation. The vein was tied well below the saphenous opening and the smaller branches not tied at all, with the result that the condition was unrelieved. This led to serious administrative and psychological difficulties. It had to be explained to the soldier that a repetition of the operation was necessary for the cure of the condition and consent had to be obtained from him. The operation also tended to get an undeservedly bad name amongst the men. This skimping of operative techniques by unskilled or irresponsible operators—I purposely do not use the word 'surgeon' —was even more serious in its effects in the army than in civilian practice. In conjunction with the Trendelenberg procedure, injection of sclerosing solution was frequently made into the distal portion of the saphenous vein at the site of the operation.

Injections: Apart from the injection of the main vein at the time of operation, as mentioned above, injections were given into localised varicosities involving branches of the main veins. These were usually given in an out-patient clinic, and repeated as considered advisable.

Clinics

There was a tendency to develop special clinics for this purpose in the base hospitals, just as there are such clinics in civilian hospitals. An enthusiastic surgeon can attract a big clientele in civil life, and it can be readily understood that it was still easier to do so in the army. The out-patient visit to the hospital could be a welcome break in the monotony of military camp life, and if a period of excused duty was also available, the outing became still more attractive. A symptomless varicosity can thus become a useful abnormality to the soldier.

This condition only arose in a minor degree in 2 NZEF, but in some of the British hospitals it became a matter of importance. Investigation carried out showed that men had been attending the clinics regularly for months, even up to periods of well over a year, with the consequent man wastage. Still more serious was the effect of the repeated injections. In many cases gradual obliteration of the deeper veins had occurred, with impairment to the circulation of the limb and still more serious effects on function. In some cases even amputation had finally resulted. The result of the investigation was the abolition of the clinics and a complete re-orientation of viewpoint as to the management of these cases in the army, and I am sure this viewpoint will spread to civilian practice.

It was finally realised that the well-developed case with congenital dilatation of the saphenous vein, associated with incompetent valves, must have operative treatment to prevent gravitational loading and swelling of the veins, and that the results on the whole were good.

On the other hand, the indiscriminate injecting of veins was often unwarranted, had little effect in cases where the saphenous system was at fault, and was associated with grave danger of blocking the deep veins and so causing dangerous interference with the vascular supply of the limb. The majority of smaller varicosities give rise to no symptoms and are no disability, the less notice taken of them the better, physically and psychologically. At the beginning of the war varicose veins led to a considerable loss of manpower through time spent on treatment both in hospital, and especially in varicose clinics and out-patients departments. With a fresh orientation to this problem and the discontinuance of clinics, the problem became much less important.

A review of the problem in 2 NZEF was carried out in March 1943 by the consultant surgeon.

There had been 237 operations performed and 101 injections given for varicose veins in the operating theatres in 2 NZEF. The operations had consisted almost entirely of the Trendelenberg operation, with injections of the main vein in the thigh as an added measure in a large number of cases. (There might have been injections given apart from those recorded in the operation book.)

Of these patients treated by operation or injection in 2 NZEF only three were invalided to New Zealand (one with involvement of deep veins), and only four others down-graded. Apart from this group only eight cases were invalided to New Zealand with disability of varicose veins (though in four of the cases other marked disabilities were present) and eleven others down-graded for the disability, mostly men near or over the age of forty years.

This showed that there had not been any serious disturbance with manpower in the 2 NZEF and that there had been little or no serious after-effects following injections, such as had been experienced in the RAMC. It showed that the majority of cases invalided to New Zealand and of the graded men consisted of men of the older age group, and that frequently other disabilities were associated with the veins, as one might expect.

Only 11 men had been sent back to New Zealand and only 15 cases were down-graded—a very small number in such a large force. The problem was not therefore a serious one if handled conservatively.

There were seven more cases invalided back to New Zealand later from 2 NZEF: two of these had thrombosis of the deep femoral veins not associated with varicose veins; two cases had thrombosis of deep veins, one with definite oedema of the leg and foot; another had varicose veins with oedema of the leg; another had bilateral varicose veins with ulceration; another had bilateral varicose veins and internal derangement of the knee.

It is obvious that all these cases, except the one complicated by a disability of the knee, had involvement of the deep veins. Two of them had femoral thrombosis not associated with varicosity, and another two were probably of the same nature as no reference is made to varicosity. This means that no case of varicose veins without serious damage to the deep veins was invalided back to New Zealand after March 1943. In addition, the number of men down-graded with varicose veins in 2 NZEF at any one time was under ten.

In December 1943 the Consultant Surgeon 2 NZEF made the following observations, which give a clear indication of the opinion at that period after nearly four years' experience of the management of these cases:

(a) The disability produced by varicose veins is generally very slight, as shown by soldiers with a severe degree of varicosity, carrying on in the line for long periods.
(b) If producing marked symptoms, cases with incompetency of the main valves of the saphenous veins should be referred to hospital for Trendelenberg operation, with or without sclerosing injection at the time of operation.
(c) Cases with competent valves and no dilatation of the main saphenous veins should, except in very exceptional cases, have no treatment, and carry on their full duties.
(d) Cases with obstruction of the deep veins generally require grading and should not on any account have any operative or injection treatment.
(e) The injection treatment of varicose veins is to be deprecated in the treatment of soldiers, except when associated with operation, and very exceptionally under (c), and even then, local removal of a varicose clump may be preferable.
(Serious disability can be caused by repeated injections of sclerosing fluids.

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Early in 1945 a British Army medical bulletin gave expression to opinions identical with our own, calling attention to the damage inflicted by unnecessary or over-injection and advising operative treatment when any real disability was present.

Experience of the War Pensions Department

A great many men who had injection treatment had recurrences later and the same applied to many who had the Trendelenberg operations. If recommended by an examiner, operation and injections were offered to, but not pressed upon, the pensioner. Usually he declined with a statement that he or his friends had undergone previous treatment without success. Dr D. Macdonald Wilson considered that the profession as a whole was far too optimistic as to the results of treatment.

Recommendations as to the Future

(1) Varicose veins do not as a rule cause any serious disability and their presence should be ignored unless definite signs or symptoms do arise.

(2) Grossly dilated saphenous veins, associated with a congenital inefficiency of the normal valvular action, which give rise to symptoms, should be treated by an efficient Trendelenberg operation carried out under general anaesthesia, and with the tying off of all the venous branches at the saphenous opening. Partial operations are useless. The sites of ligature, other than at the saphenous opening, should be determined by tests beforehand.

(3) Injections in cases such as the above are useless without operation. Injections generally are fraught with the grave danger of blocking the deep venous circulation— a disastrous condition. Any repetition of injections should seldom, if ever, be carried out. Beautifying injections are quite out of place in the army.

(4) Before any treatment is undertaken the presence of thrombosis of the deep veins must be ruled out.

(5) When deep thrombosis has taken place, varicose ulcers and eczema are prone to develop, and naturally all such cases are useless in the army and should be discharged.

Varicocele

It was agreed early in the war that operative treatment for varicocele was unnecessary and undesirable in the army. Operation was therefore banned overseas. It was remarkable how little was seen or heard of varicocele in the 2 NZEF, which went to prove that there was very little real disability associated with the condition. Operation undoubtedly also was associated with some danger of atrophy of the testes and certainly with the exaggeration of any psychoneurosis, which was so frequently associated with the condition.

FIRST WORLD WAR

DURING the First World War varicose veins did not loom largely as a disability in 1 NZEF, in spite of the fact that the soldier at that period was a 'foot-slogger', having to march whenever his unit changed its position. The prolonged periods in trenches, and very often wet and muddy trenches, contributed to any leg disability. Treatment at that time consisted in operative removal of the affected veins with ligature of the internal saphenous vein at the saphenous opening. Often the main vein was removed by a stripper or pulled out by means of a probe. The operations were prolonged and tedious. The results were, on the whole, satisfactory, but some recurrences inevitably occurred. The severe cases, with involvement of the deep veins, ulceration and eczema, were uncommon in the soldier.

Between the wars intravenous injections of various sclerosing agents were introduced in the treatment of varicosities and, largely because of their simplicity and relative non-interference with the normal activity of the patient, became very popular. They were specially suitable for the smaller localised bunches of dilated veins in the leg. The tedious operative procedures were to a great extent discarded in favour of the injections. The simplicity of the injections tended to encourage patients to have small symptomless varicosities dealt with, partly for the mere sake of appearance. Repeated injections became quite common, and at times the deep veins were damaged. It became clear, however, that in the case of incompetence of the main valves with dilatation of the main saphenous trunk injections were of no avail. The Trendelenberg operation became the standard method of treatment of these cases, with injections as an adjunct to deal with the localised varicosities, and also to sclerose the main vein after ligature had been carried out.

There was a tendency to simplify the Trendelenberg technique and to employ local anaesthesia for its performance. The treatment in the main was looked upon as a minor matter to be carried out as an ambulatory measure in the consulting room.

In the code of instructions issued to medical boards, regulations with regard to varicose veins were drawn up as follows:

No varix, unless very slight, should be placed in Grade I until cured. More serious cases will be placed in Grade II or III, according to the disability entailed. Cases of chronic ulceration or thin scars of healed ulcers associated with varicose veins should not be placed higher than Grade III. Cases with evidence of recurrent phlebitis should be placed in Grade IV.

The regulation that 'No varix, unless very slight, should be placed in Grade I until cured', must be taken to mean that every prominent vein had to be looked upon as a disability and that till treatment had been carried out the man had to be down-graded. Refusal of treatment necessarily meant escape from overseas service. Boards were encouraged to look for enlarged veins, and it can readily be understood that busy practitioners, with possibly little experience of the problems, were inclined to pay too much attention to the veins. The recruit naturally had his attention drawn to the slight enlargement of the veins and thereby incalculable psychological harm was done. A mountain was made out of a molehill.

The only reviews of gradings carried out after the original board were of the Grade IV cases, so that if a recruit had been placed as Grade III because of varicose veins he was lost to the army forever, and many men of fine physique were undoubtedly in this category.

The degree of disability brought about by varicose veins was difficult to assess, and the presence of dilated veins might denote no disability whatever. The practitioner, accustomed to treating minor degrees of varicosity, and often merely for beautifying purposes, would tend to lay too much stress on the condition. It was common knowledge that vigorous men, showing prowess in athletics of all kinds, were turned down on enlistment because of varicose veins. There was undue stress laid on minor anatomical abnormalities and insufficient attention paid to the all-important question of function. It was impossible for the large number of boards, operating throughout the length and breadth of New Zealand, to develop suddenly a military outlook and to shed their outlook as civilian practitioners. There was also little elasticity permissible, as is rendered possible under the Pulheems system.

Cases with moderate degrees of varicose veins were graded as temporarily unfit and referred to hospitals or their own practitioners for treatment so as to bring them up to Grade I.

It was clearly laid down, however, that remedial treatment should only be given to recruits who could be made fit for full duty in one month. Two injections only were to be given, and those below the knee, and operation was not to be carried out. In spite of recommendations to lengthen the period of treatment and enlarge its scope, particularly by operation, the original regulations were adhered to. The whole question was thereby given a wrong bias, one quite contrary to army experience. Dr D. Macdonald Wilson stated that many keen territorials graded II for varicose veins were mobilised when Japan entered the war, underwent rigorous training, and having had no symptoms were up-graded and sent overseas.

Middle East Force

The heat and debilitating conditions associated with camp life in Egypt tended to aggravate any disability due to varicose veins, especially if there was any tendency to the development of eczema.

Treatment: Men were referred to the New Zealand hospitals for both in-patient and out-patient treatment. From Base cases were referred to the hospital at Helwan. The more marked cases were admitted, but the minor cases were treated by injection as out-patients, and the injections repeated till satisfactory relief had been obtained.

Operation: The operative treatment almost universally carried out was the Trendelenberg operation, consisting of ligature of the internal saphenous and its branches at the saphenous opening, or occasionally, ligature of the external saphenous, at the lower part of the popliteal space.

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(e) The injection treatment of varicose veins is to be deprecated in the treatment of soldiers, except when associated with operation, and very exceptionally under (c), and even then, local removal of a varicose clump may be preferable.
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Experience of the War Pensions Department

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CHAPTER 23 — HAEMORRHOIDS

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Haemorrhoids

THE incidence of haemorrhoids in 2 NZEF during the war was not high and did not give rise to any marked man wastage. This was due probably to the age group involved.

The only difficulty that arose was due to the presence of mild protrusion and inflammation of the mucous membrane associated with dysentery, a condition which cleared up satisfactorily with simple treatment.

The frequency of dysentery and diarrhoea rendered surgical treatment often undesirable.

External piles, so called, were of no importance, except when needing evacuation of blood clot following thrombosis. Large internal piles, and piles associated with repeated bleeding, were referred to hospital for operation or injection.

A review of cases was made by the consultant surgeon in March 1943. Up to that time there had been the following treatments in the operating theatres of the General Hospitals:

piles—		
Operations	393	
Injections	259	
	——	
Total	652	
other cases—		
Fissure		112
Fistula		42
Anal abscess		60

There had been four cases invalided to New Zealand, the ages being 41, 42, 45, and 37.

Details of these cases were:

1. Anal stricture following pile operation. Also very depressed, with history of pre-war nervous breakdown.
2. Only one of three disabilities; had intermittent bleeding; had injections in New Zealand. Had hammer toes and very debilitated.
3. Healed large ischio-rectal abscess. Two small piles present.
4. Long history dysentery; ischio-rectal abscess; piles removed and two operations for fistula in ano. Some stricture anal canal and pruritis.

Two cases were graded and sent to New Zealand on non-medical grounds. The ages of the patients were 27 and 40. Details were:

1. Chronic ischio-rectal sinus persisting after three operations.
2. Four operations in twelve months; also chronic headache and very constipated. One large pile still present.

Three years in Egypt had provided only six cases for return to New Zealand, and of these, four were over forty years of age.

During the Italian campaign even less trouble was experienced. Anal conditions, therefore, though often calling for treatment, did not cause any marked wastage of manpower, and remarkably few cases were evacuated from the force overseas—only five cases of haemorrhoids, eight of fistula in ano, and ten of other anal conditions.

CHAPTER 24

Diseases of the Testes

THESE consisted of inflammatory and malignant conditions. Of the inflammatory there were cases of gonococcal, BCC, and also tubercular epididymitis. The gonococcal cases were infrequent, due to greatly improved treatment by the sulphonamides and later penicillin. BCC infection rarely occurred and the cases were difficult to diagnose. Tubercular epididymitis was seen in Egypt, sometimes in a very acute form rendering diagnosis at times difficult. It was more common in the Maori troops. The ligature of the vas on the healthy side to prevent spread of the infection was a matter of considerable importance from the pension point of view.

Malignant tumours were infrequent, but different types were seen:

(1) Ectopic testis removed two years previously in a Maori, recent development of very large lumbar glands of uniform elastic consistency— 'seminoma'.

(2) Slight enlargement right testis noted about a year. Development of large, very hard, somewhat irregular swelling in opposite side of abdomen, probably in lumbar glands, X-rays showed cannon ball metastases in the lung. Section after orchidectomy showed cystic teratoma with both adeno and squamous carcinoma.

(3) Chorion-epithelioma of the testis. Orchidectomy was carried out, but he developed widespread metastases, including one on the skin over the shoulder region. He died in New Zealand some months later.

Several cases of seminoma were seen and operated on. The provision of deep X-ray treatment was difficult, especially in Italy, and normally the patients were evacuated to New Zealand for X-ray treatment as soon as possible following orchidectomy. In Egypt deep X-ray was arranged at the Egyptian Civil Hospital in Cairo.

Diagnosis for cases evacuated to New Zealand from 2 NZEF, 1940–45, were: epididymitis tubercular, 15; epididymitis nonspecific, 1; carcinoma testis, 2; teratoma testis, 2; seminoma testis, 3; neoplasm testis, 1; and chorion-epithelioma testis, 1.

CHAPTER 25 — OPHTHALMOLOGY

CHAPTER 25
Ophthalmology

IN 2 NZEF the most striking feature of ophthalmology was its quantity, and it seemed that men tended to be more intolerant of small disabilities than they were in the First World War. Lieutenant-Colonel Barrett, writing of the work of 1 Australian General Hospital at Heliopolis during the Gallipoli campaign, a hospital of about 2700 beds, described its ophthalmic clinic as 'enormous'. During the eight months of its existence 1142 cases were seen. In the eight months preceding the offensive at El Alamein, 2380 new ophthalmic cases were seen at 1 NZ General Hospital at Helwan.

There were four main reasons for the volume of work. Firstly, the medical boarding of recruits in New Zealand was uneven and a number of unfit men were sent abroad. Secondly, service glasses were not available in New Zealand until after the 4th Reinforcements had sailed, and the 5th, 6th, and 7th Reinforcements were equipped with them only in part. Thirdly, ophthalmic work was concentrated at the Helwan hospital, an area hospital serving not only New Zealand base but also many thousands of RAF and British troops. Lastly, owing to the discomfort from glare and the presence of so much ocular disease and blindness amongst the natives, many men were unreasonably apprehensive about their sight. Among the more imaginative soldiers, especially those with any reason to be aware of ocular weakness, the presence of so many partially blind and disfigured natives was attributed to the climatic conditions. From the beginning, therefore, and in spite of the pressure of work, a determined effort was made by explanation and reassurance to give the men some confidence. This time was undoubtedly well spent. Discomfort from glare in Egypt can be considerable, and this, together with prevalent mild conjunctivitis, tended to unmask errors of refraction previously tolerated and make men more dependent on glasses for carrying out their duties with comfort and efficiency.

The supply of spectacles in Egypt was inadequate until late in 1942. When Major Doctor arrived in November 1940 he began to refract for service frames all those of the first three echelons who were wearing spectacles. This laborious task was just completed when Major (later Lieutenant-Colonel) Coverdale succeeded him at Helwan, but the shortage at that time was so acute that only fifteen pair were being dispensed for the hospital by the army contractor each month. There was a long and rapidly increasing waiting list of about 270 New Zealand prescriptions, and men had to wait two to four months even when their need was urgent. It was not until 1943 that, owing to the work of the Opticians' Units in New Zealand, drafts arrived in the Middle East well investigated and equipped and with almost all optically unfit men withdrawn. This ultimate relief for the ophthalmologist abroad, however welcome, was achieved by a very high rejection rate in New Zealand, and there is no doubt that the whole question of standards would repay careful study.

In June 1944 the 14th Mobile Optician Unit, extremely well equipped and under the command of Lieutenant F. O. Davis, arrived in Italy. Its inception was attended by some misfortunes and it was not able to give a complete service until late in the year. Thereafter it proved to be a valuable acquisition.

Many hundreds of men complained of the light, but no corneal changes were visible with the loupe and it was probable that the great majority suffered, not from actinic burns, but from the intensity of the visible rays. The experience of three summers enabled Coverdale to classify most of these men into three groups: (1) those whose eyes were hypersensitive because of superficial inflammations of the lids or conjunctiva, often of a very mild sort; (2) those whose ocular muscles were in a state of irritable tension from uncorrected errors of refraction; (3) those whose nervous systems in general and eyes in particular were intolerant of stimuli because of functional instability.

Men were never discouraged from attending hospital as outpatients, and when subjective disability was out of all proportion to objective findings much time and energy had to be spent in clearing the miasma of minor psychoneurosis from discoverable fact; but Major Coverdale was satisfied that, if it occurred at all, wilful simulation of incapacity was exceedingly rare amongst New Zealand and British troops. Psychoneurosis was fairly common in 1941, much less so in 1942, and thereafter almost ceased to occur. This improvement was ascribed, at least in part, to better boarding in New Zealand. It was found that amongst 95 cases of hysterical amblyopia there were 44 with eyes defective at enlistment from squint, old injury, chronic disease or developmental defects, and 9 with histories of pre-enlistment head or eye injuries, but with no signs remaining. Most of the affected men paraded sick soon after arrival in Egypt, and very few indeed were sent back from forward units in the field. Apart from a few hysterics and some cases with pathological changes, night-blindness was not heard of in 2 NZEF.

Medical Boarding Overseas

The general principle of regarding boarding as a medical assessment rather than a mechanical procedure was always adhered to, and every possible effort was made to keep men with their units in the field. The number of graded men that a Division can profitably employ is not large, and those relegated to Base and not fully engaged in useful work tended to deteriorate rapidly in morale. In spite of this conservative policy, about 200 men had to be boarded for defects present at enlistment. The visual acuity of some of these was, no doubt, Grade I in New Zealand, but other factors, especially temperamental instability, were not assessed or assessable, and the men proved to be of little use in the Middle East. One consequence of the lack of precise investigation at some centres in New Zealand was that many men were credited with much better visual acuity than they did in fact possess. Men, for instance, who had been blind in one eye for years or since birth had had their visual acuity recorded as 6/6 in each eye. Such examinations had their pensions complications. It is a matter of interest that, until late in 1940, men with squint could not be Grade I for service abroad. From experience in North Africa it was evident that, for psychological reasons, this regulation was wise.

In reboarding for defects of vision it was found to be impossible to adhere strictly to the standards of vision laid down for recruits. A man, for example, with two dioptres of myopia can seldom see 6/60 without glasses unless he peers, and yet a trained soldier with normal corrected vision, eager to serve and brought to the Middle East at great expense, cannot lightly be discarded. Major Coverdale decided, therefore, to regrade only those with high degrees of myopia of six or more dioptres, or those with degenerative changes. The number of myopes investigated who were not technically Grade I was, by August 1941, over 300, but for the whole of the North African campaign only about 20 were regraded. Nothing occurred to cause the wisdom of this decision to be questioned.

A small minority of men gave valuable service for long periods in spite of great visual handicaps. A private of 21 Battalion, for example, who made no complaint was sent to the out-patients department because he drove dangerously. One eye was blind and the other, although having 6/9 vision, had been damaged five years previously and showed an irido-dialysis, some posterior cortical cataract, and a rupture of the choroid. A private in the Maori Battalion fought through all the Middle East campaigns with one eye blind and the vision in the other reduced to 6/18 from old trachomatous keratitis. Another man, a lance-corporal in 23 Battalion, had one blind eye and the vision in the other with a - 4D cylinder reduced to 6/60 on looking to the front. He had a considerable degree of nystagmus and could see 6/18 if he looked across his nose. He served in Greece, Crete, Libya, and at El Alamein up to August 1942.

Standards of Vision

It was found that men with old abnormalities had such a tendency to hysteria or minor psychoneurosis that, even if the vision should be Grade I, they should not be sent abroad. The following are examples of such abnormalities compatible with Grade I vision:

(a) Strabismus.
(b) Old perforating injury.
(c) Congenital nystagmus.

Conditions in the Middle East were admittedly unfavourable for men with ocular defects of this type.

Men with high degrees of refractive error or with amblyopia were found to be unsuitable in the infantry, and this raised the question of what might be called unit grading. It was undesirable to have more Grade II men than Base could profitably use, and, in an effort to avoid grading down borderline cases in the infantry, some attempts were made in 1941 to have them transferred to other units. These attempts did not meet with any substantial success as it was ruled, quite correctly, that if a man is not Grade I for one unit he cannot be Grade I for any other unit. Yet an infantryman requires better vision than a man in the Field Ambulances or the Engineers.

Another type of differential grading which received some consideration overseas was known as category classification. Immediately after the campaign in Greece, and as a result of the reported reluctance of the Germans to engage at night, some unit commanders were asked if they thought anything would be gained by selecting men with exceptional night vision. It was pointed out that normal men vary considerably in this respect, but that it might not be prudent to make them conscious of the fact. The unit commanders replied that they must be able to use any of their men for any purpose at any time.

This question of dividing up Grade I men for special tasks within units was later discussed in New Zealand, though not in connection with night vision. It was evident that, while differential grading between units might have some value, category classification was undesirable.

Medical Boards

During the North African campaign 306 men, excluding battle casualties, were graded down in the ophthalmic department at Helwan, and it can be said that about 200 of these were regraded for conditions present at enlistment. It is worth while summarising the reasons for so many time-consuming medical boards.

	To NZ	To Base	Total
Chronic or recurring superficial infections, including keratitis	41	9	50
Hysteria-			
(1) Without ocular pathology	14	1	
(2) With old pathological complications	18	7	
(3) With amblyopia ex anopsia	9	1	50
Uveitis	30	14	44
Amblyopia ex anopsia	2	39	41
Errors of refraction	15	12	27
Old perforation of the globe	12	7	19
Accidental injury	10	5	15
Cataract	11	3	14
Vitreous opacities	10	4	14
Miscellaneous pathology	10	3	13
Nystagmus	6	1	7
Detachment of retina	6		6
Retrobulbar affections	4	2	6

198	108	306

It has been noted that conditions in North Africa were trying for men with visual defects and led to a high attendance rate at the ophthalmic department. Yet, in spite of this and of the somewhat haphazard testing in New Zealand, the analysis of medical boards at Helwan discloses that only 27 men were regraded for errors of refraction and none for errors of muscle balance. Nothing occurred to suggest that by the use of various refinements in testing a more efficient army could have been selected.

As time went on there was a tendency to elaborate the visual testing of recruits, due possibly to some dissatisfaction with the results obtained up to 1943. But the early defects were not so much due to weaknesses in the prescribed standards as to excessive decentralisation of the work, and it is probable that the grading of men from a purely medical point of view showed at least an equivalent margin of error. The problem was one of administration, not of visual standards or clinical competence.

Hysteria

The incidence of hysteria in eye cases was not marked. Lieutenant-Colonel Coverdale, through whose hands went all these cases in 2 NZEF, reported only 95 cases seen during the three-year period from March 1941. The total New Zealand troops during that time was 59,000. It was found that the cases were limited to susceptible individuals with an incapacitating loss of function. The incidence was highest during periods of stress, though the large majority of cases arose at Base shortly after arrival in the Middle East. After Greece and Crete there were 32 cases, 24 arising at the Base. At the second Libyan campaign period there were 17 cases, and after Minqar Qaim 13 cases. On the other hand, at the time of the advance from Alamein to Tunis only 6 cases were seen—only 1 of them from the Division, but 3 from recent arrivals in Egypt.

A high percentage of the cases had had some pre-existing ocular defect dating generally from childhood, many such cases being missed at the medical examinations of recruits in the early period of the war before the institution in New Zealand of mobile optician units. The main symptoms complained of in the series were:

Main Symptoms	Severe Cases (**50**)	Mild Cases (**45**)
Failing vision	32	36
Headache	12	14
Pain in or behind eye	9	8
Anxiety symptoms	4	7
Hemianopsia	5	
Signs—		
Amblyopia	48	44
Contracted fields of vision	43	39
Blepharospasm	14	7
Anxiety signs	7	
Defects of accommodation	2	2
Spasmodic squint	3	
Conjunctivitis (presumed self-inflicted)	3	

Of the 50 severe cases, 42 were invalided to New Zealand and 8 were graded for Base. The 45 mild cases were retained in their units. Of the 53 cases retained in the Middle East, 20 were subsequently sent back to New Zealand and 7 were graded for Base, while 3 were killed in action and 1 died of disease. At the end of the period 15 were still in the Middle East, while 12 had returned to New Zealand on furlough or for non-medical reasons.

Forty-two men judged to be hopeless cases of hysterical amblyopia were sent back to New Zealand, as their influence would have been unfavourable at all times and their presence even at Base a source of weakness and disquiet. It can be said that few of these were even Grade II at enlistment, but, in regrading them, it was anticipated that some would be able to give useful service at home. Post-war investigations have shown, however, that this view was optimistic. In March 1949 the medical files of 41 of these 42 men were examined and it was found that 37 had been pensioned for varying periods, 11, it seemed, permanently. Only 3 had had pensions refused and only 1 had made no application.

The problem of hysteria, therefore, was not a serious one, and with the elimination of susceptible men in New Zealand in the later years of the war few cases were seen.

Every grade of intensity of functional disorder, from trivial asthenopia to total uniocular blindness, was met with. The chief difficulty was in deciding what degree of incapacity was necessary to justify the serious yet only permissible diagnosis of hysteria.

This clinical embarrassment was appreciated by the DMS, who called a conference of some senior medical officers to contrive a solution, though it cannot be said that the problem was solved. The fact that when hysteria was diagnosed the man could not thereafter be convicted of malingering is sufficient to indicate that the difficulty was not mere pedantry.

The letters NYD (Not Yet Diagnosed) were allowed in our hospitals, but they often had the obvious disadvantage of being untrue. After having brought a long and exhausting investigation to a successful conclusion, to write NYD seemed unreasonable and destroyed the usefulness of the designation for cases where it was really required.

Infections

Of 8772 ophthalmic cases seen by Coverdale by the end of 1943, 2521 required treatment for infection of some kind. There were many isolated cases of acute muco-purulent conjunctivitis with hazy corneae, but no vision was lost in these from ulceration. There was never any suggestion of an epidemic in a unit or of contagion in the ward. No case of gonococcal ophthalmia was diagnosed. Whilst trachoma was prevalent amongst the Egyptians and troops of certain Allied nations, it was found in New Zealanders only in the Maori Battalion. Eleven Maoris were repatriated on this account, and of these it may be said that no more than two or three contracted the disease in Egypt.

The older men seemed less resistant to infection for it was found that, in 35 consecutive cases of pyogenic ulceration of the cornea, the average age was 32, probably well above the average age in 2 NZEF.

Blepharitis was troublesome in Egypt and, to make frequent attendance at the RAP unnecessary, men were provided with yellow oxide ointment in tube form purchased with Red Cross funds. In Italy superficial inflammations of this type were very much less common. Chronic conjunctivitis was frequently seen, and it was difficult to determine whether glare and dust were causative or merely aggravating factors.

In all lesions of the cornea repair was slow, especially in dendritic ulcers. Recurrent ulcers were common and it was necessary to keep the eyes covered for two weeks after healing.

Intra-ocular inflammation, apart from wounds and injuries, was not very common. About 60 cases were seen of active uveitis of one kind or another, about 10 of these being due to relapsing fever.

In some cases of intra-ocular infection from wounds in Northern Italy remarkable results were obtained by instilling penicillin drops every minute or two for periods of about an hour at a time.

Headache and Heterophoria

Headache was one of the commonest complaints for which men were referred to the ophthalmologist. Refractions were almost always done with the assistance of a retinoscopy under a mydriatic and the state of muscle balance was always investigated. From his experience with orthoptics Major Bruce Hamilton of the AIF contended with some reason that heterophoria could cause headache in the prevailing glare, but our very complete records made it possible to doubt the validity of this in all but a few instances. In a series of 2432 refractions it was found that the relative degrees of imbalance in 636 men complaining of headaches were almost the same as in 1796 who made no such complaint.

One effect of glare was to interfere to some extent with the suppression of an amblyopic eye and to cause transient confusion.

Battle Casualties

In North Africa men with ocular wounds were sent back as soon as possible to base hospital in Egypt, where they remained under continuity of observation and treatment until all inflammation had subsided and any risk of sympathetic inflammation had passed.

This ideal was not always practicable in Italy, where we had hospitals as it were in series from Naples to Helwan. It may be imperative for the forward one to move patients back quickly to keep beds empty for further convoys. Ophthalmic casualties could pass through several hospitals while their wounds were still in a dangerous state, and we learned from experience that a convoy by train or road or sea could be directed or diverted to a hospital where there was no ophthalmologist. There can be little doubt that once an ophthalmic casualty reaches a hospital where an equipped ophthalmologist is available it is better that he should not be transferred while any danger remains.

To give an idea of the relative proportions of different types of wounds the following analysis has been prepared of a series of 239 major battle casualties seen at 1 NZ General Hospital up to January 1945. The cases are of serious wounding and do not include functional or blast disturbances, subcutaneous foreign bodies, or head injuries not involving the orbit. In this connection it should be mentioned that, unless the precise type is stated, figures for ocular wounds can be misleading. Amongst the casualties admitted to hospital, Lieutenant-Colonel Coverdale's estimate of the proportion with ocular wounds is about 3 per cent with serious and 3 per cent with minor wounds, a fairly high percentage for the ophthalmologist when it is remembered that he is also called to see many men with subjective difficulties, but with no signs of injury.

The wounds were mostly due to shell, mortar, or mine fragments, and were often multiple and dirty with lacerations of the skin, lids, or conjunctiva.

numbers—	Middle East	Italy	Total
Right eye wounded	75	39	114
Left eye wounded	57	28	85
Both eyes wounded	22	18	40
	154	85	239

Men with other wounds elsewhere, 120.

analysis—	Middle East	Italy	Total
(1) Penetrating or perforating wounds of the globe of one or both eyes	67	30	97

(2) Penetrating or lacerating wounds of the lids or orbit—			
(a) With contusion of the globe and intra-ocular injury	44	19	63
(b) Without injury to globe	8	3	11
(3) Contusion of the globe without injury to the lids or orbit	11	6	17
(4) Superficial penetrating or lacerating wounds of the globe of one or both eyes	23	27	50
(5) Burns of the globe	1		1
	154	85	239

consequences:	Middle East	Italy	Total
Both eyes lost or blinded	7	0	7
One eye lost or blinded and the other seriously injured	5	2	7
Both eyes seriously injured	0	1	1
One eye lost or blinded	68	21	89
One eye seriously injured	20	21	41
Men with one or both eyes removed	49	16	65
Eyes removed	51	16	67
Men presumed on clinical grounds to have small retained intra-ocular foreign bodies after disposal	9	6	15

These figures cover patients treated at 1 General Hospital in Egypt and Italy up to and including January 1945, and are not complete for 2 NZEF although they probably include the great majority of cases.

Of 67 men with penetrating or perforating wounds of the globe in Egypt, 51 (76 per cent) eyes were removed—usually farther forward than the base hospital. Of 29 such cases in Italy, 16 (55 per cent) eyes were removed. The number of cases with one eye seriously injured (but not removed) was therefore proportionately higher in Italy. This may have been due, at least in part, to evacuation difficulties in the desert, but it is also evidence of the value of penicillin and albucid soluble which were not available to ophthalmologists before about April 1944. All those with contracted sockets after enucleation or evisceration in forward areas (10 in all) arrived at Helwan with fibrosis already established. The condition of the sockets was a salutary reminder that in ophthalmology there is no substitute for the day-to-day watchfulness and care of the ophthalmic surgeon. Many of these men were in transit for two weeks and the consequences could not have been avoided. A feature of interest present in about 30 per cent of wounds was the severity of the retinal and vitreous haemorrhages from foreign bodies which were either disproportionately small in size and extra-ocular, or which caused tangential or penetrating wounds of the brow or cheek not directly involving the orbit. This was commented on in the First World War, and was due, no doubt, to the velocity of the fragments.

Intra-ocular foreign bodies so frequently consisted of non-magnetic alloys, stone, or bakelite that the giant magnet was not often of value. Many eyes had retained foreign bodies of very small size, and these will need to be watched over long periods. In some situations, stone and bakelite may remain stable and cause no reaction. Time alone will show. (Six years after the war Coverdale had seen no late harmful effects.) The element of uncertainty was increased by the fact that no radiological method of exact localisation was available in the Middle East.

Problems of special importance were the penetrating injuries of the eye and the injuries to the cornea produced by small particles following mine explosions, and to a lesser extent explosions of shells and mortars. Ophthalmological specialists were attached to the CCS after the Alamein period and electro-magnets were available then, but not of sufficient power to be efficient in the majority of cases.

Minimal treatment was recommended in the forward areas before cases were seen by an ophthalmologist. Excision of the eye was restricted to completely disorganised eyes, the removal of which was necessitated by the general treatment of a face wound. A simple pad and bandage was then applied, no packing being inserted. In wounds of the globe, atropine was instilled, and if a penetrating wound was present a pad and bandage was applied, the lids being stitched together if damaged and the case evacuated lying.

At a forward ophthalmic unit the only treatment advised was that urgently necessary for the conservation of vision. Excision was carried out only for extensive rupture of one blind eye, this being done within ten days of injury. Excision of any prolapsed uvea or lens capsule was done, wounds of the sclera sutured, and wounds of the cornea covered by conjunctival flaps. Foreign bodies were removed only if easily extracted when the magnet was applied to an existing wound of the sclera, or when they could be brought forward from the anterior chamber for anterior extraction. Foreign bodies spattering the cornea were difficult to remove and were generally left alone unless causing irritation. General sulphonamide or penicillin treatment was instituted early in all perforating wounds of the eye and orbit. Corneal exposure was prevented, when necessary, by suturing the lids together. Moderate delay in the removal of foreign bodies did not prove harmful, so that patients could be evacuated to base for major operative procedure. At the Base useless eyes were removed when any danger of sympathetic ophthalmia arose. Foreign bodies were removed by the anterior or posterior route with the use of the magnet if possible. Forty per cent were magnetisable.

Sympathetic Ophthalmia

Sympathetic ophthalmia proved very uncommon, only one case being reported in the Middle East Forces in three years. No case of sympathetic ophthalmia was recorded in 2 NZEF. There were periods of anxiety, however, when cases with penetrating wounds of the globe were evacuated to the Base and any delay meant encroachment on the danger period. This was accentuated by the shortage of ophthalmologists in 2 NZEF. No ophthalmologist was attached to a New Zealand general hospital in Italy until 1 General Hospital went there five months after the force had landed. Cases during this period were referred back to Egypt, causing some danger of delay in treatment.

Equipment

The equipment of our hospital departments was left to the RAMC, which had drawn up a scale to be regarded as the irreducible minimum required. For an ophthalmic department this did not include a magnet, corneal microscope, or diathermy, but it was adequate provided that these larger instruments were available at some other hospital within easy reach.

As the Helwan hospital was one of the first to be established in Egypt, it was fortunate in obtaining an almost complete set of the standard ophthalmic equipment. Supplies soon became exhausted, and Captain Simpson's department at 2 NZ General Hospital on the Suez Canal and later at 3 NZ General Hospital at Bari, in Italy, was never equipped. It was not until Captain Trevor-Roper joined us at 2 NZ General Hospital at Caserta, near Naples, that we had two fully functioning ophthalmic departments.

As time went on and it became possible to buy instruments in England with Red Cross funds, a diathermy was obtained and later, in Italy, a corneal microscope and a supply of sodium sulphacetamide. Essential drugs such as atropine, homatropine, and argyrol were unobtainable only on rare occasions, and any shortage did not affect us as Coverdale had purchased in New Zealand and taken overseas a considerable quantity of atropine, homatropine, cocaine, and mercurochrome in crystal form. Penicillin became available for ophthalmic use in May 1944.

The supply of electricity is an essential supplement to ophthalmic equipment, and although we often lacked batteries for the torch and ophthalmoscope we were fortunate at Helwan in having an adequate supply of 220 volt alternating current. In Northern Italy, where enemy demolitions made us dependent on our own resources, the G1098 scale provided only one small engine of 3 or 4 kilowatts. We gradually accumulated several of these, which sufficed for lighting on a limited scale, and at the end of 1944 obtained a 16 kilowatt engine supplying 220 volt current.

Administration

The ophthalmic surgeon was on General Hospital establishment and was entitled to special nursing and clerical assistance only by courtesy of the Commanding Officer and Matron. The appointment of a trained ophthalmic nursing sister to look after cases in the ophthalmic ward was conceded when 1 NZ General Hospital replaced 2 NZ General Hospital at Helwan in August 1941, and then, no doubt, only with some sacrifice of administrative felicity. New Zealand hospitals were peculiar in that the establishment for nursing sisters made no provision and did not recognise the necessity for any specialisation. An excellent clerk was provided for the out-patient department at Helwan, but when No. 1 Hospital settled down among the sandhills of the Northern Adriatic, it was soon crowded beyond its establishment of beds and the ophthalmologist had to forgo this assistance.

These staffing difficulties were due to the inflexibility of a hospital's establishment, that useful refuge behind which administration could recoil in safety from an exasperated suppliant. If an ophthalmic unit with adequate trained personnel were attached to a hospital, it could move easily from one to another as need might arise and the nursing sister could do dressings in general surgical wards as well as in her own. It is noteworthy in this regard that over half the men with major ocular wounds had other wounds elsewhere, and they could not all, therefore, be segregated in one ward.

At the beginning of 1945 three nursing sisters were sent to Rome to take a special course in ophthalmic nursing organised by Lieutenant-Colonel B. W. Rycroft, RAMC.

While administration worked smoothly throughout the war, the need was felt in Egypt for a relieving ophthalmologist. The quantity of work was exhausting and so unremitting that it was seldom possible for the ophthalmologist to take any leave of absence.

Summary of Cases

Figures for Italy are not available, but some idea of the work done is provided in the following summary which includes cases seen at Helwan up to the end of December 1943. Although outpatient investigations were relatively fewer in Italy, the total for the hospital for both theatres of war would be well over 10,000.

It will be noted that nearly a third of the cases were from British or Allied units. Helwan was an Area Hospital and served the RAF Middle East Transit Camp and Signals School and the Base Depot of the Royal Corps of Signals, through all of which passed an ever-changing and unceasing stream of men. It was a pleasure to be able to reciprocate in this way:

numbers of cases up to 31 december1943—	
New Zealanders	6,800
RAF, BTE, and others	1,972
	8,772
numbers of men for whom spectacles were ordered—	
New Zealanders	2,090
RAF, BTE, and others	922
	3,012
Superficial infections of lids, conjunctiva, and cornea	2,521

For the purposes of this summary the varying and sometimes difficult distinction between a battle casualty and an accidental injury has been evaded.

Pacific Experience

In Fiji in 1941 and 1942 ophthalmic work was carried out under difficulties. Little suitable equipment was available, and there was at the time no civilian ophthalmologist practising in Suva, so that there was no one attached to the Memorial Hospital to whom cases might have been referred. The hospital did, however, lend Major L. S. Talbot a box of ophthalmic lenses and did all it could to help. It was fortunate that the period of occupation by the New Zealand forces did not include combat conditions, as it would have been difficult to give efficient ocular operative treatment for lack of surgical instruments. When the Tamavua military hospital was built in the middle of 1941 an adequate Eye and ENT examination room was provided in it, enabling refractions to be done quickly and conveniently, and the department was kept very busy as a number of civilians attended as out-patients.

Tropical eye conditions were very uncommon, as also proved to be the case in New Caledonia and the Solomon Islands. There was little trouble from heterophoria or from functional asthenopia. An idea that 'glare' in a tropical country would need to be counteracted by the wearing of tinted glasses was at first widespread among the troops. As a matter of fact glare was no more a problem in Fiji than in New Zealand. The country, at least on the Suva side, is green and the sky often cloudy, as would be expected with an annual rainfall of from 75 to 150 inches. The idea died out with persuasion and explanation. (In the Air Force special conditions are met with in which such lenses are necessary.) Little conjunctival infection occurred, and it responded well to the treatments available in the pre-penicillin era.

Though trachoma is endemic in Fiji among both Indians and Fijians, no cases of trachoma were found in New Zealand troops. It appeared that the good standard of personal cleanliness which obtained among the troops rendered infection unlikely, even when New Zealand and Fijian soldiers were training in fairly close contact.

Trachoma Scare in Fiji

In January 1945 an alarming message was received by the Director-General of Medical Services to the effect that 40 per cent of the New Zealanders serving with the Fiji Defence Force were suffering from an eye disease diagnosed as early trachoma by medical officers and the local ophthalmologist. Lieutenant-Colonel W. J. Hope-Robertson and Major L. S. Talbot, two ophthalmologists, were immediately sent to Fiji to investigate. Trachoma is thought to be a virus disease which can be spread where there is dirt, either personal or environmental. It is difficult to diagnose in its early stages. The ophthalmologists examined 102 New Zealanders and 13 other white servicemen, most of whom had previously been diagnosed as trachoma cases, but in no case did they find a trachomatous condition. A papillary hypertrophic condition only was seen in some. Of 30 Fijian servicemen examined there were only four with a slitlamp appearance of the cornea that suggested the existence of a previous pannus. There was no evidence of present or previous trachoma in 30 white residents of long standing.

The ophthalmologists were of the opinion that trachoma did exist among the native population of Fiji, but that white troops could continue to serve there without danger to their eyes if reasonable precautions against infection were taken. They recommended that an eye specialist be provided where troops were quartered in areas where there was endemic eye disease of a contagious or infectious nature. They made further recommendations regarding quartering and messing of white troops in these areas— facilities for personal cleanliness in the way of hot and cold water showers; cleanliness of clothing, with towels and handkerchiefs washed in boiling water; cooking of food for Europeans by Europeans; native servants to be employed as sparingly as practicable, and only after a careful medical examination; and the desirability of white and native troops not messing together, unless for military reasons it could not be avoided.

Recommendations for the Future

For a regular army in peacetime standards are usually raised, but for any scheme of national service or for mobilisation in war about 90 per cent of eligible men will be obviously Grade I on visual standards, about 10 per cent will need to be referred for specialist opinion, about 5 per cent will need glasses, and there will be a very small number visually unfit for any service. These rejects will amount to one or two per cent of the whole. If, however, recruits are tested for, say, colour vision and those with a defect are downgraded, some thousands of men in New Zealand will be needlessly wasted. If the results are not used to grade the men it is better that the tests should not be made. It should also be realised that to order spectacles for a man is tantamount to excluding him from service with the infantry or armoured regiments, and must not be done without very good reason.

In order to make the best use of available manpower a recruit who is not obviously Grade I should be seen by an ophthalmic surgeon for a medical estimation of his capacity. It is always unwise to grade a man only to have to grade him up again should manpower conditions change.

The minimum requirements for a division overseas are two ophthalmic surgeons, one for the ophthalmic wing at the base hospital and equipped with such heavy instruments as a giant magnet, corneal microscope and diathermy, and the other with lighter equipment for attachment to the CCS when required. In addition, there should be a mobile opticians' unit. It is important that the ophthalmic surgeons should be constitutionally fit as they are not dispensable. At the base hospital the ophthalmic surgeon requires the assistance of a trained ophthalmic nursing sister and a clerk of lance-corporal rank. For the more mobile surgeon an orderly is sufficient. These officers and other ranks should not be on a hospital's establishment. If the Force should be widely dispersed an extra ophthalmologist with assistants would be required.

The necessary equipment, which must include a generous supply of essential drugs and engines capable of generating electricity of voltage suitable for the instruments, should be accumulated in peacetime so that the units may sail prepared to function efficiently and at once wherever they may be sent.

diseases of the eye— 2 NZEF, MEF and CMF

	Admissions to Hospital, July 1941-December 1945	Invalided to New Zealand, 1940–45
Conjunctivitis	363	21
Defective vision	117	4
Keratitis	171	22
Blepharitis	79	3

Pterygium	56	3
Iritis	23	9
Choroiditis	23	20
Amblyopia	19	17
Myopia	21	9
Astigmatism	14	3
Strabismus	10	2
Cataract	9	15
Trachoma		22
Other	232	69 (Includes some injuries)
	1137	219

Appendix I

VISUAL GRADING IN NEW ZEALAND

A statistical survey of visual gradings and eye conditions was made by the Institute of Opticians in August 1941, and it covered 2579 recruits from the group of single men aged 21 to 40 years who were examined at six North Island centres. The visual grading were found to be: Grade I, 2324 (90.11 per cent); Grade II, 161 (6.24 per cent); Grade III, 81; Grade IV, 1, and referred cases, 12; a total of 94 (3.65 per cent) lower than Grade II.

Of those in Grade I 220, or 9.47 per cent, were referred for further examination in camp for the possible supply of glasses. It was estimated that 6–7 per cent of this Grade I group would require glasses to be visually efficient. In Grade II 119, or 73.9 per cent, required glasses, having high visual and refractive errors.

The reasons for Grade III grouping were: Myopia (—2.50 to —16.00 dioptres), 66 cases; high hyperopia, astigmatism, amblyopia, 9 cases; myopia with strabismus, 2; cataract, 2; recent eye operation, 1; optic atrophy, 1. The Grade IV case had congenital subluxation of the crystalline lenses. The referred cases had suspected active pathology.

Colour vision statistics were: Normal, 2366 (91.74 per cent); defective but safe, 91 (3.53 per cent); defective unsafe, 122 (4.73 per cent).

The opticians observed that relatively few more men would be obtained by lowering the standard of Grade I men. They pointed out that no attention was given to the loss of vision being in the right eye. They also stressed the danger of accepting as Grade III one-eyed men or high myopes because of the possibility of complete or serious loss of vision in these cases. They recommended only slight modification in the standards with regard especially to the elimination of the one-eye cases and high myopes. They suggested the subdivision into three categories.

It is noted that 66 of 81 cases graded III were myopes with a range of —2.50 to —16.00 dioptres. In the opinion of some ophthalmologists the majority of these cases are fit to serve overseas. Brigadier Sir William Duke-Elder, British Army Consultant, stated that myopes up to 6 and 7 dioptres were accepted by the British Army for service overseas. Lieutenant-Colonel Hope-Robertson, ophthalmic consultant to the forces in New Zealand, considered that a large number of physically fit myopes were unnecessarily debarred from overseas service.

Appendix II
EYE DISORDERS

Extract from analysis of Causes of Rejection in 42,022 men rejected from 105,311 men aged 18 to 45 years, who were examined for military service during 1942 and 1943. (Prepared by National Service Department, 14 December 1943.)

Percentage of Eye Disorders Causing Rejection In Men Examined

Central Age of Group	Number in Group Examined	Percentage other than Grade I	Defective Vision	Blindness One or Both Eyes	Other Eye Disorders	Total Eye Disorders
19 yrs (single)	10,855	22.1	3.98	0.28	0.25	4.51
28 yrs (married)	22,585	28.3	3.43	0.39	0.25	4.07
33 yrs (married)	28,239	35.2	3.41	0.42	0.32	4.15
42 yrs (married)	43,632	53.4	4.35	0.50	0.34	5.19

Disabilities Of The Eyes In Ex-service Personnel Recorded With War Pensions

Department At 31 March 1947	
Diseases of the eyes	1061
Wounds, GSW	207
Wounds, accidental	193
Errors of refraction only	957
	2418

Eye Cases Invalided To New Zealand From 2 NZEF	
battle casualties–	
Enucleation eye	120
Enucleation both eyes	1
Penetration of eye	22
Penetration of eye with blindness	10
Penetration of eye retained FB	9
Penetration of both eyes	6
Penetration of both eyes with blindness	3
Perforation both eyes	2
Injury cornea both eyes	6
Injury cornea and contusion	2
Contusion	15
Contusion with blindness	4
Contusion with retained FB	1
Contusion with haemorrhage	2
Contusion with perforation	5
Choroido-retinitis	1
Burns both cornea	1
Injury cornea and cataract	1
FB cornea and partial loss sight	1
DISEASES—	
Conjunctivitis	21
Defective vision	4
Keratitis	22
Blepharitis	3
Pterygium	3
Iritis	9

Choroiditis	20
Amblyopia	17
Myopia	9
Astigmatsm	3
Strabismus	2
Cataract	15
Trachoma	22
Other	69
	—
	219
accidental injuries—	
Enucleation	6
Penetration	2
Penetration and cataract	2
Penetration and loss vision	2
Penetration and retained FB	1
Contusion	2
Optic atrophy	2
Blind eye (PW)	1
Detached retina	1
Corneal Leucoma	1
Macular choroiditis	1
OLD CASES—	
Loss vision	1
Defective vision	1
Perforation	1
Detached retina	1
Choroido-retinitis	1
Vitreous opacities	1

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WAR SURGERY AND MEDICINE

[SECTION]

IN 2 NZEF the most striking feature of ophthalmology was its quantity, and it seemed that men tended to be more intolerant of small disabilities than they were in the First World War. Lieutenant-Colonel Barrett, writing of the work of 1 Australian General Hospital at Heliopolis during the Gallipoli campaign, a hospital of about 2700 beds, described its ophthalmic clinic as 'enormous'. During the eight months of its existence 1142 cases were seen. In the eight months preceding the offensive at El Alamein, 2380 new ophthalmic cases were seen at 1 NZ General Hospital at Helwan.

There were four main reasons for the volume of work. Firstly, the medical boarding of recruits in New Zealand was uneven and a number of unfit men were sent abroad. Secondly, service glasses were not available in New Zealand until after the 4th Reinforcements had sailed, and the 5th, 6th, and 7th Reinforcements were equipped with them only in part. Thirdly, ophthalmic work was concentrated at the Helwan hospital, an area hospital serving not only New Zealand base but also many thousands of RAF and British troops. Lastly, owing to the discomfort from glare and the presence of so much ocular disease and blindness amongst the natives, many men were unreasonably apprehensive about their sight. Among the more imaginative soldiers, especially those with any reason to be aware of ocular weakness, the presence of so many partially blind and disfigured natives was attributed to the climatic conditions. From the beginning, therefore, and in spite of the pressure of work, a determined effort was made by explanation and reassurance to give the men some confidence. This time was undoubtedly well spent. Discomfort from glare in Egypt can be considerable, and this, together with prevalent mild conjunctivitis, tended to unmask errors of refraction previously tolerated and make men more dependent on glasses for carrying out their duties with comfort and efficiency.

The supply of spectacles in Egypt was inadequate until late in 1942. When Major Doctor arrived in November 1940 he began to refract for service frames all those of the first three echelons who were wearing spectacles. This laborious task was just completed when Major (later Lieutenant-Colonel) Coverdale succeeded him at

Helwan, but the shortage at that time was so acute that only fifteen pair were being dispensed for the hospital by the army contractor each month. There was a long and rapidly increasing waiting list of about 270 New Zealand prescriptions, and men had to wait two to four months even when their need was urgent. It was not until 1943 that, owing to the work of the Opticians' Units in New Zealand, drafts arrived in the Middle East well investigated and equipped and with almost all optically unfit men withdrawn. This ultimate relief for the ophthalmologist abroad, however welcome, was achieved by a very high rejection rate in New Zealand, and there is no doubt that the whole question of standards would repay careful study.

In June 1944 the 14th Mobile Optician Unit, extremely well equipped and under the command of Lieutenant F. O. Davis, arrived in Italy. Its inception was attended by some misfortunes and it was not able to give a complete service until late in the year. Thereafter it proved to be a valuable acquisition.

Many hundreds of men complained of the light, but no corneal changes were visible with the loupe and it was probable that the great majority suffered, not from actinic burns, but from the intensity of the visible rays. The experience of three summers enabled Coverdale to classify most of these men into three groups: (1) those whose eyes were hypersensitive because of superficial inflammations of the lids or conjunctiva, often of a very mild sort; (2) those whose ocular muscles were in a state of irritable tension from uncorrected errors of refraction; (3) those whose nervous systems in general and eyes in particular were intolerant of stimuli because of functional instability.

Men were never discouraged from attending hospital as outpatients, and when subjective disability was out of all proportion to objective findings much time and energy had to be spent in clearing the miasma of minor psychoneurosis from discoverable fact; but Major Coverdale was satisfied that, if it occurred at all, wilful simulation of incapacity was exceedingly rare amongst New Zealand and British troops. Psychoneurosis was fairly common in 1941, much less so in 1942, and thereafter almost ceased to occur. This improvement was ascribed, at least in part, to better boarding in New Zealand. It was found that amongst 95 cases of hysterical amblyopia there were 44 with eyes defective at enlistment from squint, old injury, chronic disease or developmental defects, and 9 with histories of pre-enlistment head or eye injuries, but with no signs remaining. Most of the affected men paraded sick soon after arrival in Egypt, and very few indeed were sent back from forward units in the field. Apart from a few hysterics and some cases with pathological changes, night-blindness was not heard of in 2 NZEF.

MEDICAL BOARDING OVERSEAS

Medical Boarding Overseas

The general principle of regarding boarding as a medical assessment rather than a mechanical procedure was always adhered to, and every possible effort was made to keep men with their units in the field. The number of graded men that a Division can profitably employ is not large, and those relegated to Base and not fully engaged in useful work tended to deteriorate rapidly in morale. In spite of this conservative policy, about 200 men had to be boarded for defects present at enlistment. The visual acuity of some of these was, no doubt, Grade I in New Zealand, but other factors, especially temperamental instability, were not assessed or assessable, and the men proved to be of little use in the Middle East. One consequence of the lack of precise investigation at some centres in New Zealand was that many men were credited with much better visual acuity than they did in fact possess. Men, for instance, who had been blind in one eye for years or since birth had had their visual acuity recorded as 6/6 in each eye. Such examinations had their pensions complications. It is a matter of interest that, until late in 1940, men with squint could not be Grade I for service abroad. From experience in North Africa it was evident that, for psychological reasons, this regulation was wise.

In reboarding for defects of vision it was found to be impossible to adhere strictly to the standards of vision laid down for recruits. A man, for example, with two dioptres of myopia can seldom see 6/60 without glasses unless he peers, and yet a trained soldier with normal corrected vision, eager to serve and brought to the Middle East at great expense, cannot lightly be discarded. Major Coverdale decided, therefore, to regrade only those with high degrees of myopia of six or more dioptres, or those with degenerative changes. The number of myopes investigated who were not technically Grade I was, by August 1941, over 300, but for the whole of the North African campaign only about 20 were regraded. Nothing occurred to cause the wisdom of this decision to be questioned.

A small minority of men gave valuable service for long periods in spite of great visual handicaps. A private of 21 Battalion, for example, who made no complaint was sent to the out-patients department because he drove dangerously. One eye was blind and the other, although having 6/9 vision, had been damaged five years previously and showed an irido-dialysis, some posterior cortical cataract, and a rupture of the choroid. A private in the Maori Battalion fought through all the Middle East campaigns with one eye blind and the vision in the other reduced to 6/18 from old trachomatous keratitis. Another man, a lance-corporal in 23 Battalion, had one blind eye and the vision in the other with a - 4D cylinder reduced to 6/60 on looking to the front. He had a considerable degree of nystagmus and could see 6/18 if he looked across his nose. He served in Greece, Crete, Libya, and at El Alamein up to August 1942.

STANDARDS OF VISION

Standards of Vision

It was found that men with old abnormalities had such a tendency to hysteria or minor psychoneurosis that, even if the vision should be Grade I, they should not be sent abroad. The following are examples of such abnormalities compatible with Grade I vision:

(a) Strabismus.
(b) Old perforating injury.
(c) Congenital nystagmus.

Conditions in the Middle East were admittedly unfavourable for men with ocular defects of this type.

Men with high degrees of refractive error or with amblyopia were found to be unsuitable in the infantry, and this raised the question of what might be called unit grading. It was undesirable to have more Grade II men than Base could profitably use, and, in an effort to avoid grading down borderline cases in the infantry, some attempts were made in 1941 to have them transferred to other units. These attempts did not meet with any substantial success as it was ruled, quite correctly, that if a man is not Grade I for one unit he cannot be Grade I for any other unit. Yet an infantryman requires better vision than a man in the Field Ambulances or the Engineers.

Another type of differential grading which received some consideration overseas was known as category classification. Immediately after the campaign in Greece, and as a result of the reported reluctance of the Germans to engage at night, some unit commanders were asked if they thought anything would be gained by selecting men with exceptional night vision. It was pointed out that normal men vary considerably in this respect, but that it might not be prudent to make them conscious of the fact. The unit commanders replied that they must be able to use any of their men for any purpose at any time.

This question of dividing up Grade I men for special tasks within units was later discussed in New Zealand, though not in connection with night vision. It was evident that, while differential grading between units might have some value, category classification was undesirable.

MEDICAL BOARDS

Medical Boards

During the North African campaign 306 men, excluding battle casualties, were graded down in the ophthalmic department at Helwan, and it can be said that about 200 of these were regraded for conditions present at enlistment. It is worth while summarising the reasons for so many time-consuming medical boards.

	To NZ	To Base	Total
Chronic or recurring superficial infections, including keratitis	41	9	50
Hysteria-			
(1) Without ocular pathology	14	1	
(2) With old pathological complications	18	7	
(3) With amblyopia ex anopsia	9	1	50
Uveitis	30	14	44
Amblyopia ex anopsia	2	39	41
Errors of refraction	15	12	27
Old perforation of the globe	12	7	19
Accidental injury	10	5	15
Cataract	11	3	14
Vitreous opacities	10	4	14
Miscellaneous pathology	10	3	13
Nystagmus	6	1	7
Detachment of retina	6		6
Retrobulbar affections	4	2	6
	198	108	306

It has been noted that conditions in North Africa were trying for men with visual defects and led to a high attendance rate at the ophthalmic department. Yet, in spite of this and of the somewhat haphazard testing in New Zealand, the analysis of medical boards at Helwan discloses that only 27 men were regraded for errors of refraction and none for errors of muscle balance. Nothing occurred to suggest that by the use of various refinements in testing a more efficient army could have been selected.

As time went on there was a tendency to elaborate the visual testing of recruits, due possibly to some dissatisfaction with the results obtained up to 1943. But the early defects were not so much due to weaknesses in the prescribed standards as to excessive decentralisation of the work, and it is probable that the grading of men from a purely medical point of view showed at least an equivalent margin of error. The problem was one of administration, not of visual standards or clinical competence.

HYSTERIA

Hysteria

The incidence of hysteria in eye cases was not marked. Lieutenant-Colonel Coverdale, through whose hands went all these cases in 2 NZEF, reported only 95 cases seen during the three-year period from March 1941. The total New Zealand troops during that time was 59,000. It was found that the cases were limited to susceptible individuals with an incapacitating loss of function. The incidence was highest during periods of stress, though the large majority of cases arose at Base shortly after arrival in the Middle East. After Greece and Crete there were 32 cases, 24 arising at the Base. At the second Libyan campaign period there were 17 cases, and after Minqar Qaim 13 cases. On the other hand, at the time of the advance from Alamein to Tunis only 6 cases were seen—only 1 of them from the Division, but 3 from recent arrivals in Egypt.

A high percentage of the cases had had some pre-existing ocular defect dating generally from childhood, many such cases being missed at the medical examinations of recruits in the early period of the war before the institution in New Zealand of mobile optician units. The main symptoms complained of in the series were:

Main Symptoms	Severe Cases (**50**)	Mild Cases (**45**)
Failing vision	32	36
Headache	12	14
Pain in or behind eye	9	8
Anxiety symptoms	4	7
Hemianopsia	5	
Signs—		
Amblyopia	48	44
Contracted fields of vision	43	39
Blepharospasm	14	7
Anxiety signs	7	
Defects of accommodation	2	2

Spasmodic squint	3
Conjunctivitis (presumed self-inflicted)	3

Of the 50 severe cases, 42 were invalided to New Zealand and 8 were graded for Base. The 45 mild cases were retained in their units. Of the 53 cases retained in the Middle East, 20 were subsequently sent back to New Zealand and 7 were graded for Base, while 3 were killed in action and 1 died of disease. At the end of the period 15 were still in the Middle East, while 12 had returned to New Zealand on furlough or for non-medical reasons.

Forty-two men judged to be hopeless cases of hysterical amblyopia were sent back to New Zealand, as their influence would have been unfavourable at all times and their presence even at Base a source of weakness and disquiet. It can be said that few of these were even Grade II at enlistment, but, in regrading them, it was anticipated that some would be able to give useful service at home. Post-war investigations have shown, however, that this view was optimistic. In March 1949 the medical files of 41 of these 42 men were examined and it was found that 37 had been pensioned for varying periods, 11, it seemed, permanently. Only 3 had had pensions refused and only 1 had made no application.

The problem of hysteria, therefore, was not a serious one, and with the elimination of susceptible men in New Zealand in the later years of the war few cases were seen.

Every grade of intensity of functional disorder, from trivial asthenopia to total uniocular blindness, was met with. The chief difficulty was in deciding what degree of incapacity was necessary to justify the serious yet only permissible diagnosis of hysteria.

This clinical embarrassment was appreciated by the DMS, who called a conference of some senior medical officers to contrive a solution, though it cannot be said that the problem was solved. The fact that when hysteria was diagnosed the man could not thereafter be convicted of malingering is sufficient to indicate that the difficulty was not mere pedantry.

The letters NYD (Not Yet Diagnosed) were allowed in our hospitals, but they often had the obvious disadvantage of being untrue. After having brought a long and exhausting investigation to a successful conclusion, to write NYD seemed unreasonable and destroyed the usefulness of the designation for cases where it was really required.

INFECTIONS

Infections

Of 8772 ophthalmic cases seen by Coverdale by the end of 1943, 2521 required treatment for infection of some kind. There were many isolated cases of acute muco-purulent conjunctivitis with hazy corneae, but no vision was lost in these from ulceration. There was never any suggestion of an epidemic in a unit or of contagion in the ward. No case of gonococcal ophthalmia was diagnosed. Whilst trachoma was prevalent amongst the Egyptians and troops of certain Allied nations, it was found in New Zealanders only in the Maori Battalion. Eleven Maoris were repatriated on this account, and of these it may be said that no more than two or three contracted the disease in Egypt.

The older men seemed less resistant to infection for it was found that, in 35 consecutive cases of pyogenic ulceration of the cornea, the average age was 32, probably well above the average age in 2 NZEF.

Blepharitis was troublesome in Egypt and, to make frequent attendance at the RAP unnecessary, men were provided with yellow oxide ointment in tube form purchased with Red Cross funds. In Italy superficial inflammations of this type were very much less common. Chronic conjunctivitis was frequently seen, and it was difficult to determine whether glare and dust were causative or merely aggravating factors.

In all lesions of the cornea repair was slow, especially in dendritic ulcers. Recurrent ulcers were common and it was necessary to keep the eyes covered for two weeks after healing.

Intra-ocular inflammation, apart from wounds and injuries, was not very common. About 60 cases were seen of active uveitis of one kind or another, about 10 of these being due to relapsing fever.

In some cases of intra-ocular infection from wounds in Northern Italy remarkable results were obtained by instilling penicillin drops every minute or two for periods of about an hour at a time.

HEADACHE AND HETEROPHORIA

Headache and Heterophoria

Headache was one of the commonest complaints for which men were referred to the ophthalmologist. Refractions were almost always done with the assistance of a retinoscopy under a mydriatic and the state of muscle balance was always investigated. From his experience with orthoptics Major Bruce Hamilton of the AIF contended with some reason that heterophoria could cause headache in the prevailing glare, but our very complete records made it possible to doubt the validity of this in all but a few instances. In a series of 2432 refractions it was found that the relative degrees of imbalance in 636 men complaining of headaches were almost the same as in 1796 who made no such complaint.

One effect of glare was to interfere to some extent with the suppression of an amblyopic eye and to cause transient confusion.

BATTLE CASUALTIES

Battle Casualties

In North Africa men with ocular wounds were sent back as soon as possible to base hospital in Egypt, where they remained under continuity of observation and treatment until all inflammation had subsided and any risk of sympathetic inflammation had passed.

This ideal was not always practicable in Italy, where we had hospitals as it were in series from Naples to Helwan. It may be imperative for the forward one to move patients back quickly to keep beds empty for further convoys. Ophthalmic casualties could pass through several hospitals while their wounds were still in a dangerous state, and we learned from experience that a convoy by train or road or sea could be directed or diverted to a hospital where there was no ophthalmologist. There can be little doubt that once an ophthalmic casualty reaches a hospital where an equipped ophthalmologist is available it is better that he should not be transferred while any danger remains.

To give an idea of the relative proportions of different types of wounds the following analysis has been prepared of a series of 239 major battle casualties seen at 1 NZ General Hospital up to January 1945. The cases are of serious wounding and do not include functional or blast disturbances, subcutaneous foreign bodies, or head injuries not involving the orbit. In this connection it should be mentioned that, unless the precise type is stated, figures for ocular wounds can be misleading. Amongst the casualties admitted to hospital, Lieutenant-Colonel Coverdale's estimate of the proportion with ocular wounds is about 3 per cent with serious and 3 per cent with minor wounds, a fairly high percentage for the ophthalmologist when it is remembered that he is also called to see many men with subjective difficulties, but with no signs of injury.

The wounds were mostly due to shell, mortar, or mine fragments, and were often multiple and dirty with lacerations of the skin, lids, or conjunctiva.

numbers—	Middle East	Italy	Total
Right eye wounded	75	39	114
Left eye wounded	57	28	85
Both eyes wounded	22	18	40
	154	85	239

Men with other wounds elsewhere, 120.

analysis—	Middle East	Italy	Total
(1) Penetrating or perforating wounds of the globe of one or both eyes	67	30	97
(2) Penetrating or lacerating wounds of the lids or orbit—			
(a) With contusion of the globe and intra-ocular injury	44	19	63
(b) Without injury to globe	8	3	11
(3) Contusion of the globe without injury to the lids or orbit	11	6	17
(4) Superficial penetrating or lacerating wounds of the globe of one or both eyes	23	27	50
(5) Burns of the globe	1		1
	154	85	239

consequences:	Middle East	Italy	Total
Both eyes lost or blinded	7	0	7
One eye lost or blinded and the other seriously injured	5	2	7
Both eyes seriously injured	0	1	1
One eye lost or blinded	68	21	89
One eye seriously injured	20	21	41
Men with one or both eyes removed	49	16	65
Eyes removed	51	16	67
Men presumed on clinical grounds to have small retained intra-ocular foreign bodies after disposal	9	6	15

These figures cover patients treated at 1 General Hospital in Egypt and Italy up to and including January 1945, and are not complete for 2 NZEF although they probably include the great majority of cases.

Of 67 men with penetrating or perforating wounds of the globe in Egypt, 51 (76 per cent) eyes were removed—usually farther forward than the base hospital. Of 29 such cases in Italy, 16 (55 per cent) eyes were removed. The number of cases with one eye seriously injured (but not removed) was therefore proportionately higher in Italy. This may have been due, at least in part, to evacuation difficulties in the desert, but it is also evidence of the value of penicillin and albucid soluble which were not available to ophthalmologists before about April 1944. All those with contracted sockets after enucleation or evisceration in forward areas (10 in all) arrived at Helwan with fibrosis already established. The condition of the sockets was a salutary reminder that in ophthalmology there is no substitute for the day-to-day watchfulness and care of the ophthalmic surgeon. Many of these men were in transit for two weeks and the consequences could not have been avoided. A feature of interest present in about 30 per cent of wounds was the severity of the retinal and vitreous haemorrhages from foreign bodies which were either disproportionately small in size and extra-ocular, or which caused tangential or penetrating wounds of the brow or cheek not directly involving the orbit. This was commented on in the First World War, and was due, no doubt, to the velocity of the fragments.

Intra-ocular foreign bodies so frequently consisted of non-magnetic alloys, stone, or bakelite that the giant magnet was not often of value. Many eyes had retained foreign bodies of very small size, and these will need to be watched over long periods. In some situations, stone and bakelite may remain stable and cause no reaction. Time alone will show. (Six years after the war Coverdale had seen no late harmful effects.) The element of uncertainty was increased by the fact that no radiological method of exact localisation was available in the Middle East.

Problems of special importance were the penetrating injuries of the eye and the injuries to the cornea produced by small particles following mine explosions, and to a lesser extent explosions of shells and mortars. Ophthalmological specialists were attached to the CCS after the Alamein period and electro-magnets were available then, but not of sufficient power to be efficient in the majority of cases.

Minimal treatment was recommended in the forward areas before cases were seen by an ophthalmologist. Excision of the eye was restricted to completely disorganised eyes, the removal of which was necessitated by the general treatment of a face wound. A simple pad and bandage was then applied, no packing being inserted. In wounds of the globe, atropine was instilled, and if a penetrating wound was present a pad and bandage was applied, the lids being stitched together if damaged and the case evacuated lying.

At a forward ophthalmic unit the only treatment advised was that urgently necessary for the conservation of vision. Excision was carried out only for extensive rupture of one blind eye, this being done within ten days of injury. Excision of any prolapsed uvea or lens capsule was done, wounds of the sclera sutured, and wounds of the cornea covered by conjunctival flaps. Foreign bodies were removed only if easily extracted when the magnet was applied to an existing wound of the sclera, or when they could be brought forward from the anterior chamber for anterior extraction. Foreign bodies spattering the cornea were difficult to remove and were generally left alone unless causing irritation. General sulphonamide or penicillin treatment was instituted early in all perforating wounds of the eye and orbit. Corneal exposure was prevented, when necessary, by suturing the lids together. Moderate delay in the removal of foreign bodies did not prove harmful, so that patients could be evacuated to base for major operative procedure. At the Base useless eyes were removed when any danger of sympathetic ophthalmia arose. Foreign bodies were removed by the anterior or posterior route with the use of the magnet if possible. Forty per cent were magnetisable.

Sympathetic Ophthalmia

Sympathetic ophthalmia proved very uncommon, only one case being reported in the Middle East Forces in three years. No case of sympathetic ophthalmia was recorded in 2 NZEF. There were periods of anxiety, however, when cases with penetrating wounds of the globe were evacuated to the Base and any delay meant encroachment on the danger period. This was accentuated by the shortage of ophthalmologists in 2 NZEF. No ophthalmologist was attached to a New Zealand general hospital in Italy until 1 General Hospital went there five months after the force had landed. Cases during this period were referred back to Egypt, causing some danger of delay in treatment.

EQUIPMENT

Equipment

The equipment of our hospital departments was left to the RAMC, which had drawn up a scale to be regarded as the irreducible minimum required. For an ophthalmic department this did not include a magnet, corneal microscope, or diathermy, but it was adequate provided that these larger instruments were available at some other hospital within easy reach.

As the Helwan hospital was one of the first to be established in Egypt, it was fortunate in obtaining an almost complete set of the standard ophthalmic equipment. Supplies soon became exhausted, and Captain Simpson's department at 2 NZ General Hospital on the Suez Canal and later at 3 NZ General Hospital at Bari, in Italy, was never equipped. It was not until Captain Trevor-Roper joined us at 2 NZ General Hospital at Caserta, near Naples, that we had two fully functioning ophthalmic departments.

As time went on and it became possible to buy instruments in England with Red Cross funds, a diathermy was obtained and later, in Italy, a corneal microscope and a supply of sodium sulphacetamide. Essential drugs such as atropine, homatropine, and argyrol were unobtainable only on rare occasions, and any shortage did not affect us as Coverdale had purchased in New Zealand and taken overseas a considerable quantity of atropine, homatropine, cocaine, and mercurochrome in crystal form. Penicillin became available for ophthalmic use in May 1944.

The supply of electricity is an essential supplement to ophthalmic equipment, and although we often lacked batteries for the torch and ophthalmoscope we were fortunate at Helwan in having an adequate supply of 220 volt alternating current. In Northern Italy, where enemy demolitions made us dependent on our own resources, the G1098 scale provided only one small engine of 3 or 4 kilowatts. We gradually accumulated several of these, which sufficed for lighting on a limited scale, and at the end of 1944 obtained a 16 kilowatt engine supplying 220 volt current.

Administration

The ophthalmic surgeon was on General Hospital establishment and was entitled to special nursing and clerical assistance only by courtesy of the Commanding Officer and Matron. The appointment of a trained ophthalmic nursing sister to look after cases in the ophthalmic ward was conceded when 1 NZ General Hospital replaced 2 NZ General Hospital at Helwan in August 1941, and then, no doubt, only with some sacrifice of administrative felicity. New Zealand hospitals were peculiar in that the establishment for nursing sisters made no provision and did not recognise the necessity for any specialisation. An excellent clerk was provided for the out-patient department at Helwan, but when No. 1 Hospital settled down among the sandhills of the Northern Adriatic, it was soon crowded beyond its establishment of beds and the ophthalmologist had to forgo this assistance.

These staffing difficulties were due to the inflexibility of a hospital's establishment, that useful refuge behind which administration could recoil in safety from an exasperated suppliant. If an ophthalmic unit with adequate trained personnel were attached to a hospital, it could move easily from one to another as need might arise and the nursing sister could do dressings in general surgical wards as well as in her own. It is noteworthy in this regard that over half the men with major ocular wounds had other wounds elsewhere, and they could not all, therefore, be segregated in one ward.

At the beginning of 1945 three nursing sisters were sent to Rome to take a special course in ophthalmic nursing organised by Lieutenant-Colonel B. W. Rycroft, RAMC.

While administration worked smoothly throughout the war, the need was felt in Egypt for a relieving ophthalmologist. The quantity of work was exhausting and so unremitting that it was seldom possible for the ophthalmologist to take any leave of absence.

SUMMARY OF CASES

Summary of Cases

Figures for Italy are not available, but some idea of the work done is provided in the following summary which includes cases seen at Helwan up to the end of December 1943. Although outpatient investigations were relatively fewer in Italy, the total for the hospital for both theatres of war would be well over 10,000.

It will be noted that nearly a third of the cases were from British or Allied units. Helwan was an Area Hospital and served the RAF Middle East Transit Camp and Signals School and the Base Depot of the Royal Corps of Signals, through all of which passed an ever-changing and unceasing stream of men. It was a pleasure to be able to reciprocate in this way:

numbers of cases up to 31 december1943—	
New Zealanders	6,800
RAF, BTE, and others	1,972
	——
	8,772
numbers of men for whom spectacles were ordered—	
New Zealanders	2,090
RAF, BTE, and others	922
	——
	3,012
Superficial infections of lids, conjunctiva, and cornea	2,521
Major battle casualties and accidental injuries	618

For the purposes of this summary the varying and sometimes difficult distinction between a battle casualty and an accidental injury has been evaded.

PACIFIC EXPERIENCE

Pacific Experience

In Fiji in 1941 and 1942 ophthalmic work was carried out under difficulties. Little suitable equipment was available, and there was at the time no civilian ophthalmologist practising in Suva, so that there was no one attached to the Memorial Hospital to whom cases might have been referred. The hospital did, however, lend Major L. S. Talbot a box of ophthalmic lenses and did all it could to help. It was fortunate that the period of occupation by the New Zealand forces did not include combat conditions, as it would have been difficult to give efficient ocular operative treatment for lack of surgical instruments. When the Tamavua military hospital was built in the middle of 1941 an adequate Eye and ENT examination room was provided in it, enabling refractions to be done quickly and conveniently, and the department was kept very busy as a number of civilians attended as out-patients.

Tropical eye conditions were very uncommon, as also proved to be the case in New Caledonia and the Solomon Islands. There was little trouble from heterophoria or from functional asthenopia. An idea that 'glare' in a tropical country would need to be counteracted by the wearing of tinted glasses was at first widespread among the troops. As a matter of fact glare was no more a problem in Fiji than in New Zealand. The country, at least on the Suva side, is green and the sky often cloudy, as would be expected with an annual rainfall of from 75 to 150 inches. The idea died out with persuasion and explanation. (In the Air Force special conditions are met with in which such lenses are necessary.) Little conjunctival infection occurred, and it responded well to the treatments available in the pre-penicillin era.

Though trachoma is endemic in Fiji among both Indians and Fijians, no cases of trachoma were found in New Zealand troops. It appeared that the good standard of personal cleanliness which obtained among the troops rendered infection unlikely, even when New Zealand and Fijian soldiers were training in fairly close contact.

Trachoma Scare in Fiji

In January 1945 an alarming message was received by the Director-General of Medical Services to the effect that 40 per cent of the New Zealanders serving with the Fiji Defence Force were suffering from an eye disease diagnosed as early trachoma by medical officers and the local ophthalmologist. Lieutenant-Colonel W. J. Hope-Robertson and Major L. S. Talbot, two ophthalmologists, were immediately sent to Fiji to investigate. Trachoma is thought to be a virus disease which can be spread where there is dirt, either personal or environmental. It is difficult to diagnose in its early stages. The ophthalmologists examined 102 New Zealanders and 13 other white servicemen, most of whom had previously been diagnosed as trachoma cases, but in no case did they find a trachomatous condition. A papillary hypertrophic condition only was seen in some. Of 30 Fijian servicemen examined there were only four with a slitlamp appearance of the cornea that suggested the existence of a previous pannus. There was no evidence of present or previous trachoma in 30 white residents of long standing.

The ophthalmologists were of the opinion that trachoma did exist among the native population of Fiji, but that white troops could continue to serve there without danger to their eyes if reasonable precautions against infection were taken. They recommended that an eye specialist be provided where troops were quartered in areas where there was endemic eye disease of a contagious or infectious nature. They made further recommendations regarding quartering and messing of white troops in these areas— facilities for personal cleanliness in the way of hot and cold water showers; cleanliness of clothing, with towels and handkerchiefs washed in boiling water; cooking of food for Europeans by Europeans; native servants to be employed as sparingly as practicable, and only after a careful medical examination; and the desirability of white and native troops not messing together, unless for military reasons it could not be avoided.

RECOMMENDATIONS FOR THE FUTURE

Recommendations for the Future

For a regular army in peacetime standards are usually raised, but for any scheme of national service or for mobilisation in war about 90 per cent of eligible men will be obviously Grade I on visual standards, about 10 per cent will need to be referred for specialist opinion, about 5 per cent will need glasses, and there will be a very small number visually unfit for any service. These rejects will amount to one or two per cent of the whole. If, however, recruits are tested for, say, colour vision and those with a defect are downgraded, some thousands of men in New Zealand will be needlessly wasted. If the results are not used to grade the men it is better that the tests should not be made. It should also be realised that to order spectacles for a man is tantamount to excluding him from service with the infantry or armoured regiments, and must not be done without very good reason.

In order to make the best use of available manpower a recruit who is not obviously Grade I should be seen by an ophthalmic surgeon for a medical estimation of his capacity. It is always unwise to grade a man only to have to grade him up again should manpower conditions change.

The minimum requirements for a division overseas are two ophthalmic surgeons, one for the ophthalmic wing at the base hospital and equipped with such heavy instruments as a giant magnet, corneal microscope and diathermy, and the other with lighter equipment for attachment to the CCS when required. In addition, there should be a mobile opticians' unit. It is important that the ophthalmic surgeons should be constitutionally fit as they are not dispensable. At the base hospital the ophthalmic surgeon requires the assistance of a trained ophthalmic nursing sister and a clerk of lance-corporal rank. For the more mobile surgeon an orderly is sufficient. These officers and other ranks should not be on a hospital's establishment. If the Force should be widely dispersed an extra ophthalmologist with assistants would be required.

The necessary equipment, which must include a generous supply of essential drugs and engines capable of generating electricity of voltage suitable for the instruments, should be accumulated in peacetime so that the units may sail prepared to function efficiently and at once wherever they may be sent.

diseases of the eye— 2 NZEF, MEF and CMF

	Admissions to Hospital, July 1941-December 1945	Invalided to New Zealand, 1940–45
Conjunctivitis	363	21
Defective vision	117	4
Keratitis	171	22
Blepharitis	79	3
Pterygium	56	3
Iritis	23	9
Choroiditis	23	20
Amblyopia	19	17
Myopia	21	9
Astigmatism	14	3
Strabismus	10	2
Cataract	9	15
Trachoma		22
Other	232	69 (Includes some injuries)
	1137	219

APPENDIX I — VISUAL GRADING IN NEW ZEALAND

Appendix I
VISUAL GRADING IN NEW ZEALAND

A statistical survey of visual gradings and eye conditions was made by the Institute of Opticians in August 1941, and it covered 2579 recruits from the group of single men aged 21 to 40 years who were examined at six North Island centres. The visual grading were found to be: Grade I, 2324 (90.11 per cent); Grade II, 161 (6.24 per cent); Grade III, 81; Grade IV, 1, and referred cases, 12; a total of 94 (3.65 per cent) lower than Grade II.

Of those in Grade I 220, or 9.47 per cent, were referred for further examination in camp for the possible supply of glasses. It was estimated that 6–7 per cent of this Grade I group would require glasses to be visually efficient. In Grade II 119, or 73.9 per cent, required glasses, having high visual and refractive errors.

The reasons for Grade III grouping were: Myopia (—2.50 to —16.00 dioptres), 66 cases; high hyperopia, astigmatism, amblyopia, 9 cases; myopia with strabismus, 2; cataract, 2; recent eye operation, 1; optic atrophy, 1. The Grade IV case had congenital subluxation of the crystalline lenses. The referred cases had suspected active pathology.

Colour vision statistics were: Normal, 2366 (91.74 per cent); defective but safe, 91 (3.53 per cent); defective unsafe, 122 (4.73 per cent).

The opticians observed that relatively few more men would be obtained by lowering the standard of Grade I men. They pointed out that no attention was given to the loss of vision being in the right eye. They also stressed the danger of accepting as Grade III one-eyed men or high myopes because of the possibility of complete or serious loss of vision in these cases. They recommended only slight modification in the standards with regard especially to the elimination of the one-eye cases and high myopes. They suggested the subdivision into three categories.

It is noted that 66 of 81 cases graded III were myopes with a range of —2.50 to —16.00 dioptres. In the opinion of some ophthalmologists the majority of these cases are fit to serve overseas. Brigadier Sir William Duke-Elder, British Army Consultant, stated that myopes up to 6 and 7 dioptres were accepted by the British Army for service overseas. Lieutenant-Colonel Hope-Robertson, ophthalmic consultant to the forces in New Zealand, considered that a large number of physically fit myopes were unnecessarily debarred from overseas service.

APPENDIX II — EYE DISORDERS

Appendix II
EYE DISORDERS

Extract from analysis of Causes of Rejection in 42,022 men rejected from 105,311 men aged 18 to 45 years, who were examined for military service during 1942 and 1943. (Prepared by National Service Department, 14 December 1943.)

Percentage of Eye Disorders Causing Rejection In Men Examined

Central Age of Group	Number in Group Examined	Percentage other than Grade I	Defective Vision	Blindness One or Both Eyes	Other Eye Disorders	Total Eye Disorders
19 yrs (single)	10,855	22.1	3.98	0.28	0.25	4.51
28 yrs (married)	22,585	28.3	3.43	0.39	0.25	4.07
33 yrs (married)	28,239	35.2	3.41	0.42	0.32	4.15
42 yrs (married)	43,632	53.4	4.35	0.50	0.34	5.19

Disabilities Of The Eyes In Ex-service Personnel Recorded With War Pensions Department At 31 March 1947

Diseases of the eyes	1061
Wounds, GSW	207
Wounds, accidental	193
Errors of refraction only	957
	——
	2418

Eye Cases Invalided To New Zealand From 2 NZEF

battle casualties–	
Enucleation eye	120

Enucleation both eyes	1
Penetration of eye	22
Penetration of eye with blindness	10
Penetration of eye retained FB	9
Penetration of both eyes	6
Penetration of both eyes with blindness	3
Perforation both eyes	2
Injury cornea both eyes	6
Injury cornea and contusion	2
Contusion	15
Contusion with blindness	4
Contusion with retained FB	1
Contusion with haemorrhage	2
Contusion with perforation	5
Choroido-retinitis	1
Burns both cornea	1
Injury cornea and cataract	1
FB cornea and partial loss sight	1
DISEASES—	
Conjunctivitis	21
Defective vision	4
Keratitis	22
Blepharitis	3
Pterygium	3
Iritis	9
Choroiditis	20
Amblyopia	17
Myopia	9
Astigmatsm	3
Strabismus	2
Cataract	15
Trachoma	22
Other	69
	—
	219
accidental injuries—	
Enucleation	6

Penetration	2
Penetration and cataract	2
Penetration and loss vision	2
Penetration and retained FB	1
Contusion	2
Optic atrophy	2
Blind eye (PW)	1
Detached retina	1
Corneal Leucoma	1
Macular choroiditis	1
OLD CASES—	
Loss vision	1
Defective vision	1
Perforation	1
Detached retina	1
Choroido-retinitis	1
Vitreous opacities	1

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CHAPTER 26
Ear, Nose, and Throat Conditions

EAR, nose, and throat conditions, though generally of a minor nature, account for a great deal of disability in an army. It has been stressed by Colonel R. A. Elliott, first ENT specialist in 2 NZEF, that there is an enormous, and often unnecessary, wastage of manpower due to the relatively trivial diseases of the ear, nose, and throat.

During the First World War a high incidence of infections of the ear was noted in the NZEF in the Middle East, and sinus infection was also prevalent. It was noted that many cases of old healed otitis media with perforation tended to develop fresh infection, and recommendations were made that such cases should not be accepted for overseas service.

Medical Boarding in New Zealand, 1939–45

The examining of recruits was undertaken by a panel of general practitioners. At one stage provision was made for a specialist ENT surgeon to be a member of the board, but this was not possible with the small number of specialists available. Arrangements were made by the boards to refer doubtful cases to specialists for their opinion. The short time allowed for examination tended to the elimination of special examination of the ears, and auriscopes were not used as a routine in examination of the drum. The estimation of deafness also was made on rough tests and the audiometer not used. It was inevitable, therefore, that many recruits with old perforated drums, many with chronic otitis media, and many with otosclerosis were accepted for service. Numbers were invalided back to New Zealand after a relatively short stay in Egypt.

In New Zealand the numerous cases referred for tonsillectomy created a serious problem for the civil hospitals and great delay in getting the recruits into camp. Undoubtedly tonsillectomy was recommended too frequently.

Specialist Staff in 2 NZEF

Shortly after the arrival of the First Echelon in Egypt, ENT consultations were arranged in camp and later at the hospital established at Helwan, to which Captain

R. A. Elliott was posted. The RMOs were thereby enabled to get advice, both as regards treatment and the grading of personnel, from an ENT specialist. By attending the clinics they also gained valuable experience of the treatment of ENT conditions. Up to eighty cases were seen at each of the two clinics held each week. These out-patient clinics were continued when 2 General Hospital took over at Helwan, and similar clinics were set up by the other hospitals whenever circumstances warranted it.

In all the Middle East Forces it was found that 8 per cent of all troops, 20 per cent of all new patients, and 11.35 per cent of all admissions to hospital were suffering from ENT diseases. Endeavours were made by the British authorities to provide specialised staff for the hospitals, and mobile oto-laryngological teams were formed to provide specialist services in the forward hospitals and for men in rest areas behind the line. Ear treatment centres were also set up at the hospitals. New equipment on a more liberal scale was also provided. A consultant in ENT diseases was appointed later and was available in Italy.

In the first years of the war 2 NZEF had insufficient ENT specialists to provide an officer at each of the three hospitals, and was unable to get replacements from New Zealand. Only three ENT specialists went from New Zealand to the Middle East throughout the war. The appointment of specialists to administrative positions, as promotion to higher ranks was not possible in the specialties, also depleted the clinical staffs. Arrangements were therefore made to concentrate the cases in two of the hospitals. A relatively large number of men in widespread locations with minor ENT disabilities caused considerable wastage of manpower when there was an insufficient number of specialists to deal with them. An ENT specialist would have been very useful in the forward areas in preventing evacuation of men to Base.

Clinical Experience in Egypt

The ENT disabilities in the Middle East that called for treatment fell into two categories—those dating from pre-enlistment and cases arising on service. Pre-enlistment disabilities that had been missed at medical examination, or which recurred under the climatic and service conditions of Egypt, included the chronic perforations of the eardrum in which otorrhoea persisted or recurred, re-infected radical mastoid cavities, nasal polypi, and chronic sinusitis. It was felt that most of these should have been eliminated at the original boarding or else in camp before going overseas. Many of these cases were sent back on the first available ship. But the greatest problem in Middle East conditions was otitis externa, a very large number of men reporting sick with this annoying complaint. Acute and chronic rhinitis, often associated with sinusitis, was common, as was acute and recurrent tonsillitis. Factors contributing to these conditions were the hot, dusty climate, the primitive sanitation of the native race, and the large amount of swimming by the troops in overcrowded inland swimming pools. The mucosa of the upper respiratory tract was also rendered vulnerable by the extremely dry and hot atmosphere, with its drying effect on the normal secretions of the mucosa.

Men with a history of chronic nasal allergy did badly in Egypt, and this was borne out by the aggravation of asthmatic symptoms in the same climate. Swimming was blamed for a good deal of ear and nose trouble, and at various times orders were given banning high diving or underwater swimming. It would appear that the irritation of the water treated by substances intended to sterilise it caused at least as much trouble as water that was merely dirty and infected. Major Elliott considered that dust, dirt, sweat, and the drying air were the chief causes of the incidence of ear, nose, and throat diseases.

Otitis externa: As the condition is at first a trivial one, apart from acute furunculosis of the meatus, these men were usually treated first at their RAP, and reached the ENT specialist only when otitis was chronic and well-established. The first essential for successful treatment was found to be adequate and thorough daily toilets of the meatus done by a trained man with proper apparatus and adequate illumination. The lack of success with various antiseptics was illustrated by the number of these used. Elliott found that the best results were obtained by thorough frequent cleansing and the daily application of gauze wicks lightly packed into the full depth of the meatus. In the more acute cases he found that aluminium acetate on these wicks was helpful, and during healing some antiseptic such as acriflavine in spirit. Various antiseptic drops or ointments were used later to prevent recurrence. Others used lotio calamine if there was much weeping, and calamine cream if dry. For severe cases argyrol 10 per cent or protargol 5 per cent was painted on the meatus, or introduced on a wick of ribbon gauze and left on for twenty-four hours. Bathing was strictly forbidden. The recurrence rate was high. During the summers in

Italy the conditions were as bad as, if not worse than, those in North Africa.

Otitis media was a very common complaint. Acute cases were admitted to hospital, if possible, and treated on the usual lines of sulphonamides by mouth, paracentesis where necessary, and careful ear toilets. Carbolic acid in glycerine was generally used in acute cases, followed later by boracic powder or spirit. Local sulphonamide treatment proved unsatisfactory. The results were very good as the cases were under the daily supervision of the specialist and the authorities wisely allowed certain nursing sisters to remain for lengthy periods attached to the ENT wards, and they thus became highly skilled at local treatments of the ear. Simple mastoid operations were done if urgently required, or if necessary to render a man safe for transport in a hospital ship.

Cases of chronic suppurative otitis media did badly if treated as out-patients at the RAP. The perfunctory administration of ear drops by an orderly on top of a pool of pus in the meatus was worse than useless. Many cases of suppurative otitis media were due to blast wounds in action.

Otorrhoea: All cases of chronic otorrhoea were admitted to hospital for intensive and skilled treatment, if beds were available. Under these conditions many healed. If the perforation persisted the man was boarded and usually returned to New Zealand, unless he had some special skill which could be utilised under good living conditions.

The radical mastoid operation was not done except for complications of an urgent nature, as these men were still unfit after operation to serve in the Middle East.

Nasal Sinusitis: A fairly large number of cases of chronic sinusitis which had not been eliminated by medical boards in New Zealand had to be down-graded or invalided. A much larger group were those who arrived as fit men and later acquired acute or chronic nasal infection. Treatment at the RAP by the dropping of a few minims of ephedrine solution up the nose was illusory as a cure or relief. The minor and favourable case recovered with, or in spite of, treatment. The resistant case could only be coped with by admission to hospital. Early in the war the new techniques of ephedrine replacements were not known, and treatment was inclined to be too radical. In the early years of the war Elliott tried ephedrine drops and inhalations. If these failed he did a small antrostomy purely to facilitate easy antral lavage. After the symptoms were relieved the antrostomy often closed. This routine cleared up most cases, combined as it was with the fact that the patient in hospital was living away from a dusty atmosphere. The resistant case was down-graded. Radical surgery of the antrum or frontal sinus was frowned upon, unless of lifesaving urgency.

A survey of 59 cases referred for investigation of sinuses in February 1944 was made by Captain Simpson at 3 General Hospital, Bari. Twenty-one were sent from the forward units with a diagnosis of sinusitis, and the other cases arose among the in-patients and out-patients of the hospital. Simpson pointed out that the diagnosis was difficult except in obvious cases with mucopus pouring like lava into the middle meatus. Symptoms of pain and nasal discharge, combined with signs such as fever, tenderness over one or other sinus, or mucopus in the nose, led to a diagnosis of sinusitis, especially by RMOs. If these signs and symptoms were bilateral, the conditions might well be a common head cold more severe than the average. If the signs and symptoms were unilateral, the condition was much more likely to be sinusitis. A symptom of great significance was the occurrence of bouts of pain, relieved by discharge from the nose. The discharge in true sinusitis varied in consistency but was always yellow. Maxillary sinusitis had been found to be the most common, true frontal sinusitis being a rarity. Cases of severe persistent headache should be evacuated 'Headache NYD' to be fully investigated at the hospital, and not diagnosed as sinusitis lest soldiers become 'sinus conscious'. At the hospital X-ray was a help in diagnosis, but the final decision depended on diagnostic puncture, by which the contents of the maxillary antrum could be inspected and also a judgment formed as to the thickness of the mucosa and the presence or absence of polyposis. The finding of thick yellow mucopus in sufficient quantity (at least 1 c.c.) justified positive diagnosis and operative interference. A small quantity of grey mucopus or flakes was inadequate evidence. Gross polyposis, even in the absence of pus, generally required operation. Of the 59 cases, 49 were clinically negative, and in these X-ray was positive in 29; diagnostic puncture done on 23 of the 29 cases was positive in 9. An analysis indicated that the most certain diagnoses could be made in those cases where clinical and X-ray findings were both positive, but unless X-rays were taken and diagnostic puncture performed in selected cases from those clinically negative, then a large number of positive cases would be overlooked.

Nasal Polypi and Chronic Allergic Rhinitis: Nasal polypi were in Elliott's opinion a definite bar to a man serving out of a temperate climate, and at that, outside a base organisation. A history of nasal polypi should result in a recruit being graded for home service only. In the Middle East polypi recurred in a matter of weeks after removal. The polypi were removed with a simple snare and the soldier regraded. Chronic allergic rhinitis, if a very definite cause cannot be found for the allergy, should preclude a man serving out of a temperate climate.

Deflected Nasal Septum: Many men who are quite fit for any vigorous exercise in a temperate climate, and who are rightly passed as fit for active service, find difficulties in a hot, dusty theatre of war. Many of these men have nasal obstruction due to either a congenital or acquired deflection of the nasal septum. In Egypt it was found that the hot climate increased the respiratory rate. The soldier, burdened with his equipment and weapons, marched often in a cloud of dust raised by his comrades ahead. The mouth breather was sadly handicapped, and was either forced to fall out of the line of march or ended the day severely fatigued. Many of these cases were referred to the ENT specialist and were found to have nasal obstruction due to a deviated nasal septum. The SMR operation was carried out in a large number of cases with excellent results. Under normal conditions SMR operations were not advised, and the AIF actually prohibited the operation later in the war.

The Tonsil Problem: The question of tonsillectomy on the soldier serving overseas is a very vexed one. In 2 NZEF the principle was adopted that, if a man was otherwise fit and was disabled on several occasions by acute tonsillitis with fever, then tonsillectomy was justified in the hope that the man would then be fit for normal duties. In camp conditions a soldier should remain at least twelve days in a general hospital and then another ten days either in a convalescent depot, or excused duty, before resuming training.

Operations Overseas: In general, routine ENT operations, as all other similar operative procedures elsewhere in the body, were not performed overseas. Operation was restricted to those cases of urgency and to those which would normally lead to the increased efficiency and lengthened service of the soldier, without too long hospitalisation.

Battle Casualties

The only battle casualties that are worthy of special comment are those due to the effects of blast on the ear. These cases fell into two main groups—the sudden injury and the gradual one.

Sudden injury due to blast was a very common one. It was far more common than generally realised, as a man with a painful wound from a near-bursting missile often failed to notice his aural symptoms until much later, or, if they healed, failed ever to be aware of them. When Major Elliott was in command of an ADS at the Battle of Alamein he made a survey of ear injuries. In this battle the vast majority of wounds were due to mines, mortar and aerial bombs, and to shells. All these weapons produce a blast effect not present with small-arms fire. Of all cases passing through the ADS at least 30 per cent showed some clinical lesion of the eardrum. These ranged from gross perforation through contusion and flame-shaped haemorrhage, down to minimal hyperaemia with deafness and tinnitus. Many of the men did not complain of aural symptoms until questioned.

In the early days of the war perforations of the eardrum with the usual haemorrhage due to blast were treated by the instillation of spirit drops, or even by syringeing out the blood clot. They nearly all became infected and became cases of suppurative otitis media, often chronic, and resulted in permanent damage to the ear and down-grading. Later in the war the standard treatment, laid down by definite orders, was that no local treatment should be employed apart from a plug of sterile dry cottonwool in the ear. Sulphonamides were often given by mouth. A prophylactic course of sulphonamide was given for blast rupture, and a full therapeutic course for all infected cases. Cases so treated usually healed without infection. After healing of the drumhead, hearing often returned, but a fair percentage had permanent impairment of hearing, usually of the high tone type. Troublesome tinnitus was a frequent sequel and was very difficult to relieve, still being seen often in war pensioners.

In a survey of 1000 battle casualties admitted to 2 NZ General Hospital in 1944–45, Major F. B. Korkis found that 3.1 per cent had deafness attributable to blast. Half of these cases were found to have had a rupture of the drum. Deafness was generally of mixed middle and inner ear types, 83 per cent having some nerve deafness which showed little or no recovery. Infection in some degree had occurred in half the cases with rupture of the drum. Acute mastoiditis was uncommon, but the sub-acute type was relatively common and was treated by drainage when it persisted for more than five weeks. The smaller lesions of the drum healed spontaneously in the absence of infection.

Blast injury of gradual onset is an occupational disease of gunners, mortar crews, and the like. The incidence varies according to the weapon, the high-velocity gun such as the anti-tank gun and guns fitted with muzzle breaks being the worst offenders. Gunners of long service often began to get troublesome tinnitus and developed a high tone nerve deafness. These disabilities were found to be permanent and are frequent causes of pensions claims. During the Second World War much attention was given to the problem, but it was never satisfactorily solved. The use of verbal orders precluded the wearing of efficient ear protectors, and, in Middle East conditions, certain types of ear plugs caused a high incidence of otitis externa. A vaselined wool plug was held to be reasonably effective. This is a subject requiring more research both by medical and artillery officers.

Other Wounds: Wounds of the temporal bone, the larynx, and the facial bones were dealt with in consultation with the general and the plastic surgeons.

Neurosis Aspect: There was a danger of establishing a neurosis complex through the interpretation of minor nasopharangeal symptoms as a chronic disability. Major Elliott believed that most of the troops who went through the North African desert campaign or a summer of fighting in hot and dusty Italy had nasal symptoms and headaches to a greater or lesser degree. The threshold at which a man reported sick depended on the stamina and will to fight of the individual.

In Italy in May 1944 Captain Simpson said: 'An increasing number of soldiers are becoming "sinus conscious" and every headache is attributed to sinusitis—in some cases to an obsessive degree. It is a more fixed idea where a previous attack has been labelled sinusitis. These obsessions may be infectious unless the RMOs narrow down the diagnosis of sinusitis to the true cases, and discourage loose talk on the subject.'

Medical Boarding

As a general rule it was 2 NZEF policy not to carry out surgical procedures unless they were urgent or else offered the prospect of permanent relief of symptoms sufficient to enable a man to be retained in useful employment overseas. Cases that were graded for return to New Zealand included all the chronic suppurative otitis media cases, cases of chronic sinusitis that had failed to respond satisfactorily to treatment, cases of nasal polypi, cases of deafness that would tend to deteriorate under service conditions, all cases of chronic laryngitis, and some selected cases of otitis externa which were resistant to treatment and had a nuisance value owing to constant requirement of medical supervision. The sort of case that could safely be retained overseas was the dry aural perforation in a safe area of the drum or the mildly deaf.

Pacific Experience

When the New Zealand brigade went to Fiji in 1940 it had at first no specialist ENT service, but Major L. S. Talbot was sent there in January 1941. Very little equipment was available, and it had to be supplemented with what could be spared from Talbot's personal supplies. In 1942 more equipment became available, some from America. Clinical conditions were found to be much the same as those occurring in New Zealand, but the hot, humid climate was favourable to middle ear infections, and some ears that had been 'dry' for long periods became active. Likewise chronic nasal accessory sinus infections became troublesome and did not respond well to local treatment. Such cases often had to be employed at Base, or else returned home.

The climate of New Caledonia was much the same as that of Fiji during the summer and autumn months, and the high humidity at this period had much the same effect on middle ear diseases, sinus cases, and allergic manifestations. However, the cases did better in the winter, and the equipment provided was a very considerable improvement on that available in Fiji.

External otitis was very prevalent in the climate of the Pacific—in Fiji, New Caledonia, and the Solomons. By the time patients were referred to a hospital the infection, whether mycotic or bacterial at first, had usually become a mixed one, with great swelling and tenderness of the tissues of the external auditory canal, so that local treatment was difficult to apply effectively. The method found by Major Talbot to give the best response was the repeated application of hypertonic solutions, such as 15 to 20 per cent magnesium sulphate, sometimes introducing it into the depths of the canal with a blunt hypodermic needle. It was found that the patient was more quickly returned to full duty by a period in hospital to enable such treatment to be applied effectively. When the swelling was reduced, other treatments applied on gauze wicks could be used at the RAP. Complete cure was difficult, and the patient was usually left with a chronic or recurrent otitis which could to a certain extent be kept in check by daily ear toilet.

RNZAF Experience in Pacific

The sickness rate for ear diseases was found by the RNZAF in the Pacific to be more than three times the New Zealand rate in 1944–45 (33.6 as against 9.8 per thousand per annum). The increase was principally due to a high incidence of otitis externa and otitis media in the Pacific. The warmth and humidity encouraged all bacterial and fungoid growth, and it was thought that minute particles of sand or coral in suspension in swimming water were causative agents. Most cases of otitis externa were found to have occurred in those who had been swimming within the preceding week. Sea water was the chief offender, probably owing to contamination by drainage from camps and refuse from ships, but bathing and diving in fresh-water pools in the coral also preceded infection. The primary lesion was thought to be caused by small abrasions of the lining of the external auditory meatus by particles of coral or sand, with bacteria from the water or air rapidly invading the wound and producing infection. With appropriate treatment healing occurred rapidly, the infection subsiding within ten to fourteen days. In the absence of any or appropriate treatment the condition would become chronic and remain so for weeks. In all cases there was a marked tendency to recur.

The most important part of the treatment was considered by Squadron Leader A. North, at Espiritu Santo, to lie in the constant and careful personal examination and supervision by the medical officer himself at all stages. In his opinion the commonest cause of recurrence was incomplete healing in the medial parts of the external auditory meatus at the time the patient was discharged as cured. In a series of 44 cases of otitis externa he found that the most effective and reliable treatment consisted in cleansing the meatus daily, insertion of cotton-wool wicks soaked in 10 per cent sodium sulphadiazine solution for three to five days till dry, followed by daily insufflations with 0.75 per cent iodised boracic powder till healed. Results of treatment with propamidine 0.1 per cent suspension in water soluble jelly base were not as good. From experience at the hospital at Espiritu Santo it was suggested that, if practicable, a separate ear clinic be held where there were a number of cases of otitis externa. One tray could be set up and the instruments re-sterilised between each case. This allowed better observation, attention, and concentration on treatment, also saving time for both patients and staff.

Otosclerosis

The lack of any audiometer examination of the recruits made it inevitable that many cases of otosclerosis should be overlooked and men be accepted for service with no note of any impairment. This in turn has led to the granting of pensions to many of these cases, as under the law any disability arising or increasing during service is held attributable to service. Some therefore contend that pensions of a permanent nature are being paid for what is a constitutional disease in no way caused, though in some cases possibly aggravated, by service in the forces. The sum paid is a large one amounting to about £40,000 yearly. On the other hand, it is held that the majority of these men performed full service overseas and applied for pension when the increasing deafness became noticeable after their return to New Zealand. This is borne out by the Pensions Department figures, which show that only 130 had applied for pensions at the end of March 1944, but that 687 had applied by 1950. Audiometer examination could have eliminated most of these cases and pensions payments been reduced accordingly. As against this the forces would have lost the service given by those men, which for the want of contrary evidence must be assumed to have been satisfactory.

The introduction of the Pulheems system and more efficient examination of recruits will not provide a solution to the problem, which turns almost entirely on the pensions legislation. If a pension was not paid unless the condition was actually caused by service, and the men with slight constitutional disability were accepted for service on that understanding, the men would be able to give valuable service to their country without the question of pensions payments arising. The more marked cases of deafness would, of course, not be accepted for service.

APPLICATIONS FOR WAR PENSIONS AT 31 MARCH 1951

Applications for War Pensions at 31 March 1951

	Service Overseas	NZ	Total
ears—			
Suppurative diseases	1158	241	1399
Deafness, catarrhal and otosclerosis	688	162	850
Deafness, concussion	1046	34	1080
	—	—	—
	2892	437	3329
NASAL: Sinusitis	1579	354	1933

Recommendations for the Future

1. In the medical boarding of recruits a careful history should be taken of any nasal or aural discharge, headache, nasal obstruction, sore throat, or operation. Every ear should be examined with an electrically lighted otoscope, or with a head mirror and ear speculum, and, if necessary, wax or debris removed till the drum is clearly seen. If necessary the cavity should be syringed with warm normal saline solution. If the drum cannot be clearly seen, or if there is any perforation or discharge, or if there is any history of aural disease, or any scar of previous operation, or any doubt, the case should be referred to a specialist. Hearing should be tested under satisfactory conditions of quiet and space by test sentences or words by the spoken voice at ordinary conversation pitch at 20 feet distance, the ears being tested separately, one being shut off by a finger. When any doubt exists the hearing should be tested with an audiometer under the supervision of a specialist. The pharynx should be examined and the ability to breathe through each nostril tested.
2. Men with any of the following disabilities should not be sent overseas: chronic otitis media, any large perforation of the drum, old radical mastoid operation, chronic sinusitis, nasal polypi, serious deafness.
3. Overseas there should be an ENT specialist for every general hospital, and one available for consultation on treatment and grading at the divisional level. Normally he could be attached to the CCS.
4. Higher rank should be granted to the senior ENT specialist, and specialist rank to any fully qualified specialist.
5. Specialists should not be appointed to field or administrative posts unless there is

a full quota of specialists for clinical duties.

6. Sisters and orderlies trained in specialist treatments should be made available.
7. Special ear treatment rooms should be set up in base camps and in the divisional area with trained staff on call to carry out toilets and dressings.
8. Operations for remedial treatment in New Zealand, such as tonsillectomy, should be strictly limited, and likewise operations overseas, except for acute conditions.

Patients Invalided from 2 NZEF with Ear Disabilities

	Battle Casualties	Accidental Injuries
Rupture drum, bilateral, and otitis media	8	1
Rupture drum, bilateral, and deafness	47	
Rupture drum, single, and otitis media	18	1
Rupture drum, single, and deafness	11	3
Rupture drum, bilateral	9	
Rupture drum, single	15	
Blast and deafness	4	
Penetrating ear, with deafness	3	
Other	5	

ear sickness—		nose and throat—	
Otitis media	191	Sinusitis	61
Mastoiditis	8	Pansinusitis	4
Otitis externa	6	Rhinitis	6
Deafness, middle ear	19	Epistaxis	2
Nerve deafness	25	Cleft palate and obstr.	3
Catarrhal deafness	3	BC trachea	2
Mixed deafness	2	BC nose and loss tissue	1
Bilateral deafness	4		
Otosclerosis	15		
Other	6		

admissions to hospital, 1941–45 (battle casualties)—

Rupture membranatympani	386
Mastoid region	30
Otitis media	80
Otitis externa	3
Nerve deafness	57
Contusions, etc	108

References

R. A. Elliott	2 NZEF Survey (unpublished).
F. B. Korkis	British Medical Journal, 9 February 1946.
A. North	Report on RNZAF in Pacific (unpublished).
W. H. Simpson	Report on Sinus infection in Italy (unpublished).

Admissions to Hospital, 2 NZEF, J ul1941–Dec 1945 (Sick)

Otitis media	141	Deafness	85
Otitis externa	548	Otosclerosis	27
Furunculosis	88	Rupture of tympani	16
Mastoiditis	32	Tinnitus aurium	11
Sebaceous cyst	28	Other	59

WAR SURGERY AND MEDICINE

[SECTION]

EAR, nose, and throat conditions, though generally of a minor nature, account for a great deal of disability in an army. It has been stressed by Colonel R. A. Elliott, first ENT specialist in 2 NZEF, that there is an enormous, and often unnecessary, wastage of manpower due to the relatively trivial diseases of the ear, nose, and throat.

During the First World War a high incidence of infections of the ear was noted in the NZEF in the Middle East, and sinus infection was also prevalent. It was noted that many cases of old healed otitis media with perforation tended to develop fresh infection, and recommendations were made that such cases should not be accepted for overseas service.

Medical Boarding in New Zealand, 1939–45

The examining of recruits was undertaken by a panel of general practitioners. At one stage provision was made for a specialist ENT surgeon to be a member of the board, but this was not possible with the small number of specialists available. Arrangements were made by the boards to refer doubtful cases to specialists for their opinion. The short time allowed for examination tended to the elimination of special examination of the ears, and auriscopes were not used as a routine in examination of the drum. The estimation of deafness also was made on rough tests and the audiometer not used. It was inevitable, therefore, that many recruits with old perforated drums, many with chronic otitis media, and many with otosclerosis were accepted for service. Numbers were invalided back to New Zealand after a relatively short stay in Egypt.

In New Zealand the numerous cases referred for tonsillectomy created a serious problem for the civil hospitals and great delay in getting the recruits into camp. Undoubtedly tonsillectomy was recommended too frequently.

SPECIALIST STAFF IN 2 NZEF

Specialist Staff in 2 NZEF

Shortly after the arrival of the First Echelon in Egypt, ENT consultations were arranged in camp and later at the hospital established at Helwan, to which Captain R. A. Elliott was posted. The RMOs were thereby enabled to get advice, both as regards treatment and the grading of personnel, from an ENT specialist. By attending the clinics they also gained valuable experience of the treatment of ENT conditions. Up to eighty cases were seen at each of the two clinics held each week. These out-patient clinics were continued when 2 General Hospital took over at Helwan, and similar clinics were set up by the other hospitals whenever circumstances warranted it.

In all the Middle East Forces it was found that 8 per cent of all troops, 20 per cent of all new patients, and 11.35 per cent of all admissions to hospital were suffering from ENT diseases. Endeavours were made by the British authorities to provide specialised staff for the hospitals, and mobile oto-laryngological teams were formed to provide specialist services in the forward hospitals and for men in rest areas behind the line. Ear treatment centres were also set up at the hospitals. New equipment on a more liberal scale was also provided. A consultant in ENT diseases was appointed later and was available in Italy.

In the first years of the war 2 NZEF had insufficient ENT specialists to provide an officer at each of the three hospitals, and was unable to get replacements from New Zealand. Only three ENT specialists went from New Zealand to the Middle East throughout the war. The appointment of specialists to administrative positions, as promotion to higher ranks was not possible in the specialties, also depleted the clinical staffs. Arrangements were therefore made to concentrate the cases in two of the hospitals. A relatively large number of men in widespread locations with minor ENT disabilities caused considerable wastage of manpower when there was an insufficient number of specialists to deal with them. An ENT specialist would have been very useful in the forward areas in preventing evacuation of men to Base.

Clinical Experience in Egypt

The ENT disabilities in the Middle East that called for treatment fell into two categories—those dating from pre-enlistment and cases arising on service. Pre-enlistment disabilities that had been missed at medical examination, or which recurred under the climatic and service conditions of Egypt, included the chronic perforations of the eardrum in which otorrhoea persisted or recurred, re-infected radical mastoid cavities, nasal polypi, and chronic sinusitis. It was felt that most of these should have been eliminated at the original boarding or else in camp before going overseas. Many of these cases were sent back on the first available ship. But the greatest problem in Middle East conditions was otitis externa, a very large number of men reporting sick with this annoying complaint. Acute and chronic rhinitis, often associated with sinusitis, was common, as was acute and recurrent tonsillitis. Factors contributing to these conditions were the hot, dusty climate, the primitive sanitation of the native race, and the large amount of swimming by the troops in overcrowded inland swimming pools. The mucosa of the upper respiratory tract was also rendered vulnerable by the extremely dry and hot atmosphere, with its drying effect on the normal secretions of the mucosa.

Men with a history of chronic nasal allergy did badly in Egypt, and this was borne out by the aggravation of asthmatic symptoms in the same climate. Swimming was blamed for a good deal of ear and nose trouble, and at various times orders were given banning high diving or underwater swimming. It would appear that the irritation of the water treated by substances intended to sterilise it caused at least as much trouble as water that was merely dirty and infected. Major Elliott considered that dust, dirt, sweat, and the drying air were the chief causes of the incidence of ear, nose, and throat diseases.

Otitis externa: As the condition is at first a trivial one, apart from acute furunculosis of the meatus, these men were usually treated first at their RAP, and reached the ENT specialist only when otitis was chronic and well-established. The first essential for successful treatment was found to be adequate and thorough daily toilets of the meatus done by a trained man with proper apparatus and adequate illumination. The lack of success with various antiseptics was illustrated by the number of these used. Elliott found that the best results were obtained by thorough frequent cleansing and the daily application of gauze wicks lightly packed into the full depth of the meatus. In the more acute cases he found that aluminium acetate on these wicks was helpful, and during healing some antiseptic such as acriflavine in spirit. Various antiseptic drops or ointments were used later to prevent recurrence. Others used lotio calamine if there was much weeping, and calamine cream if dry. For severe cases argyrol 10 per cent or protargol 5 per cent was painted on the meatus, or introduced on a wick of ribbon gauze and left on for twenty-four hours. Bathing was strictly forbidden. The recurrence rate was high. During the summers in Italy the conditions were as bad as, if not worse than, those in North Africa.

Otitis media was a very common complaint. Acute cases were admitted to hospital, if possible, and treated on the usual lines of sulphonamides by mouth, paracentesis where necessary, and careful ear toilets. Carbolic acid in glycerine was generally used in acute cases, followed later by boracic powder or spirit. Local sulphonamide treatment proved unsatisfactory. The results were very good as the cases were under the daily supervision of the specialist and the authorities wisely allowed certain nursing sisters to remain for lengthy periods attached to the ENT wards, and they thus became highly skilled at local treatments of the ear. Simple mastoid operations were done if urgently required, or if necessary to render a man safe for transport in a hospital ship.

Cases of chronic suppurative otitis media did badly if treated as out-patients at the RAP. The perfunctory administration of ear drops by an orderly on top of a pool of pus in the meatus was worse than useless. Many cases of suppurative otitis media were due to blast wounds in action.

Otorrhoea: All cases of chronic otorrhoea were admitted to hospital for intensive and skilled treatment, if beds were available. Under these conditions many healed. If the perforation persisted the man was boarded and usually returned to New Zealand, unless he had some special skill which could be utilised under good living conditions.

The radical mastoid operation was not done except for complications of an urgent nature, as these men were still unfit after operation to serve in the Middle East.

Nasal Sinusitis: A fairly large number of cases of chronic sinusitis which had not been eliminated by medical boards in New Zealand had to be down-graded or invalided. A much larger group were those who arrived as fit men and later acquired acute or chronic nasal infection. Treatment at the RAP by the dropping of a few minims of ephedrine solution up the nose was illusory as a cure or relief. The minor and favourable case recovered with, or in spite of, treatment. The resistant case could only be coped with by admission to hospital. Early in the war the new techniques of ephedrine replacements were not known, and treatment was inclined to be too radical. In the early years of the war Elliott tried ephedrine drops and inhalations. If these failed he did a small antrostomy purely to facilitate easy antral lavage. After the symptoms were relieved the antrostomy often closed. This routine cleared up most cases, combined as it was with the fact that the patient in hospital was living away from a dusty atmosphere. The resistant case was down-graded. Radical surgery of the antrum or frontal sinus was frowned upon, unless of lifesaving urgency.

A survey of 59 cases referred for investigation of sinuses in February 1944 was made by Captain Simpson at 3 General Hospital, Bari. Twenty-one were sent from the forward units with a diagnosis of sinusitis, and the other cases arose among the in-patients and out-patients of the hospital. Simpson pointed out that the diagnosis was difficult except in obvious cases with mucopus pouring like lava into the middle meatus. Symptoms of pain and nasal discharge, combined with signs such as fever, tenderness over one or other sinus, or mucopus in the nose, led to a diagnosis of sinusitis, especially by RMOs. If these signs and symptoms were bilateral, the conditions might well be a common head cold more severe than the average. If the signs and symptoms were unilateral, the condition was much more likely to be sinusitis. A symptom of great significance was the occurrence of bouts of pain, relieved by discharge from the nose. The discharge in true sinusitis varied in consistency but was always yellow. Maxillary sinusitis had been found to be the most common, true frontal sinusitis being a rarity. Cases of severe persistent headache should be evacuated 'Headache NYD' to be fully investigated at the hospital, and not diagnosed as sinusitis lest soldiers become 'sinus conscious'. At the hospital X-ray was a help in diagnosis, but the final decision depended on diagnostic puncture, by which the contents of the maxillary antrum could be inspected and also a judgment formed as to the thickness of the mucosa and the presence or absence of polyposis. The finding of thick yellow mucopus in sufficient quantity (at least 1 c.c.) justified positive diagnosis and operative interference. A small quantity of grey mucopus or flakes was inadequate evidence. Gross polyposis, even in the absence of pus, generally required operation. Of the 59 cases, 49 were clinically negative, and in these X-ray was positive in 29; diagnostic puncture done on 23 of the 29 cases was positive in 9. An analysis indicated that the most certain diagnoses could be made in those cases where clinical and X-ray findings were both positive, but unless X-rays were taken and diagnostic puncture performed in selected cases from those clinically negative, then a large number of positive cases would be overlooked.

Nasal Polypi and Chronic Allergic Rhinitis: Nasal polypi were in Elliott's opinion a definite bar to a man serving out of a temperate climate, and at that, outside a base organisation. A history of nasal polypi should result in a recruit being graded for home service only. In the Middle East polypi recurred in a matter of weeks after removal. The polypi were removed with a simple snare and the soldier regraded. Chronic allergic rhinitis, if a very definite cause cannot be found for the allergy, should preclude a man serving out of a temperate climate.

Deflected Nasal Septum: Many men who are quite fit for any vigorous exercise in a temperate climate, and who are rightly passed as fit for active service, find difficulties in a hot, dusty theatre of war. Many of these men have nasal obstruction due to either a congenital or acquired deflection of the nasal septum. In Egypt it was found that the hot climate increased the respiratory rate. The soldier, burdened with his equipment and weapons, marched often in a cloud of dust raised by his comrades ahead. The mouth breather was sadly handicapped, and was either forced to fall out of the line of march or ended the day severely fatigued. Many of these cases were referred to the ENT specialist and were found to have nasal obstruction due to a deviated nasal septum. The SMR operation was carried out in a large number of cases with excellent results. Under normal conditions SMR operations were not advised, and the AIF actually prohibited the operation later in the war.

The Tonsil Problem: The question of tonsillectomy on the soldier serving overseas is a very vexed one. In 2 NZEF the principle was adopted that, if a man was otherwise fit and was disabled on several occasions by acute tonsillitis with fever, then tonsillectomy was justified in the hope that the man would then be fit for normal duties. In camp conditions a soldier should remain at least twelve days in a general hospital and then another ten days either in a convalescent depot, or excused duty, before resuming training.

Operations Overseas: In general, routine ENT operations, as all other similar operative procedures elsewhere in the body, were not performed overseas. Operation was restricted to those cases of urgency and to those which would normally lead to the increased efficiency and lengthened service of the soldier, without too long hospitalisation.

Battle Casualties

The only battle casualties that are worthy of special comment are those due to the effects of blast on the ear. These cases fell into two main groups—the sudden injury and the gradual one.

Sudden injury due to blast was a very common one. It was far more common than generally realised, as a man with a painful wound from a near-bursting missile often failed to notice his aural symptoms until much later, or, if they healed, failed ever to be aware of them. When Major Elliott was in command of an ADS at the Battle of Alamein he made a survey of ear injuries. In this battle the vast majority of wounds were due to mines, mortar and aerial bombs, and to shells. All these weapons produce a blast effect not present with small-arms fire. Of all cases passing through the ADS at least 30 per cent showed some clinical lesion of the eardrum. These ranged from gross perforation through contusion and flame-shaped haemorrhage, down to minimal hyperaemia with deafness and tinnitus. Many of the men did not complain of aural symptoms until questioned.

In the early days of the war perforations of the eardrum with the usual haemorrhage due to blast were treated by the instillation of spirit drops, or even by syringeing out the blood clot. They nearly all became infected and became cases of suppurative otitis media, often chronic, and resulted in permanent damage to the ear and down-grading. Later in the war the standard treatment, laid down by definite orders, was that no local treatment should be employed apart from a plug of sterile dry cottonwool in the ear. Sulphonamides were often given by mouth. A prophylactic course of sulphonamide was given for blast rupture, and a full therapeutic course for all infected cases. Cases so treated usually healed without infection. After healing of the drumhead, hearing often returned, but a fair percentage had permanent impairment of hearing, usually of the high tone type. Troublesome tinnitus was a frequent sequel and was very difficult to relieve, still being seen often in war pensioners.

In a survey of 1000 battle casualties admitted to 2 NZ General Hospital in 1944–45, Major F. B. Korkis found that 3.1 per cent had deafness attributable to blast. Half of these cases were found to have had a rupture of the drum. Deafness was generally of mixed middle and inner ear types, 83 per cent having some nerve deafness which showed little or no recovery. Infection in some degree had occurred in half the cases with rupture of the drum. Acute mastoiditis was uncommon, but the sub-acute type was relatively common and was treated by drainage when it persisted for more than five weeks. The smaller lesions of the drum healed spontaneously in the absence of infection.

Blast injury of gradual onset is an occupational disease of gunners, mortar crews, and the like. The incidence varies according to the weapon, the high-velocity gun such as the anti-tank gun and guns fitted with muzzle breaks being the worst offenders. Gunners of long service often began to get troublesome tinnitus and developed a high tone nerve deafness. These disabilities were found to be permanent and are frequent causes of pensions claims. During the Second World War much attention was given to the problem, but it was never satisfactorily solved. The use of verbal orders precluded the wearing of efficient ear protectors, and, in Middle East conditions, certain types of ear plugs caused a high incidence of otitis externa. A vaselined wool plug was held to be reasonably effective. This is a subject requiring more research both by medical and artillery officers.

Other Wounds: Wounds of the temporal bone, the larynx, and the facial bones were dealt with in consultation with the general and the plastic surgeons.

Neurosis Aspect: There was a danger of establishing a neurosis complex through the interpretation of minor nasopharangeal symptoms as a chronic disability. Major Elliott believed that most of the troops who went through the North African desert campaign or a summer of fighting in hot and dusty Italy had nasal symptoms and headaches to a greater or lesser degree. The threshold at which a man reported sick depended on the stamina and will to fight of the individual.

In Italy in May 1944 Captain Simpson said: 'An increasing number of soldiers are becoming "sinus conscious" and every headache is attributed to sinusitis—in some cases to an obsessive degree. It is a more fixed idea where a previous attack has been labelled sinusitis. These obsessions may be infectious unless the RMOs narrow down the diagnosis of sinusitis to the true cases, and discourage loose talk on the subject.’

MEDICAL BOARDING

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As a general rule it was 2 NZEF policy not to carry out surgical procedures unless they were urgent or else offered the prospect of permanent relief of symptoms sufficient to enable a man to be retained in useful employment overseas. Cases that were graded for return to New Zealand included all the chronic suppurative otitis media cases, cases of chronic sinusitis that had failed to respond satisfactorily to treatment, cases of nasal polypi, cases of deafness that would tend to deteriorate under service conditions, all cases of chronic laryngitis, and some selected cases of otitis externa which were resistant to treatment and had a nuisance value owing to constant requirement of medical supervision. The sort of case that could safely be retained overseas was the dry aural perforation in a safe area of the drum or the mildly deaf.

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When the New Zealand brigade went to Fiji in 1940 it had at first no specialist ENT service, but Major L. S. Talbot was sent there in January 1941. Very little equipment was available, and it had to be supplemented with what could be spared from Talbot's personal supplies. In 1942 more equipment became available, some from America. Clinical conditions were found to be much the same as those occurring in New Zealand, but the hot, humid climate was favourable to middle ear infections, and some ears that had been 'dry' for long periods became active. Likewise chronic nasal accessory sinus infections became troublesome and did not respond well to local treatment. Such cases often had to be employed at Base, or else returned home.

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External otitis was very prevalent in the climate of the Pacific—in Fiji, New Caledonia, and the Solomons. By the time patients were referred to a hospital the infection, whether mycotic or bacterial at first, had usually become a mixed one, with great swelling and tenderness of the tissues of the external auditory canal, so that local treatment was difficult to apply effectively. The method found by Major Talbot to give the best response was the repeated application of hypertonic solutions, such as 15 to 20 per cent magnesium sulphate, sometimes introducing it into the depths of the canal with a blunt hypodermic needle. It was found that the patient was more quickly returned to full duty by a period in hospital to enable such treatment to be applied effectively. When the swelling was reduced, other treatments applied on gauze wicks could be used at the RAP. Complete cure was difficult, and the patient was usually left with a chronic or recurrent otitis which could to a certain extent be kept in check by daily ear toilet.

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Otosclerosis

The lack of any audiometer examination of the recruits made it inevitable that many cases of otosclerosis should be overlooked and men be accepted for service with no note of any impairment. This in turn has led to the granting of pensions to many of these cases, as under the law any disability arising or increasing during service is held attributable to service. Some therefore contend that pensions of a permanent nature are being paid for what is a constitutional disease in no way caused, though in some cases possibly aggravated, by service in the forces. The sum paid is a large one amounting to about £40,000 yearly. On the other hand, it is held that the majority of these men performed full service overseas and applied for pension when the increasing deafness became noticeable after their return to New Zealand. This is borne out by the Pensions Department figures, which show that only 130 had applied for pensions at the end of March 1944, but that 687 had applied by 1950. Audiometer examination could have eliminated most of these cases and pensions payments been reduced accordingly. As against this the forces would have lost the service given by those men, which for the want of contrary evidence must be assumed to have been satisfactory.

The introduction of the Pulheems system and more efficient examination of recruits will not provide a solution to the problem, which turns almost entirely on the pensions legislation. If a pension was not paid unless the condition was actually caused by service, and the men with slight constitutional disability were accepted for service on that understanding, the men would be able to give valuable service to their country without the question of pensions payments arising. The more marked cases of deafness would, of course, not be accepted for service.

APPLICATIONS FOR WAR PENSIONS AT 31 MARCH 1951

Applications for War Pensions at 31 March 1951

	Service		
	Overseas	NZ	Total

ears—

Suppurative diseases	1158	241	1399
Deafness, catarrhal and otosclerosis	688	162	850
Deafness, concussion	1046	34	1080
—		—	—
	2892	437	3329
NASAL: Sinusitis	1579	354	1933

Recommendations for the Future

1. In the medical boarding of recruits a careful history should be taken of any nasal or aural discharge, headache, nasal obstruction, sore throat, or operation. Every ear should be examined with an electrically lighted otoscope, or with a head mirror and ear speculum, and, if necessary, wax or debris removed till the drum is clearly seen. If necessary the cavity should be syringed with warm normal saline solution. If the drum cannot be clearly seen, or if there is any perforation or discharge, or if there is any history of aural disease, or any scar of previous operation, or any doubt, the case should be referred to a specialist. Hearing should be tested under satisfactory conditions of quiet and space by test sentences or words by the spoken voice at ordinary conversation pitch at 20 feet distance, the ears being tested separately, one being shut off by a finger. When any doubt exists the hearing should be tested with an audiometer under the supervision of a specialist. The pharynx should be examined and the ability to breathe through each nostril tested.
2. Men with any of the following disabilities should not be sent overseas: chronic otitis media, any large perforation of the drum, old radical mastoid operation, chronic sinusitis, nasal polypi, serious deafness.
3. Overseas there should be an ENT specialist for every general hospital, and one available for consultation on treatment and grading at the divisional level. Normally he could be attached to the CCS.
4. Higher rank should be granted to the senior ENT specialist, and specialist rank to any fully qualified specialist.
5. Specialists should not be appointed to field or administrative posts unless there is a full quota of specialists for clinical duties.
6. Sisters and orderlies trained in specialist treatments should be made available.
7. Special ear treatment rooms should be set up in base camps and in the divisional area with trained staff on call to carry out toilets and dressings.
8. Operations for remedial treatment in New Zealand, such as tonsillectomy, should be strictly limited, and likewise operations overseas, except for acute conditions.

Patients Invalided from 2 NZEF with Ear Disabilities

	Battle Casualties	Accidental Injuries
Rupture drum, bilateral, and otitis media	8	1
Rupture drum, bilateral, and deafness	47	
Rupture drum, single, and otitis media	18	1

Rupture drum, single, and deafness	11	3
Rupture drum, bilateral	9	
Rupture drum, single	15	
Blast and deafness	4	
Penetrating ear, with deafness	3	
Other	5	

ear sickness—		nose and throat—	
Otitis media	191	Sinusitis	61
Mastoiditis	8	Pansinusitis	4
Otitis externa	6	Rhinitis	6
Deafness, middle ear	19	Epistaxis	2
Nerve deafness	25	Cleft palate and obstr.	3
Catarrhal deafness	3	BC trachea	2
Mixed deafness	2	BC nose and loss tissue	1
Bilateral deafness	4		
Otosclerosis	15		
Other	6		

admissions to hospital, 1941–45 (battle casualties)—

Rupture membranatympani	386
Mastoid region	30
Otitis media	80
Otitis externa	3
Nerve deafness	57
Contusions, etc	108

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R. A. Elliott	2 NZEF Survey (unpublished).
F. B. Korkis	British Medical Journal, 9 February 1946.
A. North	Report on RNZAF in Pacific (unpublished).
W. H. Simpson	Report on Sinus infection in Italy (unpublished).

Admissions to Hospital, 2 NZEF, J ul1941–Dec 1945 (Sick)

Otitis media	141	Deafness	85
Otitis externa	548	Otosclerosis	27
Furunculosis	88	Rupture of tympani	16
Mastoiditis	32	Tinnitus aurium	11
Sebaceous cyst	28	Other	59

CHAPTER 27
Clinical Work among Prisoners of War

FOR sick and wounded prisoners of war captured in Greece and Crete the major part of the clinical work, especially surgery, was performed in the early months at Kokkinia hospital, Piraeus, Athens. This hospital was opened on 9 May 1941 in a large American orphanage, only just completed, and was staffed by Australian, British, and New Zealand medical personnel. By early June the admissions to the hospital totalled 2038, made up as follows: from 5 Australian General Hospital, Ekali, 91; from 26 British General Hospital, Kephissia, 290; from Corinth and Kalamata hospitals, 260; from Crete, 1397.

At Corinth from 27 April Captain Slater and other New Zealand medical officers ran a hospital of 120 beds in the Ionian Palace Hotel. The medical officers were able to do dressings and simple surgical procedures, but cases requiring major surgery were transferred to the local Greek hospital or to a German military hospital. Most wounds were infected, one with gas gangrene, and the medical conditions included dysentery, but there were remarkably few deaths in the two weeks this hospital operated, despite the appalling lack of medical and sanitary facilities and the small amount of food. Some medical supplies were made available from the local Greek hospital. At Kalamata, in the south of Greece, Major G. H. Thomson, NZMC, and British medical officers set up a hospital in a hall.

In Crete the wounded were treated by the medical officers captured with their patients. Those from units near Maleme airfield were concentrated in the Tavronitis valley. Farther back near Canea Captain Ballantyne treated the wounded in his ADS, as did 7 General Hospital and Australian, British, and New Zealand medical staffs at the sites where seriously wounded were gathered on the road to Sfakia. The medical officers did all that their limited equipment would allow. By 23 May the RMOs of 5 Brigade, first Captain Longmore, then Captains Stewart and Hetherington, had joined up with Flying Officer T. Cullen, RAF, and staffed a dressing station in the Tavronitis valley. They worked in a stable attached to an inn. The German medical officers were overworked and were willing to let the captured medical officers set up their own dressing station for their own wounded with such equipment as the Germans could spare. At the dressing station some 700 cases were put through, with only seven deaths, before the wounded were taken by plane to Athens.

At Ballantyne's ADS near Canea eight patients died of gas gangrene and others of abdominal wounds for whom little could be done. The Germans were generally helpful with equipment, and in arranging early transfers to Kokkinia hospital in Greece. At Lieutenant-Colonel Bull's emergency dressing station at Neon Khorion, four of the 46 wounded died. The Germans were slow to provide medical and surgical necessities. The patients were moved to Maleme on 7 June and then to Greece.

For the sick from the main crowded prisoner-of-war camp near Galatas Lieutenant-Colonel Bull organised a 200-bedded camp reception hospital, and cases included dysentery, malaria, poliomyelitis, diphtheria, catarrhal jaundice, and malnutrition. Between 9 June and 23 September there were 1212 admissions with 23 deaths. (Of the 402 New Zealanders admitted 4 died.)

Kokkinia Hospital

At Kokkinia hospital New Zealand medical officers and orderlies shared in the treatment of British, Australian, and New Zealand battle casualties from Greece and Crete. The hospital was well equipped, largely from 5 Australian General Hospital, whence came the operating theatre, laboratory, and X-ray equipment. Dental equipment of the New Zealand Mobile Dental Unit was recovered from Voulas camp. Dispensary stocks came from the Australian hospital, from 26 British General Hospital after it closed at Kephissia, and the Germans issued some items from the captured British Medical Stores Depots. Antiseptics and opiates were in good supply, but there was a shortage of sulphonamide drugs, dressings, adhesive plaster, and plaster-of-paris. German plaster-of-paris was used later, but its quality was very poor at times. There was a serious shortage of syringes, surgical scissors, and dressing forceps.

In the five months' operations at Kokkinia 68 patients died, while 2334 were discharged as cured or relieved, and 109 still required hospital treatment.

The clinical work performed in the hospital was considerable, as the following details show. Most of the patients came from Crete by air and practically all their wounds were suppurating, the men being very ill, hungry, thirsty, and poorly clad. Some of the patients from Corinth and Kalamata were in a similar condition.

Head Injuries: Eighty-eight cases were treated, 19 being operated on. There were 13 deaths altogether among the 37 patients with perforating injuries; 14 of them developed cerebral abscess which caused 2 of the deaths. Four patients died within the first three days after admission. Dr Pfeiffer, the consultant neurosurgeon to the German forces in Greece, visited the hospital and operated on some cases, using Cushing's technique.

Chest Injuries: Most of the wounded with severe chest injuries died before reaching the hospital. Of the 100 patients admitted 5 died, all except 1 having other serious injuries such as head wounds. Haemothorax was present in 24 cases and empyema in 12. Of the latter, 2 died, 1 having a pyo-pneumothorax and a lung abscess.

Abdominal Injuries: Again, the severe casualties did not survive to reach hospital. Altogether there were 39 cases, of which 29 had perforating injuries, and of these 6 died from peritonitis or toxaemia.

Fractures: Some 349 compound fractures were treated, with 11 deaths and 27 amputations, while there were 68 simple fractures. On admission all fracture cases were X-rayed and then operated on, the wound edges being excised and the wound irrigated with hydrogen peroxide. Tulle gras or vaseline gauze dressings and plaster splints were then applied. Sulphonamides were given. The results generally were satisfactory, though deformity was commonly seen in the fractured femora, due to much bone and soft-tissue damage and to the lack of a portable X-ray plant. The treatment of individual fractures was on the following lines:

(a) Shoulder and humerus. Abduction frames made by orderlies from Kramer wire were used. Only a few had thoraco-brachial plasters as there was a shortage of plaster.

(b) Fractures of the elbow were put up at 90 degrees flexion, and in the mid-position of pronation and supination.

(c) Two simple fractures of the radius and ulna required open reduction.

(Hand wounds were put up in dorsiflexion of the wrist and flexion of the

(d) fingers.

(e) Fractures of the femur were treated in Thomas splints with Kirschner wire traction. Balkan beams were used. Lower-third fractures were treated in a Braun splint with Kirschner wire extension through the tibial tuberosity.

(f) Fractures of the tibia were treated in plaster splints. When extension was necessary this was carried out by Kirschner wire above the malleolus in a Braun splint. A Bohler frame was available for the reduction of lower limb fractures.

The plasters were changed at monthly intervals unless offensive discharge or infection necessitated earlier inspection. At the change of plaster any sequestra present were removed.

Secondary haemorrhage occurred during the first month after wounding. Some mild cases cleared with packing of the wound, but several with bleeding of the femoral artery required amputation of the limb.

Joint Injuries: Of 132 cases 9 died from infection and haemorrhage and 9 had amputation performed. Plaster splints were largely used in treatment. One knee-joint case had been treated by German doctors by the insertion of two corrugated rubber drains into the joint and another across the popliteal space, and amputation was necessary when erosion of the femoral artery with brisk haemorrhage ensued. Blood transfusions were given to patients for haemorrhage and for secondary anaemia from chronic sepsis, orderlies being used as donors.

Nerve and Vascular Injuries: There were 153 nerve lesions, none of which was operated on in Greece, and 23 cleared up. Injuries of large vessels totalled 13, and some of the aneurysms were operated on and excised.

Simple Wounds: Some 613 major cases were admitted, many with very extensive wounds, and most were treated by the closed plaster technique. There were 15 deaths—4 from gas gangrene, 6 from sepsis, and 3 from secondary haemorrhage.

Jaw and Face Injuries: The 30 cases were mostly extensive injuries with much loss of bone and soft tissues, many cases in later years requiring grafting. Three deaths occurred within forty-eight hours of admission from pneumonia or sepsis. Lieutenant P. Noakes of the New Zealand Mobile Dental Unit treated the fracture cases with interdental wiring.

Eye Injuries: Forty-six cases were admitted and 16 eyes were removed, vulcanite artificial eyes being made by the dental department.

Burns: There were 2 deaths in 17 cases.

Tetanus: Two cases of tetanus were recorded and both died. Both had had previous prophylactic injections of tetanus toxoid, but no anti-tetanus serum was given after wounding. One of the patients was a Maori.

Gas Gangrene: Sixteen cases of gas gangrene were recorded and 7 died.

Of the other admissions to Kokkinia there were 335 with minor injuries, 297 with infectious diseases, and 502 with other diseases. There were 8 deaths from disease, the causes being bacillary dysentery associated with pneumonia, pulmonary tuberculosis, gastric carcinoma, bacterial endocarditis, splenomegaly, oesophageal stricture, and empyema following pneumonia.

Salonika Transit Camp Hospital

At Salonika, the most northern port of Greece, there was a transit camp for prisoners of war on their way to Germany. Conditions at the camp were deplorable in every way. In a period of six months some 30,000 prisoners of war were passed through the camp. At a hospital staffed by five British medical officers and thirty orderlies, including some New Zealanders, there were three thousand patients of all nationalities during the period. Seventy-nine of them died. Sickness included malaria, sandfly fever, pneumonia, bronchitis, diphtheria, jaundice, beriberi, nephritis, enteritis, typhoid, typhus, and poliomyelitis. Most of the surgical cases were sent to a Greek hospital under control of the Germans. At one time there were over 800 patients in the transit camp hospital, including 'through' patients from Kokkinia and other hospitals. Many of these patients were taken on to Germany, in a journey lasting up to eleven days, in cattle trucks, with straw for a bed and no blankets, very little food, and no medical attention.

Italy

Although 15 officers and 182 other ranks of the New Zealand Medical Corps were taken to Italy in December 1941 after their capture in the second Libyan campaign, it was some months before any of them were allowed to care for British wounded. Most of the wounded captured in Libya, including 206 New Zealanders, were taken across the Mediterranean by hospital ship. Some went to a hospital at Bari, where conditions and treatment were poor in the extreme; others went to a hospital at Caserta, where conditions were reasonably good, and where three British medical officers and orderlies who were allowed to work from December onwards were able to bring about improvements in treatment. While the staff was wholly Italian, they did not attempt to wash any of the patients, and bed sores were quite common. There were shortages of instruments and drugs.

As a result of the battles of Minqar Qaim, Ruweisat, and El Mreir in the summer of 1942, 1800 more New Zealanders were captured and taken to Italy to join the 1600 captured in the Libyan campaign seven months before. From hospitals in Matruh, Tobruk, and Benghazi the 258 wounded New Zealanders were taken to Bari and Caserta, but these hospitals became overcrowded so that the Italians found it necessary to set up special hospitals at Lucca, Bergamo, and other towns. Captured medical personnel were transferred from camps to help staff these hospitals. Thus at Lucca 2 New Zealand medical officers and 80 orderlies were included in the staff of 13 captured medical officers and 104 orderlies who worked under Italians in looking after some 530 patients.

The captured medical officers were apparently expected to do dressings only, but conditions were such that they felt compelled to 'infiltrate' themselves to help at operations, where advice could be given to Italian surgeons, whose standards were low. Much of their work was done without anaesthesia. Their treatment of fractures was appalling. They never used anaesthetics for them, made no attempt at reduction, splinted them roughly with plaster-of-paris or starched bandages, and left them to unite in any position of shortening, angulation, or rotation. In cases admitted later, and by that time treated by British medical staff, incomparably better results were achieved.

Lucca was one of the better hospitals: general equipment was satisfactory and there was no shortage of bandages, gauze, and wool, but lotions for dressings were few, most dressing being done with some fish-oil preparation. There was a curious substitute for iodine. Sulphonamides were scarcely known, and the Italians seldom prescribed more than four half-grain tablets a day. (Later, when Red Cross medical parcels arrived, the British officers were able to prescribe the usual doses.) There was no chloroform, and only small quantities of spinal anaesthetic and intravenous pento-thal. There were no splints except Kramer wire, but plaster-of-paris bandages, never more than three inches wide however, were nearly always available. It took about two hours' hard work to put on a good hip spica for a fractured femur, and that with numerous Heath Robinson improvisations by the British staff. Sanitary and washing facilities were very limited in the old hospital building.

Red Cross food parcels began to arrive a few weeks after the prisoner-of-war hospital was opened at Lucca, where the food was rather better than elsewhere but still inadequate, especially in fats; and with their distribution large wounds which had been stubborn in healing commenced to heal as if by magic. Later clothing, boots, and books arrived through Red Cross channels, and patients could be discharged fully clad.

After the fall of Tobruk many prisoners developed malaria in the transit camps of southern Italy, but little treatment was given. Those who reached Lucca were adequately treated as there were good stocks of both quinine and plasmoquine. Dysentery patients from nearby prisoner-of-war camps were common, and from one camp (Campo 60) sited on flat, marshy ground, there were over fifty cases of frostbite in the winter. When 120 starving and filthy Yugoslav patients were admitted after dreadful treatment by the Italians, there was a fear of typhus, but fortunately no cases developed.

Patients with major disabilities had their names sent forward by the medical officers for submission to the Mixed Medical Commission and in due course came before it for approval for repatriation. Arrangements for repatriation were protracted, and, apart from three New Zealand amputees included in a small group of British wounded and protected personnel exchanged in April 1942, not many sick and wounded were repatriated until April, May, and June 1943, when in a series of exchanges 60 sick and wounded New Zealanders and 114 New Zealand Medical Corps personnel were repatriated. A further exchange in September 1943 was prevented by the events of the Armistice in Italy, and medical officers and orderlies were taken north with their patients to Germany, where they continued their work.

Prisoner-of-War Hospitals in Germany

There were four types of hospital in which prisoners of war received medical treatment, namely, general hospitals exclusively for British prisoners, special hospitals exclusively for British prisoners, mixed general hospitals for prisoners of any nationality, and wards in local German hospitals. The hospitals for British prisoners were staffed by British personnel, including New Zealanders, under a German commanding officer. The mixed hospitals were staffed by men of all nationalities, including some New Zealanders. The patients treated in the German hospitals were those in districts where there were no special prisoner-of-war hospitals, or those requiring specialist treatment such as deep X-ray therapy, neurosurgery, or orthopaedic surgery. There were a number of specialists among the British medical officers, and these were employed in the hospitals in their own specialties.

Hospital supplies were generally adequate, and these were supplemented by supplies from the British Red Cross organisation, and also by surgical instruments saved by British medical officers captured in Greece. Improvisation enabled some equipment such as blood transfusion sets to be provided.

Lazarett Lamsdorf is illustrative of a special prisoner-of-war hospital, and it had many New Zealanders on its staff and among its patients.

Lazarett Lamsdorf

This hospital, opened on 13 October 1941, was planned to serve the needs of over 30,000 men and was undoubtedly the best designed and equipped hospital for British prisoners of war in Germany. It occupied six acres of flat land in a forest, and its eleven concrete buildings were fitted with double windows and wooden shutters. In every room was a large, efficient tiled stove. Six buildings were self-contained parallel blocks of wards, each holding from 70 to 100 patients. The five service buildings were the staff, administrative, and treatment blocks, kitchen and morgue. In the area was a large brick Red Cross as a sign for aircraft.

The ward blocks were divided into large and small wards with service rooms and with the necessary sanitary conveniences as in a modern hospital. The operating theatres were well equipped with efficient sterilising and full X-ray and laboratory facilities. Although the overall control was in the hands of a German medical officer, full control of the clinical work was given to the British, Australian, and New Zealand medical officers working under a senior British officer. The nursing staff, all medical personnel among the prisoners of war, lived at the hospital, while a daily party of general duty men was drawn from Stalag VIIIB, a mile away. There was a German chief dispenser in control of the stores, but otherwise the staff of the service departments was British. Besides physicians and surgeons there were anaesthetic, ophthalmic, radiological, neurosurgical, psychiatric, and ENT specialists available, either on the regular staff or visiting the hospital from time to time.

A Mixed Medical Commission of one German and two Swiss doctors visited the hospital twice a year to inspect it and also to determine which patients should be repatriated. At first the Germans insisted on all the preliminary investigation being carried out by German staff, thus necessitating the temporary transfer of the patient to a German hospital. Later the clinical reports of the British staff were generally accepted. Full case records were kept, with copies available for the Germans and the original for the United Kingdom, German forms being used. Admissions from the camp were arranged from a waiting list drawn up by the senior physician and surgeon at consultation clinics in the camp, and urgent cases were admitted at any time. Special accommodation was provided for the infectious and mental cases. The rations supplied by the Germans were meagre, but the Red Cross parcels enabled a satisfactory diet to be maintained, and four meals a day were served in the wards from a communal kitchen.

Entertainment and sport were permitted freely. In general, the Germans appear to have provided an excellent hospital with all supplies satisfactory except the rations, and allowed the British medical personnel to carry out their work with a minimum of control.

Surgical Work: Captain Slater, NZMC, was chief surgeon at Lamsdorf from October 1941 to March 1943 and developed the surgical service. A record of eleven months' work (March 1944 to February 1945) kept by Captain J. Borrie shows that 373 patients were admitted to one of the two surgical blocks. The patients were thoroughly investigated and records carefully kept. The majority were cases of appendicitis, hernia, rectal and genito-urinary diseases, orthopaedic problems, and nerve injuries. Simple fractures and late effects of septic gunshot wounds were common.

Peripheral nerve injuries were operated on by a visiting British neurosurgeon. Herniorraphy was performed under local anaesthesia, and the Germans finally agreed that none should work for three months after such operations. Deep X-ray therapy was administered for malignant cases at the University clinic in Breslau. In 1944 an inter-medullary nail was used with good primary results at the Breslau hospital in a case of mal-union of the femur. For the fracture cases excellent walking calipers and other splints were made by RAMC men from material obtained from Red Cross or German sources. Altogether opportunity was available for the performance of efficient surgical work.

The 432 complaints treated in the 373 patients were: appendicitis, 63; hernia, 50; fractures, 61; genito-urinary, 62; alimentary, 23; rectal, 6; peripheral nerve injury, 29; orthopaedic, 25; spinal disease, 13; joints, 26; osteomyelitis, 25; muscle and tendon, 3; tumours, 13; ENT, 7; minor surgery, 25.

Medical Supplies: There was in Germany the equivalent of most standard British medical preparations in the way of lotions, powders, solutions, ointments, anaesthetics, and sedatives. These were indented for by British medical officers and were apportioned out from central stocks by German dispensers. Some of the earlier sulphonamide drugs (sulphapyridine and sulphathiazole) were supplied to British medical officers by the Germans, but a German sulphaguanidine preparation was not available. Penicillin, of course, was not available.

Throughout the war the German supply to hospitals of cotton bandages, cotton wool, and dressings was inadequate, the standard issue being paper bandages and paper wadding which were also used for German casualties in base hospitals. The paper dressings were useful as they were absorbent, but the paper bandages were unsatisfactory. Fortunately the British Red Cross sent liberal supplies of bandages, cotton wool, and lint in their medical parcels for prisoners of war.

Medical Equipment: The original hospital instruments consisted of German field hospital panniers, which were not unlike British surgical panniers. In some hospitals, as at Lamsdorf, the Germans issued a sigmoidoscope, a cystoscope, and instruments for laparo-tomy, thoracotomy, spinal anaesthesia, wiring fractures, and plaster work. For intravenous work the Germans had a very useful 2 c.cm. syringe with a side inlet on the barrel. Suture needles were usually of the French or split eye variety. Record syringes and needles were available in all sizes. Silk, cotton, or catgut were used for suturing, and Michel clips were obtainable for skin. Blood transfusion sets had to be improvised. In general the equipment supplied was adequate for most surgical operations done, including even excision of semi-lunar cartilages from the knee joint, and partial gastrectomy.

GENERAL HEALTH OF PRISONERS OF WAR

The health of prisoners of war in Germany and Italy seems to have been much better than one might have expected, and was certainly better than that of those who were prisoners of the Japanese. Fortunately there were only a few New Zealanders captured in the Pacific area, as against over 8000 captured in the North African and European theatres.

Accurate and complete figures of sickness for New Zealanders are naturally not available as our men formed small component parts of many scattered prisoner-of-war camps and working parties, but from general reports the sickness rate was not very high, and no extensive epidemics ravaged the camps. There is no doubt that the presence of so many Allied medical officers and orderlies among the prisoners of war was a contributing factor to their good health, and that the receipt of Red Cross parcels was most important.

These factors were also contributory to a low death rate among the New Zealand prisoners. The death rate per thousand from sickness was slightly over twice as high as the comparative rate within 2 NZEF. There were 105 deaths from sickness, the causes being notified as: pneumonia, 12; dysentery, 12; meningitis, 8; heart, 6; neoplasms, 5; pulmonary tuberculosis, 4; diphtheria, 4; toxaemia, 4; nephritis, 3; peritonitis, 3; enterocolitis, 3; malaria, 2; cachexia, 2; other causes, 25; with causes not notified in the case of 12 deaths. Had sulphonamides and penicillin and other drugs been freely available to medical officers it is likely that the deaths would have been fewer still.

Typhus: Probably the greatest threat to health came from typhus fever, to which thousands of Russian prisoners and many German soldiers fell victim. Typhus fever raged through the Russian camps from November 1941. Two New Zealanders, Captain Foreman and Private Butler, NZMC, who, with Captain Stevenson-Wright, volunteered to go and assist at the hospital at the Russian camp at Neuhammer, developed typhus in March 1942, but both recovered. The sick at this hospital came from the 60,000 Russians in the nearby camp, where conditions were deplorable. Most of the cases treated in the hospital were suffering from starvation associated with hunger oedema, tuberculosis, dysentery, and typhus. The daily diet in the camp consisted of no more than 1200–1400 calories, and the diet for the sick Russians in hospital was 250 grammes of bread, 10 grammes of margarine, 10 grammes of sugar, and swede soup morning and evening. The hospital of twenty wooden barracks, each housing 100 patients, was overcrowded; there was no soap, medical supplies were very inadequate, and there were no laboratory and surgical facilities. There were 100–200 typhus cases in hospital at one time, and 80–90 Russians died each day. As far as typhus was concerned, good nursing was the only possible treatment. This description of the conditions of the Russians gives an indication of what could have been the fate of our own prisoners of war.

On 28 November 1941 there was an outbreak of typhus fever (the German fleckfieber, or typhus exanthematous) at the camp at Lamsdorf, where there were many New Zealanders. The first six cases occurred among medical orderlies who were working in the delousing station, which was used for Russians from adjoining camps as well as for the British camp. Prompt measures were taken by our medical officers. By 2 December all hair had been removed from the heads and bodies of all the 10,000 inmates of the camp, while an anti-louse campaign was in full swing, largely due to the arrangements made by Lieutenant-Colonel Bull with the Camp Commandant and senior German medical officer in regard to isolation, disinfestation, and improved facilities for personal hygiene. In all, 18 British developed typhus, with three, including one medical officer, succumbing.

Typhoid: There were sporadic cases of typhoid but no major outbreak among British prisoners in Germany. Each summer, in May, inmates of most of the large camps were given a 1 c.c. injection of German standard TAB vaccine. In 1944, at Lazarett Lamsdorf, one patient fatally perforated a typhoid ulcer in his terminal ileum.

Dysentery: Summer diarrhoea and Shiga dysentery occurred from time to time. Rarely was it severe among British working parties. Most cases subsided in two to three days; some were hospitalised in the camps. Amoebic dysentery was not uncommon; it usually required long courses of emetine and yatran before cures were effected. Sigmoidoscopes were available both at Lamsdorf and Cosel hospitals for ocular control of the ulcers. A few liver abscesses were treated at Lamsdorf by aspiration.

Famine Oedema: In Salonika camp from June until September 1941 famine oedema abounded, filling the wards of the hospital. Food and essential vitamins were most difficult to procure, but supplies of fresh fruit from the Greek Red Cross warded off scurvy. With better feeding for the British prisoners in Germany itself, famine oedema was not seen again until the last phase of the war, following semi-starvation on the 600–mile march west from Silesia from January to March 1945.

Tuberculosis: There was a small but steady incidence of tuberculosis. Besides pulmonary tuberculosis some cases of bone and joint tuberculosis were seen. All such patients were given an extra diet containing an increase of protein. About every six months the cases of pulmonary tuberculosis would be transported to Königswartha Sanatorium, where major surgery would be undertaken when indicated.

Conditions at Königswartha were far from satisfactory, as accommodation was very poor, equipment limited, and there was a shortage of staff despite the transfer of British medical officers and orderlies to the hospital in 1942. After the arrival of Lieutenant-Colonel L. E. Le Souef, AAMC, in August 1942, administration, organisation, and treatment all improved, but Le Souef petitioned for better conditions with the result that in March 1943 the patients were transferred to Elsterhorst, where a general hospital for prisoners of war had been specially built. At Elsterhorst facilities for surgery were much better and special thoracic instruments had been obtained by then. Later in the year serial radiography was begun among prisoner-of-war working parties to detect cases of tuberculosis. After being passed by the Mixed Medical Commission, groups of patients were repatriated in October 1943, May and September 1944, and January 1945. All sputum positive cases came in 1944 to be automatically accepted by the German authorities for repatriation, and most of the other cases recommended were approved by the Mixed Medical Commission. The result was that there were few patients left when Elsterhorst was evacuated in February 1945 from the path of the Russian advance. Lieutenant-Colonel Le Souef was transferred elsewhere in May 1944 and his place as Senior British Medical Officer was taken by Lieutenant-Colonel Bull, NZMC, who published the following statistics of cases. Over 1000 British patients, most of them from the United Kingdom, passed through the hospitals. There were only 22 New Zealanders admitted and two died; but 20 more cases were first diagnosed after repatriation to England in April 1945.

Types of treatment given to the British patients were:

Conservative	653
APT right or left	339
APT bilateral	49
APT failed or abandoned	44
Pleuroscopies only	16
Pleuroscopy with adhesion section	129
Pleuroscopy with section repeated	32
Phrenic crushes	35
Thoracoplasties	4

It can be seen that full scope was given to the modern and the surgical aspects of treatment.

Estimated results of treatment were:

Results	Conservative		Active (APT, etc.)	
	Number of Cases	Average Stay in Hospital (Months)	Number of Cases	Average Stay in Hospital (Months)
Improved	194 (28.17%)	9	185 (47.65%)	9
Unchanged	427 (65.39%)	3½	176 (45.36%)	6
Worse	32 (6.44%)	13	27 (6.99%)	12

Improved Negative sputum after original positive.

Improved Normal or only slightly increased BSR.

Improved Increased weight.

Incidence of Active Pulmonary Tuberculosis among British Troops (Pleurisies and Fibrotics Excluded)

Country of Origin	Numbers of Prisoners	Diagnosed in Germany	England	Incidence per 1000
United Kingdom	117,942	601	300	7.6
Canada	6,340	18	32	7.8
Australia	6,341	15	12	4.2
New Zealand	6,831	18	20	5.5
South Africa—				
European	9,183	8	16	2.6
Non-European	1,172	4	14	15.3
India	10,742	89	161	23.3

The actual incidence was higher as a few cases in Germany did not reach the tuberculosis hospitals, and other cases were diagnosed after their return from England to their own countries.

In a survey of War Pensions files at the end of 1949 Dr D. Macdonald Wilson found that 155 cases of pulmonary tuberculosis had arisen among prisoners and ex-prisoners of war, the number of cases diagnosed each year being: 1941, 4; 1942, 10; 1943, 8; 1944, 23; 1945, 70; 1946, 12; 1947, 14; 1948, 6; 1949, 8. Of these, 84 were not X-rayed at enlistment. The incidence among prisoners of war was over double that of the whole New Zealand overseas army group.

Cerebro-spinal Meningitis: In spite of the constant overcrowding of British prisoners of war in Germany there was never any major outbreak of cerebro-spinal meningitis. In one camp, Arbeitskom-mando E3 of Stalag VIIIB, there were three cases in 1943, and yet these occurred among the NCOs, where five men were sleeping in huts instead of the normal 24.

Skin Diseases: Skin diseases, particularly boils, became very prevalent amongst otherwise fit men when serving on working parties in Eastern Germany. Men often in what appeared to be the prime of physical fitness, who took great care of personal cleanliness, who worked in the open clothed only in shorts, would, for no apparent reason, come out in crops of boils, often situated on their arms, their axillae, neck, or face. These boils would frequently spread to become a localised, and at times generalised, weeping eczema, which would take weeks of careful nursing to clear. Nothing could be specifically blamed for their appearance, yet there was a general feeling that it was related to the lack of fresh milk, fresh fruit and vitamins; none of the men was proved to be a diabetic, and few showed any rapid improvement with vitamin extracts. Some men had their annual crop of boils in the winter, some in the summer. Undoubtedly the commonest ailment amongst 1000 men in a working party was skin disease, and of these, boils easily headed the list. One could rely on a steady 50 per 1000 men each month.

The Germans had a staphylococcal vaccine called 'staphar', which helped some. Colloidol manganese helped a few. Some even had to be admitted to the camp hospital, while others had to be returned to the main camp as convalescents.

Scabies: Where washing facilities were reasonable scabies was not seen, but in the crowding of the central camps it every now and again made a sporadic appearance. Treatment consisted in sterilising the clothing, either in a delouser or in a Serbian barrel. The skin was shaved and sulphur ointment applied. The Germans also had a colloidal sulphur preparation called 'pellidol' which was sometimes applied. The British Red Cross forwarded disinfectant parcels.

Tinea of the Feet was relatively common and responded to a proprietary preparation of salicylic acid 5 per cent.

Tinea Cruris also broke out from time to time. It usually required admission to the camp hospital, shaving of the pubic region and perineum, and then painting the large butterfly-shaped affected area, which usually extended from the root of the penis back to behind the anus, with gentian violet in spirit, or a German synthetic iodine, or with Whitfield's ointment.

There were also several victims of chronic psoriasis who could keep their ailment in check with chrysarobin for the scalp and cignolin for the trunk. Such men were best sent to working parties with good showering facilities.

Teeth: There was little increase in dental caries attributable to the life and the diet.

Goitre: There was a remarkably low incidence of goitre. In Lazarett Lamsdorf, which did the surgery for 30,000 prisoners of war, not more than ten men had thyroid operations in four years, and all these were for solitary adenoma.

Parasites: Bilharzial infection was seen, but rarely in patients who had come into captivity via the Middle East. It was diagnosed following a history of dysuria and haematuria. The protozoa were found in the urine, and on cystoscopy the characteristic 'tubercle' and cystitis demonstrated.

Frostbite: Those British prisoners captured in France in 1940 experienced a bitter winter between 1940 and 1941. No British Red Cross clothing had reached them at that time, and medical officers who treated men on working parties all testified to the minor frostbite which occurred among the men.

Following the great trek from Upper Silesia to Western and Central Germany in 1945, there were cases of frostbite. Major cases were hospitalised en route, and there treated by British or German surgeons. The lesser degrees, i.e., those with dry gangrene of toes, fingers or heels, were transported through to the central collecting camps between Nuremberg and Munich. These cases were treated by wound toilet to remove slough, application of sulphanilamide powder, and non-sticking vaseline (or cod-liver oil in vaseline) dressing. With daily bathing, dressings, and the return of warmer weather, these lesions rapidly began to heal, and were well on the way to recovery at the time of liberation on 6 April 1945.

Occupational Diseases

Prisoners suffered from certain occupational diseases.

Teno-synovitis: Men engaged in lumbering often developed teno-synovitis of the dorsal tendon sheaths of the wrist, and one attack in no way conferred an immunity. It is true to say that one attack predisposed to another, for one attack showed the patient an excellent way of getting a week's rest from work. The real danger to himself was to be labelled a 'chronic invalid', because one month's continued ill health meant return from the comparative comfort of a working party to the crowded discomfort of a central stalag.

Those who carried heavy loads of iron bars or cement might contract teno-synovitis in the tendon sheaths of the extensors of the toes, or in the gastrocnemius sheath. There was only one treatment—rest. If on the wrist, the forearm, hand and fingers were splinted on a padded Kramer wire splint, bound up tightly, supported in a sling and left for seven days. Similarly for the leg, except that the patient was also admitted to the camp hospital. No man could be trusted to ‘rest’ in his room.

Foreign Bodies in Eyes: These usually were stone or iron flakes, seen in men working lathes, or near lathes. They were usually readily removed with the aid of a binocular ‘lupe’, cocaine drops, eyelid retractor and eye spud. Sometimes an ulcer developed, requiring cauterising. Major Thomson, RAMC ophthalmologist, dealt with several cases in Lazarett Lamsdorf in which the anterior chamber of the eye was penetrated.

Conjunctivitis: This frequently arose in those near electric welding machines. Refusal to use the goggles provided was the cause of some; others had no goggles to wear. These were provided after protesting via the camp authorities to the Works Controllers.

Accidents

‘Gefangener's Toe’: This was a compound comminuted fracture of the terminal phalanx of the great toe, the result of dropping a brick or iron bar across the toe. Most were accidents, some intentional. Either way, they were painful, but they insured a two-months' rest from all work.

Treatment under anaesthesia was to remove the damaged toenail, clean up the wound, and dress with sterile cod-liver oil in vaseline dressing. The patient was then admitted to camp hospital (if only to rest the foot), and kept there till the toe healed. These cases were frequently X-rayed to determine the extent of the bony damage. They were slow to heal, and frequently ended in a deformed toenail which would give trouble later.

Finger Injuries: Crushed middle fingers with completely severed tendons, blood vessels, and nerves necessitated amputation.

Hernia: Occasionally indirect inguinal hernia occurred while working. One man, subjected to operation by a German surgeon in a German military hospital, had bilateral inguinal hernia repaired by Bassini technique, but without excising the sac. One side promptly recurred, requiring a second operation at which the sac was excised.

Varicose Veins: If small, these were treated with injections of sodium morrhuate called 'Varicocid'. This was partly successful; some were cured, some developed other veins. Larger veins required a Trendelenberg operation with ties in the thigh and calf.

Mental Disorders

As was only to be expected, mental disorders were in evidence among prisoners of war, but not to the extent that one might think. In general, the psychoneuroses appeared to be related to home conditions and domestic difficulties as disclosed in letters rather than to environmental conditions. There were those who became 'browned off' because of bad news from home—the death of a parent, disloyalty of a wife, etc. Several times it fell to medical officers to help initiate arrangements for a divorce.

Some men were mental misfits; they just could not settle down to the routine of the camp life, and asked for a change of working party. Some liked to change once a year, others more frequently. Usually only by way of some medical excuse, real or fictitious, could such change be effected.

Occasionally some member would rebel against British camp discipline. With such there was only one treatment—summary removal from camp, from the security of his environment and his friends.

Homosexuality was said to occur, but it was very difficult to get direct proof of such. Suicides were not common, but there were some suicides both in working parties and large camps. Others who became 'Stalag happy' literally tried to climb over the barbed-wire fences, being riddled to death by machine-gun fire from sentry boxes. Try as the British medical officers might, they could never persuade the German authorities to command their sentries that such men as these were usually mental, and that if they must shoot, they should shoot low.

WAR SURGERY AND MEDICINE

[SECTION]

FOR sick and wounded prisoners of war captured in Greece and Crete the major part of the clinical work, especially surgery, was performed in the early months at Kokkinia hospital, Piraeus, Athens. This hospital was opened on 9 May 1941 in a large American orphanage, only just completed, and was staffed by Australian, British, and New Zealand medical personnel. By early June the admissions to the hospital totalled 2038, made up as follows: from 5 Australian General Hospital, Ekali, 91; from 26 British General Hospital, Kephissia, 290; from Corinth and Kalamata hospitals, 260; from Crete, 1397.

At Corinth from 27 April Captain Slater and other New Zealand medical officers ran a hospital of 120 beds in the Ionian Palace Hotel. The medical officers were able to do dressings and simple surgical procedures, but cases requiring major surgery were transferred to the local Greek hospital or to a German military hospital. Most wounds were infected, one with gas gangrene, and the medical conditions included dysentery, but there were remarkably few deaths in the two weeks this hospital operated, despite the appalling lack of medical and sanitary facilities and the small amount of food. Some medical supplies were made available from the local Greek hospital. At Kalamata, in the south of Greece, Major G. H. Thomson, NZMC, and British medical officers set up a hospital in a hall.

In Crete the wounded were treated by the medical officers captured with their patients. Those from units near Maleme airfield were concentrated in the Tavronitis valley. Farther back near Canea Captain Ballantyne treated the wounded in his ADS, as did 7 General Hospital and Australian, British, and New Zealand medical staffs at the sites where seriously wounded were gathered on the road to Sfakia. The medical officers did all that their limited equipment would allow. By 23 May the RMOs of 5 Brigade, first Captain Longmore, then Captains Stewart and Hetherington, had joined up with Flying Officer T. Cullen, RAF, and staffed a dressing station in the Tavronitis valley. They worked in a stable attached to an inn. The German medical officers were overworked and were willing to let the captured medical officers set up their own dressing station for their own wounded with such equipment as the

Germans could spare. At the dressing station some 700 cases were put through, with only seven deaths, before the wounded were taken by plane to Athens.

At Ballantyne's ADS near Canea eight patients died of gas gangrene and others of abdominal wounds for whom little could be done. The Germans were generally helpful with equipment, and in arranging early transfers to Kokkinia hospital in Greece. At Lieutenant-Colonel Bull's emergency dressing station at Neon Khorion, four of the 46 wounded died. The Germans were slow to provide medical and surgical necessities. The patients were moved to Maleme on 7 June and then to Greece.

For the sick from the main crowded prisoner-of-war camp near Galatas Lieutenant-Colonel Bull organised a 200-bedded camp reception hospital, and cases included dysentery, malaria, poliomyelitis, diphtheria, catarrhal jaundice, and malnutrition. Between 9 June and 23 September there were 1212 admissions with 23 deaths. (Of the 402 New Zealanders admitted 4 died.)

KOKKINIA HOSPITAL

Kokkinia Hospital

At Kokkinia hospital New Zealand medical officers and orderlies shared in the treatment of British, Australian, and New Zealand battle casualties from Greece and Crete. The hospital was well equipped, largely from 5 Australian General Hospital, whence came the operating theatre, laboratory, and X-ray equipment. Dental equipment of the New Zealand Mobile Dental Unit was recovered from Voulas camp. Dispensary stocks came from the Australian hospital, from 26 British General Hospital after it closed at Kephissia, and the Germans issued some items from the captured British Medical Stores Depots. Antiseptics and opiates were in good supply, but there was a shortage of sulphonamide drugs, dressings, adhesive plaster, and plaster-of-paris. German plaster-of-paris was used later, but its quality was very poor at times. There was a serious shortage of syringes, surgical scissors, and dressing forceps.

In the five months' operations at Kokkinia 68 patients died, while 2334 were discharged as cured or relieved, and 109 still required hospital treatment.

The clinical work performed in the hospital was considerable, as the following details show. Most of the patients came from Crete by air and practically all their wounds were suppurating, the men being very ill, hungry, thirsty, and poorly clad. Some of the patients from Corinth and Kalamata were in a similar condition.

Head Injuries: Eighty-eight cases were treated, 19 being operated on. There were 13 deaths altogether among the 37 patients with perforating injuries; 14 of them developed cerebral abscess which caused 2 of the deaths. Four patients died within the first three days after admission. Dr Pfeiffer, the consultant neurosurgeon to the German forces in Greece, visited the hospital and operated on some cases, using Cushing's technique.

Chest Injuries: Most of the wounded with severe chest injuries died before reaching the hospital. Of the 100 patients admitted 5 died, all except 1 having other serious injuries such as head wounds. Haemothorax was present in 24 cases and empyema in 12. Of the latter, 2 died, 1 having a pyo-pneumothorax and a lung abscess.

Abdominal Injuries: Again, the severe casualties did not survive to reach hospital. Altogether there were 39 cases, of which 29 had perforating injuries, and of these 6 died from peritonitis or toxaemia.

Fractures: Some 349 compound fractures were treated, with 11 deaths and 27 amputations, while there were 68 simple fractures. On admission all fracture cases were X-rayed and then operated on, the wound edges being excised and the wound irrigated with hydrogen peroxide. Tulle gras or vaseline gauze dressings and plaster splints were then applied. Sulphonamides were given. The results generally were satisfactory, though deformity was commonly seen in the fractured femora, due to much bone and soft-tissue damage and to the lack of a portable X-ray plant. The treatment of individual fractures was on the following lines:

(a) Shoulder and humerus. Abduction frames made by orderlies from Kramer wire were used. Only a few had thoraco-brachial plasters as there was a shortage of plaster.
(b) Fractures of the elbow were put up at 90 degrees flexion, and in the mid-position of pronation and supination.
(c) Two simple fractures of the radius and ulna required open reduction.
(d) Hand wounds were put up in dorsiflexion of the wrist and flexion of the fingers.
(e) Fractures of the femur were treated in Thomas splints with Kirschner wire traction. Balkan beams were used. Lower-third fractures were treated in a Braun splint with Kirschner wire extension through the tibial tuberosity.
(f) Fractures of the tibia were treated in plaster splints. When extension was necessary this was carried out by Kirschner wire above the malleolus in a Braun splint. A Bohler frame was available for the reduction of lower limb fractures.

The plasters were changed at monthly intervals unless offensive discharge or infection necessitated earlier inspection. At the change of plaster any sequestra present were removed.

Secondary haemorrhage occurred during the first month after wounding. Some mild cases cleared with packing of the wound, but several with bleeding of the femoral artery required amputation of the limb.

Joint Injuries: Of 132 cases 9 died from infection and haemorrhage and 9 had amputation performed. Plaster splints were largely used in treatment. One knee-joint case had been treated by German doctors by the insertion of two corrugated rubber drains into the joint and another across the popliteal space, and amputation was necessary when erosion of the femoral artery with brisk haemorrhage ensued. Blood transfusions were given to patients for haemorrhage and for secondary anaemia from chronic sepsis, orderlies being used as donors.

Nerve and Vascular Injuries: There were 153 nerve lesions, none of which was operated on in Greece, and 23 cleared up. Injuries of large vessels totalled 13, and some of the aneurysms were operated on and excised.

Simple Wounds: Some 613 major cases were admitted, many with very extensive wounds, and most were treated by the closed plaster technique. There were 15 deaths—4 from gas gangrene, 6 from sepsis, and 3 from secondary haemorrhage.

Jaw and Face Injuries: The 30 cases were mostly extensive injuries with much loss of bone and soft tissues, many cases in later years requiring grafting. Three deaths occurred within forty-eight hours of admission from pneumonia or sepsis. Lieutenant P. Noakes of the New Zealand Mobile Dental Unit treated the fracture cases with interdental wiring.

Eye Injuries: Forty-six cases were admitted and 16 eyes were removed, vulcanite artificial eyes being made by the dental department.

Burns: There were 2 deaths in 17 cases.

Tetanus: Two cases of tetanus were recorded and both died. Both had had previous prophylactic injections of tetanus toxoid, but no anti-tetanus serum was given after wounding. One of the patients was a Maori.

Gas Gangrene: Sixteen cases of gas gangrene were recorded and 7 died.

Of the other admissions to Kokkinia there were 335 with minor injuries, 297 with infectious diseases, and 502 with other diseases. There were 8 deaths from disease, the causes being bacillary dysentery associated with pneumonia, pulmonary tuberculosis, gastric carcinoma, bacterial endocarditis, splenomegaly, oesophageal stricture, and empyema following pneumonia.

SALONIKA TRANSIT CAMP HOSPITAL

Salonika Transit Camp Hospital

At Salonika, the most northern port of Greece, there was a transit camp for prisoners of war on their way to Germany. Conditions at the camp were deplorable in every way. In a period of six months some 30,000 prisoners of war were passed through the camp. At a hospital staffed by five British medical officers and thirty orderlies, including some New Zealanders, there were three thousand patients of all nationalities during the period. Seventy-nine of them died. Sickness included malaria, sandfly fever, pneumonia, bronchitis, diphtheria, jaundice, beriberi, nephritis, enteritis, typhoid, typhus, and poliomyelitis. Most of the surgical cases were sent to a Greek hospital under control of the Germans. At one time there were over 800 patients in the transit camp hospital, including 'through' patients from Kokkinia and other hospitals. Many of these patients were taken on to Germany, in a journey lasting up to eleven days, in cattle trucks, with straw for a bed and no blankets, very little food, and no medical attention.

ITALY

Italy

Although 15 officers and 182 other ranks of the New Zealand Medical Corps were taken to Italy in December 1941 after their capture in the second Libyan campaign, it was some months before any of them were allowed to care for British wounded. Most of the wounded captured in Libya, including 206 New Zealanders, were taken across the Mediterranean by hospital ship. Some went to a hospital at Bari, where conditions and treatment were poor in the extreme; others went to a hospital at Caserta, where conditions were reasonably good, and where three British medical officers and orderlies who were allowed to work from December onwards were able to bring about improvements in treatment. While the staff was wholly Italian, they did not attempt to wash any of the patients, and bed sores were quite common. There were shortages of instruments and drugs.

As a result of the battles of Minqar Qaim, Ruweisat, and El Mreir in the summer of 1942, 1800 more New Zealanders were captured and taken to Italy to join the 1600 captured in the Libyan campaign seven months before. From hospitals in Matruh, Tobruk, and Benghazi the 258 wounded New Zealanders were taken to Bari and Caserta, but these hospitals became overcrowded so that the Italians found it necessary to set up special hospitals at Lucca, Bergamo, and other towns. Captured medical personnel were transferred from camps to help staff these hospitals. Thus at Lucca 2 New Zealand medical officers and 80 orderlies were included in the staff of 13 captured medical officers and 104 orderlies who worked under Italians in looking after some 530 patients.

The captured medical officers were apparently expected to do dressings only, but conditions were such that they felt compelled to ‘infiltrate’ themselves to help at operations, where advice could be given to Italian surgeons, whose standards were low. Much of their work was done without anaesthesia. Their treatment of fractures was appalling. They never used anaesthetics for them, made no attempt at reduction, splinted them roughly with plaster-of-paris or starched bandages, and left them to unite in any position of shortening, angulation, or rotation. In cases admitted later, and by that time treated by British medical staff, incomparably better results were achieved.

Lucca was one of the better hospitals: general equipment was satisfactory and there was no shortage of bandages, gauze, and wool, but lotions for dressings were few, most dressing being done with some fish-oil preparation. There was a curious substitute for iodine. Sulphonamides were scarcely known, and the Italians seldom prescribed more than four half-grain tablets a day. (Later, when Red Cross medical parcels arrived, the British officers were able to prescribe the usual doses.) There was no chloroform, and only small quantities of spinal anaesthetic and intravenous pento-thal. There were no splints except Kramer wire, but plaster-of-paris bandages, never more than three inches wide however, were nearly always available. It took about two hours' hard work to put on a good hip spica for a fractured femur, and that with numerous Heath Robinson improvisations by the British staff. Sanitary and washing facilities were very limited in the old hospital building.

Red Cross food parcels began to arrive a few weeks after the prisoner-of-war hospital was opened at Lucca, where the food was rather better than elsewhere but still inadequate, especially in fats; and with their distribution large wounds which had been stubborn in healing commenced to heal as if by magic. Later clothing, boots, and books arrived through Red Cross channels, and patients could be discharged fully clad.

After the fall of Tobruk many prisoners developed malaria in the transit camps of southern Italy, but little treatment was given. Those who reached Lucca were adequately treated as there were good stocks of both quinine and plasmoquine. Dysentery patients from nearby prisoner-of-war camps were common, and from one camp (Campo 60) sited on flat, marshy ground, there were over fifty cases of frostbite in the winter. When 120 starving and filthy Yugoslav patients were admitted after dreadful treatment by the Italians, there was a fear of typhus, but fortunately no cases developed.

Patients with major disabilities had their names sent forward by the medical officers for submission to the Mixed Medical Commission and in due course came before it for approval for repatriation. Arrangements for repatriation were protracted, and, apart from three New Zealand amputees included in a small group of British wounded and protected personnel exchanged in April 1942, not many sick and wounded were repatriated until April, May, and June 1943, when in a series of exchanges 60 sick and wounded New Zealanders and 114 New Zealand Medical Corps personnel were repatriated. A further exchange in September 1943 was prevented by the events of the Armistice in Italy, and medical officers and orderlies were taken north with their patients to Germany, where they continued their work.

Prisoner-of-War Hospitals in Germany

There were four types of hospital in which prisoners of war received medical treatment, namely, general hospitals exclusively for British prisoners, special hospitals exclusively for British prisoners, mixed general hospitals for prisoners of any nationality, and wards in local German hospitals. The hospitals for British prisoners were staffed by British personnel, including New Zealanders, under a German commanding officer. The mixed hospitals were staffed by men of all nationalities, including some New Zealanders. The patients treated in the German hospitals were those in districts where there were no special prisoner-of-war hospitals, or those requiring specialist treatment such as deep X-ray therapy, neurosurgery, or orthopaedic surgery. There were a number of specialists among the British medical officers, and these were employed in the hospitals in their own specialties.

Hospital supplies were generally adequate, and these were supplemented by supplies from the British Red Cross organisation, and also by surgical instruments saved by British medical officers captured in Greece. Improvisation enabled some equipment such as blood transfusion sets to be provided.

Lazarett Lamsdorf is illustrative of a special prisoner-of-war hospital, and it had many New Zealanders on its staff and among its patients.

Lazarett Lamsdorf

This hospital, opened on 13 October 1941, was planned to serve the needs of over 30,000 men and was undoubtedly the best designed and equipped hospital for British prisoners of war in Germany. It occupied six acres of flat land in a forest, and its eleven concrete buildings were fitted with double windows and wooden shutters. In every room was a large, efficient tiled stove. Six buildings were self-contained parallel blocks of wards, each holding from 70 to 100 patients. The five service buildings were the staff, administrative, and treatment blocks, kitchen and morgue. In the area was a large brick Red Cross as a sign for aircraft.

The ward blocks were divided into large and small wards with service rooms and with the necessary sanitary conveniences as in a modern hospital. The operating theatres were well equipped with efficient sterilising and full X-ray and laboratory facilities. Although the overall control was in the hands of a German medical officer, full control of the clinical work was given to the British, Australian, and New Zealand medical officers working under a senior British officer. The nursing staff, all medical personnel among the prisoners of war, lived at the hospital, while a daily party of general duty men was drawn from Stalag VIIIB, a mile away. There was a German chief dispenser in control of the stores, but otherwise the staff of the service departments was British. Besides physicians and surgeons there were anaesthetic, ophthalmic, radiological, neurosurgical, psychiatric, and ENT specialists available, either on the regular staff or visiting the hospital from time to time.

A Mixed Medical Commission of one German and two Swiss doctors visited the hospital twice a year to inspect it and also to determine which patients should be repatriated. At first the Germans insisted on all the preliminary investigation being carried out by German staff, thus necessitating the temporary transfer of the patient to a German hospital. Later the clinical reports of the British staff were generally accepted. Full case records were kept, with copies available for the Germans and the original for the United Kingdom, German forms being used. Admissions from the camp were arranged from a waiting list drawn up by the senior physician and surgeon at consultation clinics in the camp, and urgent cases were admitted at any time. Special accommodation was provided for the infectious and mental cases. The rations supplied by the Germans were meagre, but the Red Cross parcels enabled a satisfactory diet to be maintained, and four meals a day were served in the wards from a communal kitchen.

Entertainment and sport were permitted freely. In general, the Germans appear to have provided an excellent hospital with all supplies satisfactory except the rations, and allowed the British medical personnel to carry out their work with a minimum of control.

Surgical Work: Captain Slater, NZMC, was chief surgeon at Lamsdorf from October 1941 to March 1943 and developed the surgical service. A record of eleven months' work (March 1944 to February 1945) kept by Captain J. Borrie shows that 373 patients were admitted to one of the two surgical blocks. The patients were thoroughly investigated and records carefully kept. The majority were cases of appendicitis, hernia, rectal and genito-urinary diseases, orthopaedic problems, and nerve injuries. Simple fractures and late effects of septic gunshot wounds were common.

Peripheral nerve injuries were operated on by a visiting British neurosurgeon. Herniorraphy was performed under local anaesthesia, and the Germans finally agreed that none should work for three months after such operations. Deep X-ray therapy was administered for malignant cases at the University clinic in Breslau. In 1944 an inter-medullary nail was used with good primary results at the Breslau hospital in a case of mal-union of the femur. For the fracture cases excellent walking calipers and other splints were made by RAMC men from material obtained from Red Cross or German sources. Altogether opportunity was available for the performance of efficient surgical work.

The 432 complaints treated in the 373 patients were: appendicitis, 63; hernia, 50; fractures, 61; genito-urinary, 62; alimentary, 23; rectal, 6; peripheral nerve injury, 29; orthopaedic, 25; spinal disease, 13; joints, 26; osteomyelitis, 25; muscle and tendon, 3; tumours, 13; ENT, 7; minor surgery, 25.

Medical Supplies: There was in Germany the equivalent of most standard British medical preparations in the way of lotions, powders, solutions, ointments, anaesthetics, and sedatives. These were indented for by British medical officers and were apportioned out from central stocks by German dispensers. Some of the earlier sulphonamide drugs (sulphapyridine and sulphathiazole) were supplied to British medical officers by the Germans, but a German sulphaguanidine preparation was not available. Penicillin, of course, was not available.

Throughout the war the German supply to hospitals of cotton bandages, cotton wool, and dressings was inadequate, the standard issue being paper bandages and paper wadding which were also used for German casualties in base hospitals. The paper dressings were useful as they were absorbent, but the paper bandages were unsatisfactory. Fortunately the British Red Cross sent liberal supplies of bandages, cotton wool, and lint in their medical parcels for prisoners of war.

Medical Equipment: The original hospital instruments consisted of German field hospital panniers, which were not unlike British surgical panniers. In some hospitals, as at Lamsdorf, the Germans issued a sigmoidoscope, a cystoscope, and instruments for laparo-tomy, thoracotomy, spinal anaesthesia, wiring fractures, and plaster work. For intravenous work the Germans had a very useful 2 c.cm. syringe with a side inlet on the barrel. Suture needles were usually of the French or split eye variety. Record syringes and needles were available in all sizes. Silk, cotton, or catgut were used for suturing, and Michel clips were obtainable for skin. Blood transfusion sets had to be improvised. In general the equipment supplied was adequate for most surgical operations done, including even excision of semi-lunar cartilages from the knee joint, and partial gastrectomy.

GENERAL HEALTH OF PRISONERS OF WAR

GENERAL HEALTH OF PRISONERS OF WAR

The health of prisoners of war in Germany and Italy seems to have been much better than one might have expected, and was certainly better than that of those who were prisoners of the Japanese. Fortunately there were only a few New Zealanders captured in the Pacific area, as against over 8000 captured in the North African and European theatres.

Accurate and complete figures of sickness for New Zealanders are naturally not available as our men formed small component parts of many scattered prisoner-of-war camps and working parties, but from general reports the sickness rate was not very high, and no extensive epidemics ravaged the camps. There is no doubt that the presence of so many Allied medical officers and orderlies among the prisoners of war was a contributing factor to their good health, and that the receipt of Red Cross parcels was most important.

These factors were also contributory to a low death rate among the New Zealand prisoners. The death rate per thousand from sickness was slightly over twice as high as the comparative rate within 2 NZEF. There were 105 deaths from sickness, the causes being notified as: pneumonia, 12; dysentery, 12; meningitis, 8; heart, 6; neoplasms, 5; pulmonary tuberculosis, 4; diphtheria, 4; toxaemia, 4; nephritis, 3; peritonitis, 3; enterocolitis, 3; malaria, 2; cachexia, 2; other causes, 25; with causes not notified in the case of 12 deaths. Had sulphonamides and penicillin and other drugs been freely available to medical officers it is likely that the deaths would have been fewer still.

Typhus: Probably the greatest threat to health came from typhus fever, to which thousands of Russian prisoners and many German soldiers fell victim. Typhus fever raged through the Russian camps from November 1941. Two New Zealanders, Captain Foreman and Private Butler, NZMC, who, with Captain Stevenson-Wright, volunteered to go and assist at the hospital at the Russian camp at Neuhammer, developed typhus in March 1942, but both recovered. The sick at this hospital came from the 60,000 Russians in the nearby camp, where conditions were deplorable. Most of the cases treated in the hospital were suffering from starvation associated with hunger oedema, tuberculosis, dysentery, and typhus. The daily diet in the camp consisted of no more than 1200–1400 calories, and the diet for the sick Russians in hospital was 250 grammes of bread, 10 grammes of margarine, 10 grammes of sugar, and swede soup morning and evening. The hospital of twenty wooden barracks, each housing 100 patients, was overcrowded; there was no soap, medical supplies were very inadequate, and there were no laboratory and surgical facilities. There were 100–200 typhus cases in hospital at one time, and 80–90 Russians died each day. As far as typhus was concerned, good nursing was the only possible treatment. This description of the conditions of the Russians gives an indication of what could have been the fate of our own prisoners of war.

On 28 November 1941 there was an outbreak of typhus fever (the German fleckfieber, or typhus exanthematous) at the camp at Lamsdorf, where there were many New Zealanders. The first six cases occurred among medical orderlies who were working in the delousing station, which was used for Russians from adjoining camps as well as for the British camp. Prompt measures were taken by our medical officers. By 2 December all hair had been removed from the heads and bodies of all the 10,000 inmates of the camp, while an anti-louse campaign was in full swing, largely due to the arrangements made by Lieutenant-Colonel Bull with the Camp Commandant and senior German medical officer in regard to isolation, disinfestation, and improved facilities for personal hygiene. In all, 18 British developed typhus, with three, including one medical officer, succumbing.

Typhoid: There were sporadic cases of typhoid but no major outbreak among British prisoners in Germany. Each summer, in May, inmates of most of the large camps were given a 1 c.c. injection of German standard TAB vaccine. In 1944, at Lazarett Lamsdorf, one patient fatally perforated a typhoid ulcer in his terminal ileum.

Dysentery: Summer diarrhoea and Shiga dysentery occurred from time to time. Rarely was it severe among British working parties. Most cases subsided in two to three days; some were hospitalised in the camps. Amoebic dysentery was not uncommon; it usually required long courses of emetine and yatran before cures were effected. Sigmoidoscopes were available both at Lamsdorf and Cosel hospitals for ocular control of the ulcers. A few liver abscesses were treated at Lamsdorf by aspiration.

Famine Oedema: In Salonika camp from June until September 1941 famine oedema abounded, filling the wards of the hospital. Food and essential vitamins were most difficult to procure, but supplies of fresh fruit from the Greek Red Cross warded off scurvy. With better feeding for the British prisoners in Germany itself, famine oedema was not seen again until the last phase of the war, following semi-starvation on the 600–mile march west from Silesia from January to March 1945.

Tuberculosis: There was a small but steady incidence of tuberculosis. Besides pulmonary tuberculosis some cases of bone and joint tuberculosis were seen. All such patients were given an extra diet containing an increase of protein. About every six months the cases of pulmonary tuberculosis would be transported to Königswartha Sanatorium, where major surgery would be undertaken when indicated.

Conditions at Königswartha were far from satisfactory, as accommodation was very poor, equipment limited, and there was a shortage of staff despite the transfer of British medical officers and orderlies to the hospital in 1942. After the arrival of Lieutenant-Colonel L. E. Le Souef, AAMC, in August 1942, administration, organisation, and treatment all improved, but Le Souef petitioned for better conditions with the result that in March 1943 the patients were transferred to Elsterhorst, where a general hospital for prisoners of war had been specially built. At Elsterhorst facilities for surgery were much better and special thoracic instruments had been obtained by then. Later in the year serial radiography was begun among prisoner-of-war working parties to detect cases of tuberculosis. After being passed by the Mixed Medical Commission, groups of patients were repatriated in October 1943, May and September 1944, and January 1945. All sputum positive cases came in 1944 to be automatically accepted by the German authorities for repatriation, and most of the other cases recommended were approved by the Mixed Medical Commission. The result was that there were few patients left when Elsterhorst was evacuated in February 1945 from the path of the Russian advance. Lieutenant-Colonel Le Souef was transferred elsewhere in May 1944 and his place as Senior British Medical Officer was taken by Lieutenant-Colonel Bull, NZMC, who published the following statistics of cases. Over 1000 British patients, most of them from the United Kingdom, passed through the hospitals. There were only 22 New Zealanders admitted and two died; but 20 more cases were first diagnosed after repatriation to England in April 1945.

Types of treatment given to the British patients were:

Conservative	653
APT right or left	339
APT bilateral	49
APT failed or abandoned	44
Pleuroscopies only	16
Pleuroscopy with adhesion section	129
Pleuroscopy with section repeated	32
Phrenic crushes	35
Thoracoplasties	4

It can be seen that full scope was given to the modern and the surgical aspects of treatment.

Estimated results of treatment were:

Results	Conservative		Active (APT, etc.)	
	Number of Cases	Average Stay in Hospital (Months)	Number of Cases	Average Stay in Hospital (Months)
Improved	194 (28.17%)	9	185 (47.65%)	9
Unchanged	427 (65.39%)	3½	176 (45.36%)	6
Worse	32 (6.44%)	13	27 (6.99%)	12

Improved Negative sputum after original positive.

Improved Normal or only slightly increased BSR.

Improved Increased weight.

Incidence of Active Pulmonary Tuberculosis among British Troops (Pleurisies and Fibrotics Excluded)

Diagnosed in

Country of Origin	Numbers of Prisoners	Germany	England	Incidence per 1000
United Kingdom	117,942	601	300	7.6
Canada	6,340	18	32	7.8
Australia	6,341	15	12	4.2
New Zealand	6,831	18	20	5.5
South Africa—				
European	9,183	8	16	2.6
Non-European	1,172	4	14	15.3
India	10,742	89	161	23.3

The actual incidence was higher as a few cases in Germany did not reach the tuberculosis hospitals, and other cases were diagnosed after their return from England to their own countries.

In a survey of War Pensions files at the end of 1949 Dr D. Macdonald Wilson found that 155 cases of pulmonary tuberculosis had arisen among prisoners and ex-prisoners of war, the number of cases diagnosed each year being: 1941, 4; 1942, 10; 1943, 8; 1944, 23; 1945, 70; 1946, 12; 1947, 14; 1948, 6; 1949, 8. Of these, 84 were not X-rayed at enlistment. The incidence among prisoners of war was over double that of the whole New Zealand overseas army group.

Cerebro-spinal Meningitis: In spite of the constant overcrowding of British prisoners of war in Germany there was never any major outbreak of cerebro-spinal meningitis. In one camp, Arbeitskom-mando E3 of Stalag VIIIB, there were three cases in 1943, and yet these occurred among the NCOs, where five men were sleeping in huts instead of the normal 24.

Skin Diseases: Skin diseases, particularly boils, became very prevalent amongst otherwise fit men when serving on working parties in Eastern Germany. Men often in what appeared to be the prime of physical fitness, who took great care of personal cleanliness, who worked in the open clothed only in shorts, would, for no apparent reason, come out in crops of boils, often situated on their arms, their axillae, neck, or face. These boils would frequently spread to become a localised, and at times generalised, weeping eczema, which would take weeks of careful nursing to clear. Nothing could be specifically blamed for their appearance, yet there was a general feeling that it was related to the lack of fresh milk, fresh fruit and vitamins; none of the men was proved to be a diabetic, and few showed any rapid improvement with vitamin extracts. Some men had their annual crop of boils in the winter, some in the summer. Undoubtedly the commonest ailment amongst 1000 men in a working party was skin disease, and of these, boils easily headed the list. One could rely on a steady 50 per 1000 men each month.

The Germans had a staphylococcal vaccine called 'staphar', which helped some. Colloidol manganese helped a few. Some even had to be admitted to the camp hospital, while others had to be returned to the main camp as convalescents.

Scabies: Where washing facilities were reasonable scabies was not seen, but in the crowding of the central camps it every now and again made a sporadic appearance. Treatment consisted in sterilising the clothing, either in a delouser or in a Serbian barrel. The skin was shaved and sulphur ointment applied. The Germans also had a colloidal sulphur preparation called 'pellidol' which was sometimes applied. The British Red Cross forwarded disinfectant parcels.

Tinea of the Feet was relatively common and responded to a proprietary preparation of salicylic acid 5 per cent.

Tinea Cruris also broke out from time to time. It usually required admission to the camp hospital, shaving of the pubic region and perineum, and then painting the large butterfly-shaped affected area, which usually extended from the root of the penis back to behind the anus, with gentian violet in spirit, or a German synthetic iodine, or with Whitfield's ointment.

There were also several victims of chronic psoriasis who could keep their ailment in check with chrysarobin for the scalp and cignolin for the trunk. Such men were best sent to working parties with good showering facilities.

Teeth: There was little increase in dental caries attributable to the life and the diet.

Goitre: There was a remarkably low incidence of goitre. In Lazarett Lamsdorf, which did the surgery for 30,000 prisoners of war, not more than ten men had thyroid operations in four years, and all these were for solitary adenoma.

Parasites: Bilharzial infection was seen, but rarely in patients who had come into captivity via the Middle East. It was diagnosed following a history of dysuria and haematuria. The protozoa were found in the urine, and on cystoscopy the characteristic 'tubercle' and cystitis demonstrated.

Frostbite: Those British prisoners captured in France in 1940 experienced a bitter winter between 1940 and 1941. No British Red Cross clothing had reached them at that time, and medical officers who treated men on working parties all testified to the minor frostbite which occurred among the men.

Following the great trek from Upper Silesia to Western and Central Germany in 1945, there were cases of frostbite. Major cases were hospitalised en route, and there treated by British or German surgeons. The lesser degrees, i.e., those with dry gangrene of toes, fingers or heels, were transported through to the central collecting camps between Nuremberg and Munich. These cases were treated by wound toilet to remove slough, application of sulphanilamide powder, and non-sticking vaseline (or cod-liver oil in vaseline) dressing. With daily bathing, dressings, and the return of warmer weather, these lesions rapidly began to heal, and were well on the way to recovery at the time of liberation on 6 April 1945.

Occupational Diseases

Prisoners suffered from certain occupational diseases.

Teno-synovitis: Men engaged in lumbering often developed teno-synovitis of the dorsal tendon sheaths of the wrist, and one attack in no way conferred an immunity. It is true to say that one attack predisposed to another, for one attack showed the patient an excellent way of getting a week's rest from work. The real danger to himself was to be labelled a 'chronic invalid', because one month's continued ill health meant return from the comparative comfort of a working party to the crowded discomfort of a central stalag.

Those who carried heavy loads of iron bars or cement might contract teno-synovitis in the tendon sheaths of the extensors of the toes, or in the gastrocnemius sheath. There was only one treatment—rest. If on the wrist, the forearm, hand and fingers were splinted on a padded Kramer wire splint, bound up tightly, supported in a sling and left for seven days. Similarly for the leg, except that the patient was also admitted to the camp hospital. No man could be trusted to 'rest' in his room.

Foreign Bodies in Eyes: These usually were stone or iron flakes, seen in men working lathes, or near lathes. They were usually readily removed with the aid of a binocular 'lupe', cocaine drops, eyelid retractor and eye spud. Sometimes an ulcer developed, requiring cauterising. Major Thomson, RAMC ophthalmologist, dealt with several cases in Lazarett Lamsdorf in which the anterior chamber of the eye was penetrated.

Conjunctivitis: This frequently arose in those near electric welding machines. Refusal to use the goggles provided was the cause of some; others had no goggles to wear. These were provided after protesting via the camp authorities to the Works Controllers.

Accidents

'Gefangener's Toe': This was a compound comminuted fracture of the terminal phalanx of the great toe, the result of dropping a brick or iron bar across the toe. Most were accidents, some intentional. Either way, they were painful, but they insured a two-months' rest from all work.

Treatment under anaesthesia was to remove the damaged toenail, clean up the wound, and dress with sterile cod-liver oil in vaseline dressing. The patient was then admitted to camp hospital (if only to rest the foot), and kept there till the toe healed. These cases were frequently X-rayed to determine the extent of the bony damage. They were slow to heal, and frequently ended in a deformed toenail which would give trouble later.

Finger Injuries: Crushed middle fingers with completely severed tendons, blood vessels, and nerves necessitated amputation.

Hernia: Occasionally indirect inguinal hernia occurred while working. One man, subjected to operation by a German surgeon in a German military hospital, had bilateral inguinal hernia repaired by Bassini technique, but without excising the sac. One side promptly recurred, requiring a second operation at which the sac was excised.

Varicose Veins: If small, these were treated with injections of sodium morrhuate called ‘Varicocid’. This was partly successful; some were cured, some developed other veins. Larger veins required a Trendelenberg operation with ties in the thigh and calf.

Mental Disorders

As was only to be expected, mental disorders were in evidence among prisoners of war, but not to the extent that one might think. In general, the psychoneuroses appeared to be related to home conditions and domestic difficulties as disclosed in letters rather than to environmental conditions. There were those who became ‘browned off’ because of bad news from home—the death of a parent, disloyalty of a wife, etc. Several times it fell to medical officers to help initiate arrangements for a divorce.

Some men were mental misfits; they just could not settle down to the routine of the camp life, and asked for a change of working party. Some liked to change once a year, others more frequently. Usually only by way of some medical excuse, real or fictitious, could such change be effected.

Occasionally some member would rebel against British camp discipline. With such there was only one treatment—summary removal from camp, from the security of his environment and his friends.

Homosexuality was said to occur, but it was very difficult to get direct proof of such. Suicides were not common, but there were some suicides both in working parties and large camps. Others who became ‘Stalag happy’ literally tried to climb over the barbed-wire fences, being riddled to death by machine-gun fire from sentry boxes. Try as the British medical officers might, they could never persuade the German authorities to command their sentries that such men as these were usually mental, and that if they must shoot, they should shoot low.

PART II — MEDICAL

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CHAPTER 1
Dysentery

FIRST WORLD WAR

IN the Middle East in the First World War the troops of 1 NZEF suffered from dysentery, as did their successors in 2 NZEF. All fresh troops were subject to attacks of diarrhoea, and large numbers of the more serious cases were hospitalised for dysentery. It was noted that New Zealand troops in general were more prone to dysenteric infection and suffered more severe attacks than did British or Indian troops.

The presence of horses in the lines in base camps in Egypt in the First World War made it difficult to maintain a high standard of hygiene. Throughout Egypt flies abounded in incredible numbers, and the general living conditions of the civilian population were worse than they were during the Second World War. On the Gallipoli Peninsula the sanitary and living conditions were exceptionally difficult. Referring to bacillary dysentery the British Medical History stated that it 'was prevalent throughout the whole war. It first claimed serious attention when it broke out in epidemic form in Gallipoli in August 1915, where in three months it was responsible for a high proportion of the 120,000 casualties evacuated from the Peninsula on account of sickness.' Many of the cases from Gallipoli were caused by the Shiga bacillus.

Figures for the total incidence in 1 NZEF are not available, but reports from 1 NZ General Hospital at Abbassia show that between 1 July 1915 and 31 March 1916 there were 6836 patients admitted, and of these 2524, or 37 per cent, suffered from diseases of the alimentary system. Dysentery and infective enteritis accounted for 1156 of the group, the highest incidence being in August and September. (Dysentery was earlier prevalent in the Samoan Expeditionary Force.)

In France the conditions of trench warfare were such as to make it difficult to maintain an efficient standard of sanitation. On the Somme in 1916 there was an outbreak of bacillary dysentery, mainly Flexner in type. There were 81 deaths from dysentery in 1 NZEF overseas.

No specific treatment for bacillary dysentery was available, and the attacks were often prolonged and very debilitating. Amoebic infection was treated with emetine both by injection and by mouth. A British survey published in Diseases of the War shows that for 2319 cases of dysentery from Gallipoli the time of treatment averaged seventy-five days. It was estimated that amoebic dysentery formed about 10 per cent of the dysentery cases from Gallipoli, 2 per cent to 7 per cent of the cases from Egypt and Palestine, and 2.8 per cent of the cases in France.

Experience in New Zealand between Wars

Dysentery did not cause any great civilian health problem in New Zealand after the return of 1 NZEF. Pensions cases were few. At 31 March 1924, for all forms of gastro-intestinal disease, there were only 43 men permanently on pension and 271 temporarily on pension. Some cases of amoebic abscess of the liver were recorded in ex-servicemen who had served in the Middle East. Occasional cases of amoebiasis have been diagnosed as late as 1948 and the infection attributed to First World War service, with the infection lying dormant since that time. Amoebic dysentery was not made a notifiable disease by the Health Department until 1926 and the first case was not notified until 1933. No further case was notified until 1941.

In the light of the experience with returned servicemen of the Second World War it is probable that a considerable number of those who returned from the First World War not only harboured amoebic infection, but also suffered various grades of ill-health, possibly for years afterwards. Such cases were either unidentified or, if pensioned, probably diagnosed as debility or neurasthenia. In many cases the infection probably remained inactive, and in most cases probably died out after a time.

SECOND WORLD WAR

Dysentery being endemic in Egypt, it was only natural that New Zealand troops in 2 NZEF in Egypt would contract the disease in some form despite good sanitation arrangements and hygiene education within the Force. As it happened, up to 4 per cent annually of the 2 NZEF were hospitalised with dysentery. In addition it was thought likely by many medical officers that the vast majority of cases of acute diarrhoea occurring in troops in the Middle East were, in reality, cases of bacillary dysentery, because the clinical features were the same in those patients from whom bacilli were not isolated as in those from whom they were.

Probably nearly every soldier in the Middle East had at least one attack of acute diarrhoea, usually soon after arrival, and only a proportion of those reporting sick were sent to hospital. New Zealand troops had had no opportunity to develop an immunity to the infection, and suffered from the disease in common with other Commonwealth troops, no matter how high the standards of camp hygiene. Some immunity seemed to be developed in Egypt, however, as in the second summer recurrences of diarrhoea were not nearly as common as initial attacks among newly arrived troops. The seasonal incidence tended to show two main peaks—in early and in late summer—the drop in mid-summer being associated with the diminution in the number of flies. This was not true of 2 NZEF in 1942; the Division was holding the Alamein line in mid-summer, and the presence of swarms of flies spread the infection at that period.

In April and May of 1940, at the beginning of the summer, there was a period of high incidence among First Echelon troops, among whom there were 140 cases. By June there were very few cases, but in October and November 1940 there were 278 cases. The Third Echelon had arrived in Egypt on 29 September, and 60 per cent of the cases were from these newly-arrived troops. The First Echelon at this stage was in the Western Desert; there the incidence of dysentery was higher than in Maadi Camp, where steady improvement in camp sanitation had taken place.

In the 505 cases in 2 NZEF in Egypt up to the end of November bacteriological examination revealed that the types of dysentery were Flexner 22.4 per cent, Shiga 4.5 per cent, Schmitz 1.4 per cent, Sonne 0.4 per cent, amoebic 2 per cent, bacillary exudate 38.4 per cent, and indefinite exudate 30.9 per cent. In November there was an increase in the relative incidence of bacillary dysentery due to infection by the Shiga bacillus. This applied to British troops as well as to New Zealanders, and the medical authorities kept a careful watch for these infections owing to the risk of a true epidemic occurring. These cases were more serious than the average Flexner dysentery, and of the three deaths caused in 2 NZEF by dysentery between February and November 1940, one at least was due to Shiga infection.

In a British hospital in Egypt the analysis of a large number of dysentery cases over two years revealed that the types of bacilli isolated occurred in the following proportions: Flexner 70 per cent, Shiga 19 per cent, Sonne 6 per cent, Schmitz 5 per cent, amoebic 1 per cent. Of the total dysenteries, 56 per cent did not pass blood and mucus, and their average stay in hospital was ten days; 20 per cent of the cases, though passing mucus, were mild, while 22 per cent were moderately severe and 2 per cent severe. Those passing mucus stayed in hospital an average of twenty days. It is likely that 2 NZEF experience with the disease was somewhat in conformity with this.

At the base hospital at Helwan special wards were constructed, apart from the main building and near the laboratory, to prevent cross infection in the wards and the spread of the disease to the rest of the hospital.

In May and June 1941 there was a rise in incidence again following the evacuation of Greece and Crete, where dysentery was also endemic, and where during the withdrawal there could not be the normal standard of control in hygiene and sanitation. Again in November 1941, when the New Zealanders were in Libya, there was an increase in the number of cases. This was thought to be in some measure due to dust-storms which swept over areas contaminated by natives and by the enemy, whose incidence of dysentery was found in the second Libyan campaign to be much higher than that of the Allies, as instanced in a prisoner-of-war camp.

In 1940 and early 1941 the dysentery cases were treated with sodium sulphate eliminative treatment, but in 1941 a new drug, sulphaguanidine, became available. It was most effective and became the standard treatment when full supplies were available. First supplies were used by 2 NZEF in June 1941. It was noted that sulphaguanidine brought marked amelioration of symptoms in cases where sodium sulphate treatment had failed. The new drug reduced the possibility of death from the disease. Of the eight deaths in 2 NZEF, only one occurred after sulphaguanidine was introduced.

In 1942 the incidence of dysentery in 2 NZEF in the summer was fairly uniform, being between 3 and 4 per thousand per month. In 1943 there was a marked increase in the number of cases in June, July, and September. In June and July the troops mostly affected were the 9th Reinforcements, who were quartered in a camp at Mena prior to the departure of the furlough drafts. The large number of gastro-intestinal complaints at Mena was considered to be due to the milk supply. The issue of fresh milk was stopped and the incidence of diarrhoea diminished. The 10th Reinforcements arrived in August, and in September there was an appreciable increase in the incidence of dysentery, the troops concerned being mainly from that reinforcement. The rates of 10.6 and 13.5 per thousand per month in July and September, together with that of 14 per thousand in April 1940, were the highest in the history of 2 NZEF.

In Italy dysentery did not account for as many cases as had been expected, though the morbidity rate was nearly double that for the British and Canadian forces. Hygiene was better, contamination less, and flies fewer than in Egypt. All New Zealand troops going to Italy had been in Egypt and were to some extent immunised. The highest incidence in June 1944 cannot be assigned to any particular cause, seemingly being due to the arrival of unseasoned troops as much as to the fact that divisional troops were on leave in Rome and other cities.

Cases continued to occur, of course, in the base units and reinforcements in Egypt. There was a sudden increase in May 1945 with the arrival of the last of the reinforcements in Egypt, but at no stage did the disease reach epidemic proportions. All fluctuations in the figures for dysentery were closely observed, and any increases were the subject of immediate inquiry and correction if possible. Seldom was dysentery found to be the result of defective hygiene and sanitation, and the Division's record as regards dysentery was particularly creditable. The highest, and almost unavoidable, incidence in 2 NZEF occurred when reinforcements with no immunity to the disease arrived in Egypt at the beginning or end of the summer, when flies were most numerous and infection most common.

Pacific Experience

In the Pacific force dysentery was much less serious a problem than in the Middle East as flies, which play such an important part in transmission, were fewer. Outbreaks of bacillary dysentery in the Pacific coincided with the establishment of new camps, and were found to be Flexner in type. Lack of flyproof latrines and cookhouses, together with inadequate fly measures, were inevitable in the early days of camp construction.

In May 1943 the average dysentery sick rate was stated to be 5 per cent per month. At Guadalcanal in September mild outbreaks of dysentery occurred in some units, and at Vella Lavella in October many cases were reported and ascribed to the poor sanitary practice of the individual soldier.

The cases seen in the Solomon Islands were stated by Major C. G. Riley to be milder than those seen in the Middle East, and the stay in hospital was short. So-called 'tropical diarrhoea', like 'gyppy tummy', was a dysenteric infection so mild that no blood and little mucus was passed. Chronic diarrhoea following an acute attack of bacillary dysentery was occasionally observed, but complications of bacillary dysentery were not common. Some mild cases of arthritis with effusion were seen, all recovering completely.

Treatment of Bacillary Dysentery

In the Second World War, due to the discovery that certain of the sulphonamide drugs exercise a specific action on dysentery bacilli, it was possible to bring about rapid cure in all cases, however severe, which came under early treatment. Sulphaguanidine was used and this became available in the Middle East in the middle of 1941. Before that the treatment was a dose of 1 oz. of castor oil at night followed by sodium sulphate in 1 dram doses two-hourly, beginning at 6 a.m., for eight doses. Fluids were given for twenty-four to forty-eight hours and then a gradually increasing diet.

The sulphaguanidine treatment given, at first for the severe cases and then for all cases, was as follows: Sulphaguanidine by mouth (a) 4 grammes on admission, (b) 2 grammes four-hourly till the stools were reduced to six to eight daily (usually in 48 hours); (c) 2 grammes six-hourly until the stools were formed; (d) 2 grammes eight-hourly till motions were free from blood and mucus. The average course lasted four to five days. Anti-dysenteric serum, in doses of 50,000–100,000 units, was at first given to all severe toxic cases if seen before the third or fourth day. Shiga anti-serum was given when Shiga infection was present, and polyvalent serum when the bacillus was not identified. The efficacy of the serum was difficult to assess.

After the introduction of sulphaguanidine there were very few seriously ill patients and only one death amongst some five thousand cases admitted to hospital in the Middle East, though there were six deaths in fewer cases before that time. Sulphaguanidine was always available to the Pacific force and was given early in all cases, whether admitted to hospital or not, and there were no deaths from bacillary dysentery.

Diet (as given in New Zealand hospitals): No milk was given.

Stage 1: Water with glucose or cane sugar; barley or rice water, tea with sugar, clear chicken broth, Bovril.

Stage 2: Orange juice, soups, marmite, calves-foot jelly; arrowroot biscuits; apple puree, sago, arrowroot, ground-rice puddings.

Stage 3: Toast and butter; bread and butter; eggs; junket; fish; chicken; well-boiled potatoes; stewed fruit.

Extra vitamin B was given if the course had been protracted.

Symptomatic: If there was severe colicky pain in the early stages, the following were tried:

1st: Hot water bottles or antiphlogistine.

2nd: Starch or opium enemas.

3rd: Tr Opii M xv by mouth, or Morphia gr. ¼.

If patient was very dehydrated and unable to drink, intravenous saline (.85 per cent) with glucose 5 per cent was given intermittently or by continuous drip.

AMOEBIASIS

Amoebiasis is often insidious, and chronic and persistent in type. There may be few or no acute bowel symptoms, but chronic signs develop in the liver as hepatitis or abscess, and in the large bowel as caecal or rectal amoebiasis. Dyspeptic and general vague abdominal symptoms associated with debility and psychoneurosis are often present.

The diagnosis of intestinal amoebiasis was dependent partly on a combination of symptoms and physical signs, partly on sigmoidoscopy, but essentially on the discovery of Entamoeba Histolytica in the stools. It proved very difficult to find the amoeba, and it became necessary to 'wring the amoebae out of the bowel' by strong purgation by calomel and salts, with the production of six fluid stools in one day. The specimens were examined immediately, at the same time being kept warm. The characteristically mobile amoeba with ingested red blood corpuscles established the diagnosis.

Sigmoidoscopy was of great value in diagnosis, and in amoebic dysentery showed (a) small superficial ulcers about 1–2 mm. in diameter on the valves of the lower four inches of the bowel, (b) pitting of the mucosa at sites of healed ulcers, (c) granular proctitis with mucus and often submucosal haemorrhages.

It was essential in the indefinite chronic cases to make an exact diagnosis by demonstrating the amoeba before embarking on a long unpleasant course of treatment.

In hepatic lesions less than half the cases gave positive results on stool examination, and the diagnosis had to be made first on clinical grounds, and finally by a therapeutic test. The high incidence of infective hepatitis in Italy increased the difficulty of diagnosis in the hepatic cases.

In Egypt amoebic dysentery was diagnosed in only a small percentage of the cases investigated. A marked increase was noted in September 1942, when 33 cases were treated at 1 General Hospital and 19 at 2 General Hospital. This increase was ascribed to infection arising in Syria. In Italy the relative incidence was much higher, and chronic amoebic infection became an important problem at the base hospital.

The figures in Italy were boosted by the intensive examinations carried out on patients at 3 General Hospital, Bari, even on a number of patients admitted primarily for other diseases. Lieutenant-Colonel G. W. Hayward made a survey of patients admitted to the medical division of 3 General Hospital from July 1944 to June 1945. Of the 4601 patients, there were 2016 with infective hepatitis; 252 with intestinal amoebiasis; 6 with acute hepatic amoebiasis; 109 with diarrhoea; 104 with bacillary dysentery; 108 with malaria; and 2006 with other diseases. Thus amoebiasis accounted for over half the admissions in the diarrhoea-dysentery group. Of the 252 cases of intestinal amoebiasis, 82 were admitted primarily for other diseases such as infective hepatitis, peptic ulcer, ascariasis, or anxiety neurosis, and the disease was in a latent or a chronic stage. These cases were difficult to diagnose. Once diagnosed the response to treatment was good and the relapse rate low. The duration of symptoms in all cases before admission varied from a few days to 18 months, with an average of three to four months. The disease was characterised either by recurrent attacks of diarrhoea or by persistent malaise with vague abdominal symptoms. Dysenteric symptoms were unusual. Tenderness and thickening in the region of the caecum were the most important physical findings. Seventy per cent of the cases showed abnormal findings on sigmoidoscopy, and it was stated that this figure would have been higher had it been realised earlier that the type and extent of the ulceration seen in Syria and North Africa were uncommon in Italy and that the changes were much less marked but none the less characteristic. Considerable difficulty in demonstrating the vegetative forms of E. Histolytica was encountered until the routine was adopted of examining all stools passed after vigorous purgation. After treatment 226 men returned to full duties, 7 were down-graded for base duties, and 19 were graded unfit for further overseas service, chiefly because of persistent hepatomegaly or the presence of some associated condition such as coronary artery disease or duodenal ulcer. Only 9 cases were known to have relapsed.

It is interesting to note that at several large military hospitals in Canada in 1944 a survey for amoebiasis was carried out among soldiers who had returned from the Mediterranean theatre. These men had been hospitalised for wounds and not for tropical disease, yet Entamoeba Histolytica was found in 11 per cent of the 259 men examined, whereas a previous study of soldiers who had not left Canada had shown an incidence of only 1 per cent. [1]

Pacific Experience

In the Pacific area there were comparatively few cases of amoebic infection hospitalised. The majority of the patients gave a history of repeated mild attacks of diarrhoea and complained of general ill-health and loss of weight. In some cases the onset was acute, owing very often to a superimposed bacillary infection.

From March to September 1943, 15 cases of amoebiasis, including one case of hepatitis, were treated at 4 General Hospital, New Caledonia. Carriers and active cases were found in a Field Bakery unit. The occurrence of chronic amoebiasis came under increasing notice during 1943 and 1944, and investigations of the accessible hospital staff disclosed a number of cases. In February 1944 two nursing sisters, three medical officers, and one laboratory technician were treated for the disease. It is apparent that had investigations been more widespread in the Force, the number of positive cases would almost certainly have been much higher. Up to the end of May 1944 there were 27 cases of amoebiasis diagnosed in 2 NZEF (IP)—10 from the Solomons and 17 from New Caledonia. The total number of dysentery cases admitted to medical units from June 1943 to July 1944 was 281.

Treatment for Amoebiasis

The standard treatment for amoebiasis in the Middle East Force was (a) emetine 1 gr. daily with quinoxyl 2½ per cent enemata for ten days; (b) carbarsone .25 gm. twice daily for eight days; (c) emetine bismuth iodide 3 gr. for twelve days.

In Italy the standard course became (a) emetine 1 gr. daily for three days; (b) emetine bismuth iodine 3 gr. concurrently with quinoxyl 2½ per cent retention enemata for ten to twelve days; (c) carbarsone .25 gm. twice daily for eight days. All cases with liver enlargement or in which there was any suspicion of amoebic hepatitis were given 10 gr. of emetine during their initial course of treatment and a further course of 6–10 gr. after three weeks at the convalescent depot.

Lieutenant-Colonel Hayward reported that the immediate results of the treatment in Italy were good and that only two cases out of 252 had positive stools three weeks after the course of treatment. Only nine cases in the group were known to have relapsed. Three of them with persistent diarrhoea, extensive ulceration of the colon, and positive stools were given a five-day course of sulphasuxidine (80 gm.) and penicillin (1,200,000 units) before being given a second course of emetine bismuth iodide and quinoxyl, with immediate good results. It was stressed that every effort should be made to eradicate the infection during the first course of treatment as the relapse rate from inadequate courses of treatment would be high.

The routine treatment adopted in the Pacific force was: emetine hydrochloride gr. 1 subcutaneously daily for five days, with the patient in bed. Carbarsone .25 gm.

thrice daily for seven days, beginning on the third day of the emetine injections. Interval of seven days if either of the above produced gastro-intestinal irritation or other toxic effects. Chiniofon 1.0 gm. thrice daily for seven days. Another interval of seven days if necessary. Carbarsone .25 gm. thrice daily for seven days. Both carbarsone and chiniofon were given by mouth, and if they did not produce toxic symptoms, the interval between their administration could be eliminated.

Major Riley stated that the course of treatment gave better results than the standard MEF course.

For amoebic hepatitis and liver abscess emetine gr. 1 was given daily for ten days, followed by the standard combined course of carbarsone and chiniofon to clear up the infection in the bowel. If emetine did not clear up the symptoms, exploratory puncture and aspiration was carried out, with operation as a last resort.

Late Results of Amoebiasis

In a lecture to medical officers of 2 NZ Division on 31 October 1944 Colonel Boyd, Consultant Physician, expressed the opinion that amoebiasis would be a main problem in New Zealand regarding infections contracted overseas. He emphasized that doctors should not be put off in a suspicious case by a man's statement that he had never had either diarrhoea or dysentery. In a number of cases the primary bowel infection remained symptomatically completely quiescent and the first evidence was a metastatic lesion. The disease might show itself as amoebic hepatitis and abscess, caecal or rectal amoebiasis. It had to be remembered that E. Histolytica was by no means easy to find—some cases of diarrhoea after repeated negative stool and sigmoidoscopic examinations eventually proved to be cases of amoebiasis. Colonel Boyd's opinion has unfortunately proved to be correct and chronic amoebiasis has been increasingly recognised as a cause of disability in returned servicemen.

Pensions Survey

This point is borne out by a survey made by Dr I. S. Wilson of the War Pensions Branch in 1949. Between 1 April 1946 and 30 September 1949 there were 148 cases accepted for pensions suffering from chronic amoebiasis, none of whom were considered to be infected on their arrival in New Zealand. Fifty-two of the cases had been classed as Grade I on their final medical board in New Zealand. Most of the cases (134) were from the Army. Operational regions in which the men served were: Middle East (including Italy), 108; Middle East and Pacific, 8; Pacific, 21; Far East, 2; Middle East and Far East, 3; Navy overseas, 6; 26 were ex-prisoners of war. The number of cases accepted for pensions year by year was 29 in year ended March 1947, 47 in year ended March 1948, 53 in year ended March 1949, and 19 in six months ended September 1949. The increase in 1947–48 was thought to be partly due to the increasing awareness by medical practitioners of the possibility of amoebiasis.

The average period between return to New Zealand and diagnosis of amoebiasis was thirty-three months, the longest being six years one month, and the shortest two months. There were 22 cases who were diagnosed and adequately treated overseas for amoebiasis and who appeared quite recovered on their return to New Zealand. The average time interval before their relapse was just over four years, the longest interval being seven and a half years and the shortest eighteen months. There were 17 cases of amoebic hepatitis, of whom the stools of 10 were negative for E. Histolytica, and 3 of amoebic abscess.

Entamoeba Histolytica was found in all but 10 per cent of the cases, and in these the diagnosis was proved by the therapeutic test. In only one case when Entamoeba Histolytica was not found did sigmoidoscopy suggest the diagnosis.

Of the 148 cases, 78 had been diagnosed as suffering from various disabilities which were in reality due to, or closely related with, the amoebic infection—dyspepsia (4 per cent), anxiety neurosis (14 per cent), recurrent diarrhoea, debility, chronic appendicitis, etc. (In 17 cases there were recurrent attacks of definite pain in the right iliac fossa which might have led to a diagnosis of chronic appendicitis.) In the series 24 cases had been quite well since return and the onset of illness was comparatively sudden.

Thirty-nine of the cases showed anxiety neurosis in some degree, and residual symptoms following treatment were more frequent and prolonged in these cases. Only three had been cured both of their neurosis and their amoebiasis and were not on pension. Yet in 100 cases not showing a neurosis, 36 were considered cured of their amoebiasis and their pension ceased. The cure rate for amoebiasis in cases showing a neurosis was 20 per cent.

The results of treatment of the 148 cases were: apparently cured, 44 (32 per cent); much improved, 48 (35 per cent); some improvement, 35 (25 per cent); no improvement, 12 (9 per cent); too early to assess result, 9.

Pension had ceased in all the apparently cured, except 5 who were still pensioned for some degree of anxiety neurosis. The 48 cases could be considered well on the way to recovery and were mostly on a small pension of 10–15 per cent. In the 35 cases with some improvement a proportion were in the early stages of treatment and supervision, a matter usually of many months, while the remainder were resistant cases or with residual symptoms such as 'irritable bowel'. In the cases where no improvement in symptoms and health occurred after adequate treatment and with stools remaining negative, the infection could be considered to be in an inactive state and playing no part in the illness, or else the patient had really been a carrier. In such cases the diagnosis was usually reviewed. The average duration of treatment and supervision from diagnosis to apparent cure was just over fifteen months, the longest period being thirty-five months, and the shortest two months. Fourteen of the 17 cases of amoebic hepatitis were cured or showed marked improvement.

This survey suggested that amoebiasis will be a continuing problem for some years at least, with fresh cases arising from time to time.

Chronic amoebiasis has proved to be the major problem associated with infective disease contracted during the Second World War.

A further review was carried out by Dr J. V. Cable at the Wellington Hospital in 1951. In the period since 1946 there had been 135 ex-service men and women treated at the hospital for amoebiasis, of whom 111 men and 4 women had vegetative forms of E. Histolytica in the stools and 20 were diagnosed on clinical grounds when efforts to isolate the parasite failed. The majority had served in the Army and there were many former prisoners of war.

Some patients had received treatment for amoebiasis overseas, but the majority had developed bowel symptoms in North Africa or Italy which had persisted or become worse on return to New Zealand. Symptoms usually complained of were recurring bouts of diarrhoea often provoked by minor dietary excesses, flatulence, a sense of fullness after meals, and rectal flatus. A proportion of cases had colicky abdominal pain, and a few complained of soreness in the right hypochondrium. More difficult to assess were complaints of lack of energy, tiredness, and general slackness.

The diagnostic procedures included, in addition to a routine physical examination, strong purgation and the examination of a series of six warm stools. For some time all cases were examined sigmoidoscopically, but as it became realised that significant findings were most exceptional this was not used as a routine in later cases. It was thought that the explanation of this lay in the fact that the disease was chiefly in the caecal region which was often tender and gave a sense of resistance or 'thickness' on palpation. Slight liver enlargement with tenderness was very common, but liver abscess was diagnosed twice only.

For four years the treatment was that usually employed in the Army, viz., emetine injections, emetine bismuth iodide by mouth, and carbarsone in addition. Enemata of chiniofon were used in addition for some time, but were discontinued when diodoquin became available for oral administration. In addition to this course relapsed cases received courses of penicillin and pthalyl sulphathia-zole. Later emetine bismuth iodide was not used and this, in addition to avoiding much gastro-intestinal upset, shortened the period in hospital from three weeks to one. Relapsed cases were then treated with aureomycin in addition to emetine injections and diodoquin and carbarsone.

A large proportion of cases required more than one course of treatment to give relief from symptoms and eliminate the protozoa from the stools. Even among those in whom it was not possible to isolate the parasite at successive examinations commencing some weeks after treatment, there were a number in whom minor disabilities persisted, chiefly some flatulence and some colonic irritability.

With regard to the question of the infectivity of the disease, the only evidence that could be produced was that only three cases with proved intestinal amoebiasis were treated who were close contacts of ex-service personnel. It was not suggested that this necessarily represented a true picture of the infectivity of the disease, because in a civilian population the possibility of the disease might not be kept in mind.

Two cases of intestinal amoebiasis in returned servicemen of the First World War were treated in the period under consideration. One of these was employed in a large camp in New Zealand during the Second World War and was in contact with returned men of the recent war who were also working in the camp. Three cases were known to have developed pulmonary tuberculosis subsequent to a diagnosis of amoebiasis being made. There was a steady decrease in the number of cases being treated, but in 1951 a few cases were still being met with in whom the disease had not been diagnosed before.

It would appear that the recognition of the problem led to efficient diagnosis and treatment with resultant success, which the discovery of new drugs has accentuated. There seems to be no danger of any spread of the disease to the civilian population of New Zealand.

(Reports from the Pensions Department late in 1952 show that few cases have been seen during the last year and that the problem is not now a serious one.)

2 NZEF, MEF and CMF

Dysentery

Admissions to Hospital

	1940	1941	1942		1943		1944		1945	
	Total	Total								
			Total	Amoebic	Total	Amoebic	Total	Amoebic	Total	Amoebic
Jan.		6	35	1	64	13	44	3	49	34
Feb.		11	15		30	7	20	2	22	15
Mar.	23	20	40		42	1	27	5	23	18
Apr.	98		101		39	3	18	3	36	18
May.		184	100	2	87	6	86	1	134	27
Jun.		124	119	3	205	2	204	8	61	10
Jul.	17	103	128	6	293	12	94	8	83	34
Aug.	19	157	92	30	142	8	128	23	65	45
Sep.	27	99	101	51	448	4	92	26	74	39

Oct.	91	102	99	13	157	7	56	34	40	16
Nov.	99	255	66	9	117	7	59	33	25	15
Dec.	25	75	39	7	49		47	32	16	6
	399	1136	935	122	1673	70	875	178	628	277

Relapses are included in these figures.

Most of 2 NZEF was in Italy from November 1943.

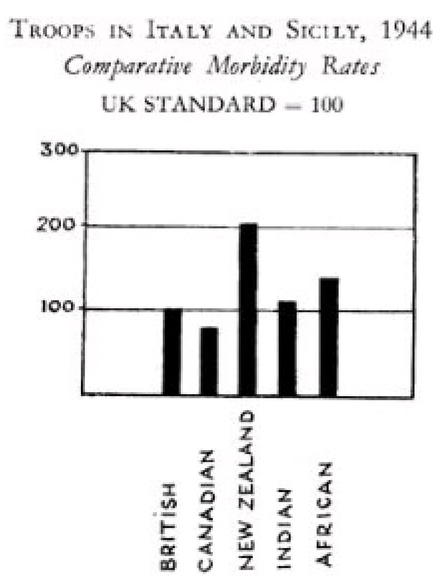
Number invalided to New Zealand from 2 NZEF, MEF and CMF	86
Deaths from dysentery in 1 NZEF	81
Deaths from dysentery in 2 NZEF	8

Admissions to hospital	281 (in one year only)
Deaths	1

Troops in Italy and Sicily, 1944

Comparative Morbidity Rates

UK STANDARD = 100



(War Office Statistical Report on the Health of the Army, 1943–45)

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[1] Army Medical Research, Canada

FIRST WORLD WAR

IN the Middle East in the First World War the troops of 1 NZEF suffered from dysentery, as did their successors in 2 NZEF. All fresh troops were subject to attacks of diarrhoea, and large numbers of the more serious cases were hospitalised for dysentery. It was noted that New Zealand troops in general were more prone to dysenteric infection and suffered more severe attacks than did British or Indian troops.

The presence of horses in the lines in base camps in Egypt in the First World War made it difficult to maintain a high standard of hygiene. Throughout Egypt flies abounded in incredible numbers, and the general living conditions of the civilian population were worse than they were during the Second World War. On the Gallipoli Peninsula the sanitary and living conditions were exceptionally difficult. Referring to bacillary dysentery the British Medical History stated that it 'was prevalent throughout the whole war. It first claimed serious attention when it broke out in epidemic form in Gallipoli in August 1915, where in three months it was responsible for a high proportion of the 120,000 casualties evacuated from the Peninsula on account of sickness.' Many of the cases from Gallipoli were caused by the Shiga bacillus.

Figures for the total incidence in 1 NZEF are not available, but reports from 1 NZ General Hospital at Abbassia show that between 1 July 1915 and 31 March 1916 there were 6836 patients admitted, and of these 2524, or 37 per cent, suffered from diseases of the alimentary system. Dysentery and infective enteritis accounted for 1156 of the group, the highest incidence being in August and September. (Dysentery was earlier prevalent in the Samoan Expeditionary Force.)

In France the conditions of trench warfare were such as to make it difficult to maintain an efficient standard of sanitation. On the Somme in 1916 there was an outbreak of bacillary dysentery, mainly Flexner in type. There were 81 deaths from dysentery in 1 NZEF overseas.

No specific treatment for bacillary dysentery was available, and the attacks were often prolonged and very debilitating. Amoebic infection was treated with emetine both by injection and by mouth. A British survey published in Diseases of the War shows that for 2319 cases of dysentery from Gallipoli the time of treatment averaged seventy-five days. It was estimated that amoebic dysentery formed about 10 per cent of the dysentery cases from Gallipoli, 2 per cent to 7 per cent of the cases from Egypt and Palestine, and 2.8 per cent of the cases in France.

Experience in New Zealand between Wars

Dysentery did not cause any great civilian health problem in New Zealand after the return of 1 NZEF. Pensions cases were few. At 31 March 1924, for all forms of gastro-intestinal disease, there were only 43 men permanently on pension and 271 temporarily on pension. Some cases of amoebic abscess of the liver were recorded in ex-servicemen who had served in the Middle East. Occasional cases of amoebiasis have been diagnosed as late as 1948 and the infection attributed to First World War service, with the infection lying dormant since that time. Amoebic dysentery was not made a notifiable disease by the Health Department until 1926 and the first case was not notified until 1933. No further case was notified until 1941.

In the light of the experience with returned servicemen of the Second World War it is probable that a considerable number of those who returned from the First World War not only harboured amoebic infection, but also suffered various grades of ill-health, possibly for years afterwards. Such cases were either unidentified or, if pensioned, probably diagnosed as debility or neurasthenia. In many cases the infection probably remained inactive, and in most cases probably died out after a time.

SECOND WORLD WAR

Dysentery being endemic in Egypt, it was only natural that New Zealand troops in 2 NZEF in Egypt would contract the disease in some form despite good sanitation arrangements and hygiene education within the Force. As it happened, up to 4 per cent annually of the 2 NZEF were hospitalised with dysentery. In addition it was thought likely by many medical officers that the vast majority of cases of acute diarrhoea occurring in troops in the Middle East were, in reality, cases of bacillary dysentery, because the clinical features were the same in those patients from whom bacilli were not isolated as in those from whom they were.

Probably nearly every soldier in the Middle East had at least one attack of acute diarrhoea, usually soon after arrival, and only a proportion of those reporting sick were sent to hospital. New Zealand troops had had no opportunity to develop an immunity to the infection, and suffered from the disease in common with other Commonwealth troops, no matter how high the standards of camp hygiene. Some immunity seemed to be developed in Egypt, however, as in the second summer recurrences of diarrhoea were not nearly as common as initial attacks among newly arrived troops. The seasonal incidence tended to show two main peaks—in early and in late summer—the drop in mid-summer being associated with the diminution in the number of flies. This was not true of 2 NZEF in 1942; the Division was holding the Alamein line in mid-summer, and the presence of swarms of flies spread the infection at that period.

In April and May of 1940, at the beginning of the summer, there was a period of high incidence among First Echelon troops, among whom there were 140 cases. By June there were very few cases, but in October and November 1940 there were 278 cases. The Third Echelon had arrived in Egypt on 29 September, and 60 per cent of the cases were from these newly-arrived troops. The First Echelon at this stage was in the Western Desert; there the incidence of dysentery was higher than in Maadi Camp, where steady improvement in camp sanitation had taken place.

In the 505 cases in 2 NZEF in Egypt up to the end of November bacteriological examination revealed that the types of dysentery were Flexner 22.4 per cent, Shiga 4.5 per cent, Schmitz 1.4 per cent, Sonne 0.4 per cent, amoebic 2 per cent, bacillary exudate 38.4 per cent, and indefinite exudate 30.9 per cent. In November there was an increase in the relative incidence of bacillary dysentery due to infection by the Shiga bacillus. This applied to British troops as well as to New Zealanders, and the medical authorities kept a careful watch for these infections owing to the risk of a true epidemic occurring. These cases were more serious than the average Flexner dysentery, and of the three deaths caused in 2 NZEF by dysentery between February and November 1940, one at least was due to Shiga infection.

In a British hospital in Egypt the analysis of a large number of dysentery cases over two years revealed that the types of bacilli isolated occurred in the following proportions: Flexner 70 per cent, Shiga 19 per cent, Sonne 6 per cent, Schmitz 5 per cent, amoebic 1 per cent. Of the total dysenteries, 56 per cent did not pass blood and mucus, and their average stay in hospital was ten days; 20 per cent of the cases, though passing mucus, were mild, while 22 per cent were moderately severe and 2 per cent severe. Those passing mucus stayed in hospital an average of twenty days. It is likely that 2 NZEF experience with the disease was somewhat in conformity with this.

At the base hospital at Helwan special wards were constructed, apart from the main building and near the laboratory, to prevent cross infection in the wards and the spread of the disease to the rest of the hospital.

In May and June 1941 there was a rise in incidence again following the evacuation of Greece and Crete, where dysentery was also endemic, and where during the withdrawal there could not be the normal standard of control in hygiene and sanitation. Again in November 1941, when the New Zealanders were in Libya, there was an increase in the number of cases. This was thought to be in some measure due to dust-storms which swept over areas contaminated by natives and by the enemy, whose incidence of dysentery was found in the second Libyan campaign to be much higher than that of the Allies, as instanced in a prisoner-of-war camp.

In 1940 and early 1941 the dysentery cases were treated with sodium sulphate eliminative treatment, but in 1941 a new drug, sulphaguanidine, became available.

It was most effective and became the standard treatment when full supplies were available. First supplies were used by 2 NZEF in June 1941. It was noted that sulphaguanidine brought marked amelioration of symptoms in cases where sodium sulphate treatment had failed. The new drug reduced the possibility of death from the disease. Of the eight deaths in 2 NZEF, only one occurred after sulphaguanidine was introduced.

In 1942 the incidence of dysentery in 2 NZEF in the summer was fairly uniform, being between 3 and 4 per thousand per month. In 1943 there was a marked increase in the number of cases in June, July, and September. In June and July the troops mostly affected were the 9th Reinforcements, who were quartered in a camp at Mena prior to the departure of the furlough drafts. The large number of gastro-intestinal complaints at Mena was considered to be due to the milk supply. The issue of fresh milk was stopped and the incidence of diarrhoea diminished. The 10th Reinforcements arrived in August, and in September there was an appreciable increase in the incidence of dysentery, the troops concerned being mainly from that reinforcement. The rates of 10.6 and 13.5 per thousand per month in July and September, together with that of 14 per thousand in April 1940, were the highest in the history of 2 NZEF.

In Italy dysentery did not account for as many cases as had been expected, though the morbidity rate was nearly double that for the British and Canadian forces. Hygiene was better, contamination less, and flies fewer than in Egypt. All New Zealand troops going to Italy had been in Egypt and were to some extent immunised. The highest incidence in June 1944 cannot be assigned to any particular cause, seemingly being due to the arrival of unseasoned troops as much as to the fact that divisional troops were on leave in Rome and other cities.

Cases continued to occur, of course, in the base units and reinforcements in Egypt. There was a sudden increase in May 1945 with the arrival of the last of the reinforcements in Egypt, but at no stage did the disease reach epidemic proportions. All fluctuations in the figures for dysentery were closely observed, and any increases were the subject of immediate inquiry and correction if possible. Seldom was dysentery found to be the result of defective hygiene and sanitation, and the Division's record as regards dysentery was particularly creditable. The highest, and almost unavoidable, incidence in 2 NZEF occurred when reinforcements with no immunity to the disease arrived in Egypt at the beginning or end of the summer, when flies were most numerous and infection most common.

Pacific Experience

In the Pacific force dysentery was much less serious a problem than in the Middle East as flies, which play such an important part in transmission, were fewer. Outbreaks of bacillary dysentery in the Pacific coincided with the establishment of new camps, and were found to be Flexner in type. Lack of flyproof latrines and cookhouses, together with inadequate fly measures, were inevitable in the early days of camp construction.

In May 1943 the average dysentery sick rate was stated to be 5 per cent per month. At Guadalcanal in September mild outbreaks of dysentery occurred in some units, and at Vella Lavella in October many cases were reported and ascribed to the poor sanitary practice of the individual soldier.

The cases seen in the Solomon Islands were stated by Major C. G. Riley to be milder than those seen in the Middle East, and the stay in hospital was short. So-called 'tropical diarrhoea', like 'gyppy tummy', was a dysenteric infection so mild that no blood and little mucus was passed. Chronic diarrhoea following an acute attack of bacillary dysentery was occasionally observed, but complications of bacillary dysentery were not common. Some mild cases of arthritis with effusion were seen, all recovering completely.

Treatment of Bacillary Dysentery

In the Second World War, due to the discovery that certain of the sulphonamide drugs exercise a specific action on dysentery bacilli, it was possible to bring about rapid cure in all cases, however severe, which came under early treatment. Sulphaguanidine was used and this became available in the Middle East in the middle of 1941. Before that the treatment was a dose of 1 oz. of castor oil at night followed by sodium sulphate in 1 dram doses two-hourly, beginning at 6 a.m., for eight doses. Fluids were given for twenty-four to forty-eight hours and then a gradually increasing diet.

The sulphaguanidine treatment given, at first for the severe cases and then for all cases, was as follows: Sulphaguanidine by mouth (a) 4 grammes on admission, (b) 2 grammes four-hourly till the stools were reduced to six to eight daily (usually in 48 hours); (c) 2 grammes six-hourly until the stools were formed; (d) 2 grammes eight-hourly till motions were free from blood and mucus. The average course lasted four to five days. Anti-dysenteric serum, in doses of 50,000–100,000 units, was at first given to all severe toxic cases if seen before the third or fourth day. Shiga anti-serum was given when Shiga infection was present, and polyvalent serum when the bacillus was not identified. The efficacy of the serum was difficult to assess.

After the introduction of sulphaguanidine there were very few seriously ill patients and only one death amongst some five thousand cases admitted to hospital in the Middle East, though there were six deaths in fewer cases before that time. Sulphaguanidine was always available to the Pacific force and was given early in all cases, whether admitted to hospital or not, and there were no deaths from bacillary dysentery.

Diet (as given in New Zealand hospitals): No milk was given.

Stage 1: Water with glucose or cane sugar; barley or rice water, tea with sugar, clear chicken broth, Bovril.

Stage 2: Orange juice, soups, marmite, calves-foot jelly; arrowroot biscuits; apple puree, sago, arrowroot, ground-rice puddings.

Stage 3: Toast and butter; bread and butter; eggs; junket; fish; chicken; well-boiled potatoes; stewed fruit.

Extra vitamin B was given if the course had been protracted.

Symptomatic: If there was severe colicky pain in the early stages, the following were tried:

1st: Hot water bottles or antiphlogistine.

2nd: Starch or opium enemas.

3rd: Tr Opii M xv by mouth, or Morphia gr. ¼.

If patient was very dehydrated and unable to drink, intravenous saline (.85 per cent) with glucose 5 per cent was given intermittently or by continuous drip.

AMOEBIASIS

Amoebiasis is often insidious, and chronic and persistent in type. There may be few or no acute bowel symptoms, but chronic signs develop in the liver as hepatitis or abscess, and in the large bowel as caecal or rectal amoebiasis. Dyspeptic and general vague abdominal symptoms associated with debility and psychoneurosis are often present.

The diagnosis of intestinal amoebiasis was dependent partly on a combination of symptoms and physical signs, partly on sigmoidoscopy, but essentially on the discovery of Entamoeba Histolytica in the stools. It proved very difficult to find the amoeba, and it became necessary to 'wring the amoebae out of the bowel' by strong purgation by calomel and salts, with the production of six fluid stools in one day. The specimens were examined immediately, at the same time being kept warm. The characteristically mobile amoeba with ingested red blood corpuscles established the diagnosis.

Sigmoidoscopy was of great value in diagnosis, and in amoebic dysentery showed (a) small superficial ulcers about 1–2 mm. in diameter on the valves of the lower four inches of the bowel, (b) pitting of the mucosa at sites of healed ulcers, (c) granular proctitis with mucus and often submucosal haemorrhages.

It was essential in the indefinite chronic cases to make an exact diagnosis by demonstrating the amoeba before embarking on a long unpleasant course of treatment.

In hepatic lesions less than half the cases gave positive results on stool examination, and the diagnosis had to be made first on clinical grounds, and finally by a therapeutic test. The high incidence of infective hepatitis in Italy increased the difficulty of diagnosis in the hepatic cases.

In Egypt amoebic dysentery was diagnosed in only a small percentage of the cases investigated. A marked increase was noted in September 1942, when 33 cases were treated at 1 General Hospital and 19 at 2 General Hospital. This increase was ascribed to infection arising in Syria. In Italy the relative incidence was much higher, and chronic amoebic infection became an important problem at the base hospital.

The figures in Italy were boosted by the intensive examinations carried out on patients at 3 General Hospital, Bari, even on a number of patients admitted primarily for other diseases. Lieutenant-Colonel G. W. Hayward made a survey of patients admitted to the medical division of 3 General Hospital from July 1944 to June 1945. Of the 4601 patients, there were 2016 with infective hepatitis; 252 with intestinal amoebiasis; 6 with acute hepatic amoebiasis; 109 with diarrhoea; 104 with bacillary dysentery; 108 with malaria; and 2006 with other diseases. Thus amoebiasis accounted for over half the admissions in the diarrhoea-dysentery group. Of the 252 cases of intestinal amoebiasis, 82 were admitted primarily for other diseases such as infective hepatitis, peptic ulcer, ascariasis, or anxiety neurosis, and the disease was in a latent or a chronic stage. These cases were difficult to diagnose. Once diagnosed the response to treatment was good and the relapse rate low. The duration of symptoms in all cases before admission varied from a few days to 18 months, with an average of three to four months. The disease was characterised either by recurrent attacks of diarrhoea or by persistent malaise with vague abdominal symptoms. Dysenteric symptoms were unusual. Tenderness and thickening in the region of the caecum were the most important physical findings. Seventy per cent of the cases showed abnormal findings on sigmoidoscopy, and it was stated that this figure would have been higher had it been realised earlier that the type and extent of the ulceration seen in Syria and North Africa were uncommon in Italy and that the changes were much less marked but none the less characteristic. Considerable difficulty in demonstrating the vegetative forms of E. Histolytica was encountered until the routine was adopted of examining all stools passed after vigorous purgation. After treatment 226 men returned to full duties, 7 were down-graded for base duties, and 19 were graded unfit for further overseas service, chiefly because of persistent hepatomegaly or the presence of some associated condition such as coronary artery disease or duodenal ulcer. Only 9 cases were known to have relapsed.

It is interesting to note that at several large military hospitals in Canada in 1944 a survey for amoebiasis was carried out among soldiers who had returned from the

Mediterranean theatre. These men had been hospitalised for wounds and not for tropical disease, yet Entamoeba Histolytica was found in 11 per cent of the 259 men examined, whereas a previous study of soldiers who had not left Canada had shown an incidence of only 1 per cent. [1]

Pacific Experience

In the Pacific area there were comparatively few cases of amoebic infection hospitalised. The majority of the patients gave a history of repeated mild attacks of diarrhoea and complained of general ill-health and loss of weight. In some cases the onset was acute, owing very often to a superimposed bacillary infection.

From March to September 1943, 15 cases of amoebiasis, including one case of hepatitis, were treated at 4 General Hospital, New Caledonia. Carriers and active cases were found in a Field Bakery unit. The occurrence of chronic amoebiasis came under increasing notice during 1943 and 1944, and investigations of the accessible hospital staff disclosed a number of cases. In February 1944 two nursing sisters, three medical officers, and one laboratory technician were treated for the disease. It is apparent that had investigations been more widespread in the Force, the number of positive cases would almost certainly have been much higher. Up to the end of May 1944 there were 27 cases of amoebiasis diagnosed in 2 NZEF (IP)—10 from the Solomons and 17 from New Caledonia. The total number of dysentery cases admitted to medical units from June 1943 to July 1944 was 281.

Treatment for Amoebiasis

The standard treatment for amoebiasis in the Middle East Force was (a) emetine 1 gr. daily with quinoxyl 2½ per cent enemata for ten days; (b) carbarsone .25 gm. twice daily for eight days; (c) emetine bismuth iodide 3 gr. for twelve days.

In Italy the standard course became (a) emetine 1 gr. daily for three days; (b) emetine bismuth iodine 3 gr. concurrently with quinoxyl 2½ per cent retention enemata for ten to twelve days; (c) carbarsone .25 gm. twice daily for eight days. All cases with liver enlargement or in which there was any suspicion of amoebic hepatitis were given 10 gr. of emetine during their initial course of treatment and a further course of 6–10 gr. after three weeks at the convalescent depot.

Lieutenant-Colonel Hayward reported that the immediate results of the treatment in Italy were good and that only two cases out of 252 had positive stools three weeks after the course of treatment. Only nine cases in the group were known to have relapsed. Three of them with persistent diarrhoea, extensive ulceration of the colon, and positive stools were given a five-day course of sulphasuxidine (80 gm.) and penicillin (1,200,000 units) before being given a second course of emetine bismuth iodide and quinoxyl, with immediate good results. It was stressed that every effort should be made to eradicate the infection during the first course of treatment as the relapse rate from inadequate courses of treatment would be high.

The routine treatment adopted in the Pacific force was: emetine hydrochloride gr. 1 subcutaneously daily for five days, with the patient in bed. Carbarsone .25 gm. thrice daily for seven days, beginning on the third day of the emetine injections. Interval of seven days if either of the above produced gastro-intestinal irritation or other toxic effects. Chiniofon 1.0 gm. thrice daily for seven days. Another interval of seven days if necessary. Carbarsone .25 gm. thrice daily for seven days. Both carbarsone and chiniofon were given by mouth, and if they did not produce toxic symptoms, the interval between their administration could be eliminated.

Major Riley stated that the course of treatment gave better results than the standard MEF course.

For amoebic hepatitis and liver abscess emetine gr. 1 was given daily for ten days, followed by the standard combined course of carbarsone and chiniofon to clear up the infection in the bowel. If emetine did not clear up the symptoms, exploratory puncture and aspiration was carried out, with operation as a last resort.

Late Results of Amoebiasis

In a lecture to medical officers of 2 NZ Division on 31 October 1944 Colonel Boyd, Consultant Physician, expressed the opinion that amoebiasis would be a main problem in New Zealand regarding infections contracted overseas. He emphasized that doctors should not be put off in a suspicious case by a man's statement that he had never had either diarrhoea or dysentery. In a number of cases the primary bowel infection remained symptomatically completely quiescent and the first evidence was a metastatic lesion. The disease might show itself as amoebic hepatitis and abscess, caecal or rectal amoebiasis. It had to be remembered that E. Histolytica was by no means easy to find—some cases of diarrhoea after repeated negative stool and sigmoidoscopic examinations eventually proved to be cases of amoebiasis. Colonel Boyd's opinion has unfortunately proved to be correct and chronic amoebiasis has been increasingly recognised as a cause of disability in returned servicemen.

Pensions Survey

This point is borne out by a survey made by Dr I. S. Wilson of the War Pensions Branch in 1949. Between 1 April 1946 and 30 September 1949 there were 148 cases accepted for pensions suffering from chronic amoebiasis, none of whom were considered to be infected on their arrival in New Zealand. Fifty-two of the cases had been classed as Grade I on their final medical board in New Zealand. Most of the cases (134) were from the Army. Operational regions in which the men served were: Middle East (including Italy), 108; Middle East and Pacific, 8; Pacific, 21; Far East, 2; Middle East and Far East, 3; Navy overseas, 6; 26 were ex-prisoners of war. The number of cases accepted for pensions year by year was 29 in year ended March 1947, 47 in year ended March 1948, 53 in year ended March 1949, and 19 in six months ended September 1949. The increase in 1947–48 was thought to be partly due to the increasing awareness by medical practitioners of the possibility of amoebiasis.

The average period between return to New Zealand and diagnosis of amoebiasis was thirty-three months, the longest being six years one month, and the shortest two months. There were 22 cases who were diagnosed and adequately treated overseas for amoebiasis and who appeared quite recovered on their return to New Zealand. The average time interval before their relapse was just over four years, the longest interval being seven and a half years and the shortest eighteen months. There were 17 cases of amoebic hepatitis, of whom the stools of 10 were negative for E. Histolytica, and 3 of amoebic abscess.

Entamoeba Histolytica was found in all but 10 per cent of the cases, and in these the diagnosis was proved by the therapeutic test. In only one case when Entamoeba Histolytica was not found did sigmoidoscopy suggest the diagnosis.

Of the 148 cases, 78 had been diagnosed as suffering from various disabilities which were in reality due to, or closely related with, the amoebic infection—dyspepsia (4 per cent), anxiety neurosis (14 per cent), recurrent diarrhoea, debility, chronic appendicitis, etc. (In 17 cases there were recurrent attacks of definite pain in the right iliac fossa which might have led to a diagnosis of chronic appendicitis.) In the series 24 cases had been quite well since return and the onset of illness was comparatively sudden.

Thirty-nine of the cases showed anxiety neurosis in some degree, and residual symptoms following treatment were more frequent and prolonged in these cases. Only three had been cured both of their neurosis and their amoebiasis and were not on pension. Yet in 100 cases not showing a neurosis, 36 were considered cured of their amoebiasis and their pension ceased. The cure rate for amoebiasis in cases showing a neurosis was 20 per cent.

The results of treatment of the 148 cases were: apparently cured, 44 (32 per cent); much improved, 48 (35 per cent); some improvement, 35 (25 per cent); no improvement, 12 (9 per cent); too early to assess result, 9.

Pension had ceased in all the apparently cured, except 5 who were still pensioned for some degree of anxiety neurosis. The 48 cases could be considered well on the way to recovery and were mostly on a small pension of 10–15 per cent. In the 35 cases with some improvement a proportion were in the early stages of treatment and supervision, a matter usually of many months, while the remainder were resistant cases or with residual symptoms such as 'irritable bowel'. In the cases where no improvement in symptoms and health occurred after adequate treatment and with stools remaining negative, the infection could be considered to be in an inactive state and playing no part in the illness, or else the patient had really been a carrier. In such cases the diagnosis was usually reviewed. The average duration of treatment and supervision from diagnosis to apparent cure was just over fifteen months, the longest period being thirty-five months, and the shortest two months. Fourteen of the 17 cases of amoebic hepatitis were cured or showed marked improvement.

This survey suggested that amoebiasis will be a continuing problem for some years at least, with fresh cases arising from time to time.

Chronic amoebiasis has proved to be the major problem associated with infective disease contracted during the Second World War.

A further review was carried out by Dr J. V. Cable at the Wellington Hospital in 1951. In the period since 1946 there had been 135 ex-service men and women treated at the hospital for amoebiasis, of whom 111 men and 4 women had vegetative forms of E. Histolytica in the stools and 20 were diagnosed on clinical grounds when efforts to isolate the parasite failed. The majority had served in the Army and there were many former prisoners of war.

Some patients had received treatment for amoebiasis overseas, but the majority had developed bowel symptoms in North Africa or Italy which had persisted or become worse on return to New Zealand. Symptoms usually complained of were recurring bouts of diarrhoea often provoked by minor dietary excesses, flatulence, a sense of fullness after meals, and rectal flatus. A proportion of cases had colicky abdominal pain, and a few complained of soreness in the right hypochondrium. More difficult to assess were complaints of lack of energy, tiredness, and general slackness.

The diagnostic procedures included, in addition to a routine physical examination, strong purgation and the examination of a series of six warm stools. For some time all cases were examined sigmoidoscopically, but as it became realised that significant findings were most exceptional this was not used as a routine in later cases. It was thought that the explanation of this lay in the fact that the disease was chiefly in the caecal region which was often tender and gave a sense of resistance or 'thickness' on palpation. Slight liver enlargement with tenderness was very common, but liver abscess was diagnosed twice only.

For four years the treatment was that usually employed in the Army, viz., emetine injections, emetine bismuth iodide by mouth, and carbarsone in addition. Enemata of chiniofon were used in addition for some time, but were discontinued when diodoquin became available for oral administration. In addition to this course relapsed cases received courses of penicillin and pthalyl sulphathia-zole. Later emetine bismuth iodide was not used and this, in addition to avoiding much gastro-intestinal upset, shortened the period in hospital from three weeks to one. Relapsed cases were then treated with aureomycin in addition to emetine injections and diodoquin and carbarsone.

A large proportion of cases required more than one course of treatment to give relief from symptoms and eliminate the protozoa from the stools. Even among those in whom it was not possible to isolate the parasite at successive examinations commencing some weeks after treatment, there were a number in whom minor disabilities persisted, chiefly some flatulence and some colonic irritability.

With regard to the question of the infectivity of the disease, the only evidence that could be produced was that only three cases with proved intestinal amoebiasis were treated who were close contacts of ex-service personnel. It was not suggested that this necessarily represented a true picture of the infectivity of the disease, because in a civilian population the possibility of the disease might not be kept in mind.

Two cases of intestinal amoebiasis in returned servicemen of the First World War were treated in the period under consideration. One of these was employed in a large camp in New Zealand during the Second World War and was in contact with returned men of the recent war who were also working in the camp. Three cases were known to have developed pulmonary tuberculosis subsequent to a diagnosis of amoebiasis being made. There was a steady decrease in the number of cases being treated, but in 1951 a few cases were still being met with in whom the disease had not been diagnosed before.

It would appear that the recognition of the problem led to efficient diagnosis and treatment with resultant success, which the discovery of new drugs has accentuated. There seems to be no danger of any spread of the disease to the civilian population of New Zealand.

(Reports from the Pensions Department late in 1952 show that few cases have been seen during the last year and that the problem is not now a serious one.)

2 NZEF, MEF AND CMF — DYSENTERY

2 NZEF, MEF and CMF

Dysentery

Admissions to Hospital

	1940 Total	1941 Total	1942		1943		1944		1945	
			Total	Amoebic	Total	Amoebic	Total	Amoebic	Total	Amoebic
Jan.		6	35	1	64	13	44	3	49	34
Feb.		11	15		30	7	20	2	22	15
Mar.	23	20	40		42	1	27	5	23	18
Apr.	98		101		39	3	18	3	36	18
May.		184	100	2	87	6	86	1	134	27
Jun.		124	119	3	205	2	204	8	61	10
Jul.	17	103	128	6	293	12	94	8	83	34
Aug.	19	157	92	30	142	8	128	23	65	45
Sep.	27	99	101	51	448	4	92	26	74	39
Oct.	91	102	99	13	157	7	56	34	40	16
Nov.	99	255	66	9	117	7	59	33	25	15
Dec.	25	75	39	7	49		47	32	16	6
	399	1136	935	122	1673	70	875	178	628	277

Relapses are included in these figures.

Most of 2 NZEF was in Italy from November 1943.

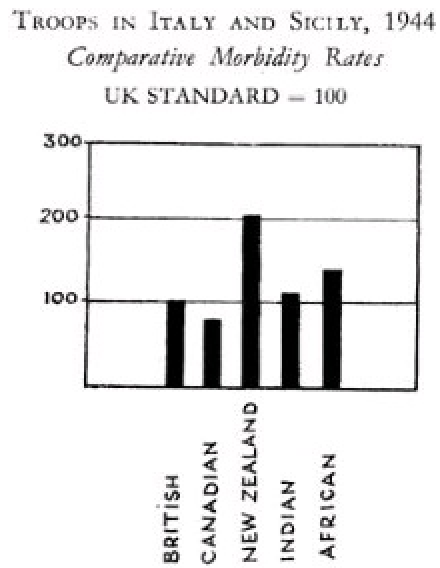
Number invalided to New Zealand from 2 NZEF, MEF and CMF	86
Deaths from dysentery in 1 NZEF	81
Deaths from dysentery in 2 NZEF	8

Admissions to hospital	281 (in one year only)
Deaths	1

Troops in Italy and Sicily, 1944

Comparative Morbidity Rates

UK STANDARD = 100



(War Office Statistical Report on the Health of the Army, 1943–45)

CHAPTER 2
Typhoid Fever

THE history of typhoid fever in New Zealand troops is really a testimony of the worth of TAB inoculations. In the First World War New Zealand troops were inoculated, either in New Zealand or on the transports going overseas, with a vaccine prepared against typhoid. In part this resulted in a striking reduction of the incidence and death-roll of typhoid compared with that experienced by troops in the South African War. Troops in Gallipoli, Mudros, and Egypt, however, in 1915 incurred several hundred cases of enteric fever, which was proved to be due in the majority of instances to paratyphoid A and B infections, and a number had to be invalided to New Zealand. In March 1916, when the hospital ship Maheno brought back to New Zealand 317 invalids from Gallipoli and Egypt, there were 56 enteric cases among the invalids. When the men were inoculated against paratyphoid in November and December 1915 the incidence of these infections decreased so much that typhoid was no longer a problem. Very few cases arose during the campaign in France. Of course, allied with inoculations was the success of preventive measures through efficient sanitation.

In the Second World War New Zealand troops were inoculated, either in camp in New Zealand or on troopships, with the triple vaccine, TAB, offering protection against the typhoid and paratyphoid infections. The result was that, apart from an epidemic among the 10th Reinforcements upon their arrival in Egypt in 1943, there were fewer than a hundred cases of typhoid in 2 NZEF and only three deaths.

In 1941, when the incidence of typhoid was high among civilians in the Cairo Health Area (for instance, 170 crude notifications and 30 deaths in four weeks ended 11 November 1941), there were only 8 cases in 2 NZEF and no deaths. In February and March 1942 there were 3 cases of typhoid among the recently arrived WAACs at 3 General Hospital at Helmieh, with 1 death. The source of infection was not discovered, though the eating of unwashed fruit and vegetables was thought to be a possible cause.

Again, in October and November 1942 there was an outbreak of typhoid among the WAAC personnel at 3 General Hospital at Beirut. There were 7 cases, but no deaths. In spite of investigations no definite source of infection could be detected. The only link between the cases was that they fed at the same mess. All the WAAC personnel who had contracted typhoid fever were invalided back to New Zealand during the period of their convalescence.

On 18 August 1943 the 10th Reinforcements (6000 men) arrived from New Zealand and an epidemic commenced in September among the new arrivals in the camp at Mena where, Maadi Camp being full, they were quartered upon disembarkation. The outbreak subsided in November after there had been 130 New Zealand cases. The attacks were quite severe but no New Zealander died. The carrier was apparently a man who washed up in a Reinforcement mess.

The Helwan hospital reported that though there were only 3 deaths, in other than New Zealand patients, many patients were severely affected, pyrexia was prolonged, and relapse frequent. All the usual complications were seen. In inoculated men the disease tended to be milder and the temperature chart abnormal. Headache was always a prominent feature, and mild respiratory signs were usually present. Convalescence was slow and debility marked, with many suffering from foot strain; these men were usually recommended for down-grading, some for return to New Zealand. It was felt that the ultimate prognosis in many cases was poor as regards further military service.

There was doubt about the vaccine used in New Zealand giving full protection against the organisms found in Egypt. In some cases the inoculation state was found to be faulty. All the 10th Reinforcement draft was re-inoculated with RAMC vaccine and the inoculation interval for TAB injections throughout 2 NZEF reduced from one year to nine months. A supplement to 2 NZEF Orders was issued to educate all ranks in the preventive measures necessary to reduce the possibility of typhoid infection. It was emphasized that the anti-typhoid inoculation was not a substitute for sanitary precautions, but an additional protective measure.

The slight rise in incidence among troops in Italy in June, July, and August 1944 was probably due to the eating of infected food, most likely lettuce. A number of cases among Italians in the locality were also reported at the time.

In August 1944 there were unfortunately 2 deaths from typhoid, 1 from toxaemia associated with deep and extensive ulceration, and 1 due to a second perforation following some days after an operation to close a first.

Although cases in 2 NZEF in Italy were fewer than in the Middle East, it was the impression of the Consultant Physician 2 NZEF that the Italian was the more severe type. A thoroughly well-inoculated man might not only acquire the disease but might die from it.

A new typhoid vaccine, alcoholised TAB vaccine, came into general use towards the end of 1944. It was introduced after experiments had proved a reduction in general reactions and also enhanced keeping properties besides a greater measure of protection.

Besides warding off infection to a remarkable extent, inoculation also modified the severity of the illness among those who did contract typhoid. Recovery was much more rapid and the death-rate reduced. The mode of onset seemed to be modified by inoculation. This made diagnosis much more difficult and was thought to have been a cause of the spread of the outbreak in 1943.

Toxaemia was not so common and not so severe in well-inoculated cases. Sulphamethazine seemed to have a good effect on the toxic features of the disease. It was not found possible to distinguish the type of organismal strain of typhoid clinically before the laboratory findings were known. In September 1943 there were outbreaks of typhoid among British troops near Maadi and Helwan, the patients being admitted to 1 General Hospital along with the New Zealand cases. Three different types of organism were isolated, a separate type for each camp. (The introduction of phage-typing, by means of which many distinct types could be recognised with precision, had led to a marked advance in the tracing of foci of infection, and we were fortunate that this method of investigation was available in the Middle East.) It appears that some vaccine may not have been protective against certain types of organism, or else the immunity was not sufficiently strong to resist a heavy infection. The low overall incidence of typhoid in 2 NZEF in the Second World War was a triumph of preventive medicine, both as regards inoculation and hygiene and sanitation.

Efficacy of TAB Vaccine

The epidemic among the recently-arrived reinforcements in September 1943 led to questioning of the efficacy of the vaccine prepared in New Zealand. In one infantry depot there were 69 cases of typhoid, and an analysis of the 67 inoculation states available showed that 58 had received New Zealand vaccine only and that 6 of these states were faulty also, while 9 had received New Zealand and RAMC vaccine but 8 of these states were faulty in one way or another. Other troops fully protected with RAMC vaccine were exposed to the infection but did not develop typhoid, and it is possible that re-inoculation with RAMC vaccine brought the epidemic to a close.

As the pathologist of 1 General Hospital pointed out, typhoid fever was of rare occurrence amongst Middle East troops properly inoculated with RAMC vaccine, and when an outbreak of typhoid fever did occur it affected almost exclusively those who had not been properly protected with RAMC vaccine. It was a common finding that the local and general reaction produced by the first dose of RAMC vaccine was often severe—surprisingly so if any great degree of immunity had been conferred by the previous inoculations in New Zealand. Subsequent doses of RAMC vaccine produced less severe reactions. It was found that a particular organismal type was common to the New Zealand cases in the epidemic and that British and RAF cases occurring at the same time were caused by different types of the organism. It seemed that the vaccine used in New Zealand did not give complete protection against organisms found in Egypt.

In the First World War the same question of the potency of vaccine given in New Zealand arose, and all the troops were re-inoculated with RAMC vaccine. The question was investigated by Major Bowerbank at 1 NZ General Hospital in Egypt in 1916. He held that the New Zealand vaccine had been effective and that nearly all the cases had been due to paratyphoid infection against which the original vaccine had not been prepared.

The use in 2 NZEF of RAMC vaccine made from local strains produced fairly complete immunity. It would appear from experience in the Middle East that vaccine should be made not from any local New Zealand strain, but from the proper strains of tested virulence and antigenic power obtained from the country of campaign. Experience also teaches that the meticulous carrying out of inoculation at specified intervals is important.

WAR SURGERY AND MEDICINE

[SECTION]

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CHAPTER 3
Infective Hepatitis

INFECTIVE hepatitis has for a long time been accepted as an illness common to soldiers on military operations. Cases have been recorded as occurring in all recent wars, and the clinical picture has been well known. The disease is world-wide in distribution, but the Mediterranean littoral has been one of high epidemicity. From October to November 1915 some 25 per cent of a section of British troops on Gallipoli and in Alexandria were affected (Martin, 1917). New Zealand troops were also affected severely, and it was found that the highest incidence was in the winter months of 1915 and 1916, whereas other gastro-intestinal infections reached their height in the summer. Efforts to discover the mode of transmission failed, and Wilcox (1916) concluded that the disease started as a gastro-intestinal infection (see Martin, 1917); but all bacteriological investigations were negative (Hunter, 1922). Kartulis (1916) declared that the pathogenic agent was intimately related to sewers and sea water, because of the decrease in incidence in Alexandria from 1898 to 1916 with the introduction of modern drainage.

At the onset of the Second World War the disease was not considered very seriously. It was thought to be a catarrhal infection with no known methods of treatment or prevention. With the arrival of New Zealand troops in Egypt in 1940 sanitation in base camps was kept at a very high level and very few cases were noted. As 1940 wore on and troops moved to the desert, a few more cases appeared in the late summer and autumn, which time, it was found later, is the time of greatest incidence. This is usually a month after the height of the dysentery epidemic.

It is noteworthy that practically no cases occurred while the Division was on active service in Greece and Crete in 1941, but later in the year 4 Brigade, which had been in Egypt since February 1940, produced cases.

From July to August 1941, 79 cases were notified from New Zealand troops; they were widely scattered and mild—mostly from those in forward areas.

At this stage it was widely accepted that the infection was due to a virus, but the method of spread was disputed. Prior to this Adler, working in Jerusalem, had failed to isolate any organism or infect any available animal. This work was supported by Van Rooyen and Gordon (1942), but Cameron interjected six human volunteers intravenously with blood from hepatitis cases and produced the disease, thus proving the communicability of the infection.

The first major epidemic among New Zealand troops occurred in 1942 and began in July and August in the Western Desert—again about a month after the height of the dysentery wave.

Between August 1942 and January 1943, 2500 cases occurred among 30,000 New Zealand troops. During September and October 1942 there were 1137 cases, of which 1059 occurred among 7500 men in the Alamein Line and 78 cases among 3900 men in the rear areas within 10 miles of the line.

This epidemic presented several problems:

1. Manpower: Nearly all cases required a month before returning to duty, and many some weeks more; a few required eventual evacuation to New Zealand. It is easy to see how serious was this problem.
2. Hospitalisation: Practically all cases were evacuated by ambulance direct to 1 New Zealand General Hospital, which was over 100 miles away. Others found their way to other New Zealand hospitals in the area. No. 1 New Zealand General Hospital, a 900-bed hospital, found it necessary to expand rapidly, and rose from 900 beds to 1300 in a few weeks, without having extra available staff to meet the situation.
3. The Study of the Epidemic: An initial survey of the cases arriving at 1 NZ General Hospital soon showed a pattern, and it was decided that there was a possibility of studying the epidemiology and mode of spread of this disease with a reasonable chance of success. This work was undertaken forthwith by Kirk and was eventually published in the Lancet (1945).

It was apparent that most of the cases were coming from units who had been in the New Zealand Box in the Alamein Line a month previously, whereas very few cases came from units in base areas five to ten miles away. This concentrated attention on the site, as the front-line troops occupied an area of five miles square and all units who spent thirty-five to forty days there before the start of the epidemic were involved—units withdrawn after a shorter stay than the remainder were less affected. After the front-line troops left this area the epidemic began to subside. No other troops in the Alamein Line were involved at this time, so that if the site were to be incriminated it had to be different from the rest of the front line at Alamein. Common factors to all at Alamein were food, water, living conditions, heat, and fatigue, so these could not account for the localised epidemic among New Zealand troops. It is to be noted that New Zealand troops have not at any time exhibited an undue susceptibility to this malady.

Firstly, the possibility of an unknown vector was ruled out. Secondly, spread by droplet infection was unlikely in the front-line units as they were living in dispersed formation with little close contact and no tents or messes. On the contrary the well troops in the rear areas were living in a more congested state, and although the incidence of catarrhal infection was low, opportunities for droplet spread were numerous.

The third possibility, and the one of choice, was that the disease was fly-borne; flies were present in millions everywhere in Alamein, both in front and rear areas, and as the site seemed to be responsible it was thought that in the forward area the insects were infected locally. The New Zealand ground was one of the few parts recently captured from the enemy. It was filthy with excreta and imperfectly buried German and Italian corpses, and it was learned from patrols and prisoners that the enemy were themselves experiencing an outbreak of infective hepatitis.

Thus the epidemic was attributed to local contamination of flies arising from the faeces and cadavers strewn over the battlefield, where food, hands, and mess tins could not be efficiently protected.

This theory of gastro-intestinal infection and spread by excreta explained why the disease did not spread in hospitals to the staff, as all men used well-protected latrines, and why it did not spread in base camps and prisoner-of-war cages where the same conditions existed.

Proof of this theory can be found in publications of work done in America by Havens et al. (1945), and Paul, Havens, Sabin, and Philip (1945); in England by McCallum and Bradley (1944); and in West Africa by Findlay and Willcox (1945).

Of the American work the following quotation summarises the results:

When faecal material from patients with the naturally occurring disease was fed to human volunteers, two out of three contracted the disease in 20 and 22 days respectively. Serum obtained from these two patients in the pre-icteric stage was filtered (Chamberlain 2) and immediately afterwards heated (56 deg. C. for 30 minutes). This heated serum filtrate (M.K.) produced infective hepatitis when fed to 4 out of 5 volunteers with an incubation period ranging from 20 to 31 days. Some of the latter group of volunteers had recovered some months before from serum jaundice, but it did not protect them against an attack of Infective Hepatitis.

Thus, employing one strain of infective hepatitis virus, jaundice was produced in 6 out of 11 subjects when serum was inoculated, 4 out of 5 when serum was fed, and in 2 out of 3 when faeces were fed, and the incubation period was invariably less than thirty-four days in these experiments. It can therefore be said that the virus of infective hepatitis is both present in faeces and possesses powers of viability to enable it to be transmitted by excreta.

Although this fact now is proved, it is not necessarily certain that this is the only means of transmission, but further information may be available in the future. The epidemiological investigations carried out in the Middle East were unable to satisfy all the anomalies that occurred; but it is certain that in the 1942 epidemic among the New Zealand troops the virus was spread by flies from excreta. During 1943 the case incidence dropped during the summer months and did not rise to the expected heights at the end of the year. The 2nd NZEF was in Italy during the winter of 1943–44 and had not received many reinforcements, which may have had some bearing on the number of susceptibles available; however, the greatest incidence was 3·2 per 1000 in October 1943, rising to 6·15 per 1000 in January 1944.

During this time there was little difference in the incidence between forward and base troops. There was a fall in numbers again in 1944, and during this time the Division was moving north in Italy; but by July cases increased, mostly among the divisional troops, and reached 11.15 per 1000. From August 1944 to February 1945, except for a rest period in November, the Division was in the Rimini- Faenza area, and the incidence reached a maximum of 14·55 per 1000 in October to December, 1944. From June 1944 onwards there was considerable movement of locations and the men were living under all types of-conditions. Flies were prevalent in the initial stages of the epidemic, and the sanitation of the local inhabitants, being of a very low standard, made any unit control of little value. There is little doubt that the mode of spread was the same as in the desert, but study in an area of towns and villages made any definite conclusions impossible.

It is significant, however, that in Italy during hepatitis epidemics there was no appreciable incidence among the local population. This is the same as was noticed in Egypt and indicates that the Mediterranean region is an endemic area with a largely immune local population.

In the epidemic in Italy, where 2461 cases occurred from July 1944 to January 1945 among 30,000 men, most of the cases came from front-line troops, and the problems of hospitalisation were again difficult. However, with the 2 NZ General Hospital in the Naples area and 1 NZ General Hospital on the Adriatic coast at Senigallia, and 3 NZ General Hospital at Bari in the south, lines of evacuation were arranged and hospital treatment was available.

McKinlay and Truelove (1945) carried out detailed investigations of some aspects of epidemiology among New Zealand and Canadian troops in Italy in the 1944 epidemic and their conclusions are as follows:

1. Infective hepatitis displays striking seasonal variations, incidence being highest in autumn and winter and lowest in spring and summer.
2. Age exerts great influence on liability to the infection. Within the age limits of an army population, liability decreases progressively with age.
3. A group which has passed through a major epidemic is less susceptible than a group which has not.
4. Age standardised incidence rates show that officers are more susceptible than other ranks. British officers showed an incidence of 400 per cent over ORs, whereas New Zealand officers were only 62 per cent.
5. Since forward troops are much more susceptible than base troops, droplet spread would not appear to be the most important method of transmission in major epidemics.
6. Though Italian troops suffered heavily from the disease in the Western Desert in 1942, the Italian civil population appears to have been free from any large-scale outbreak, while Allied troops were experiencing major epidemics.

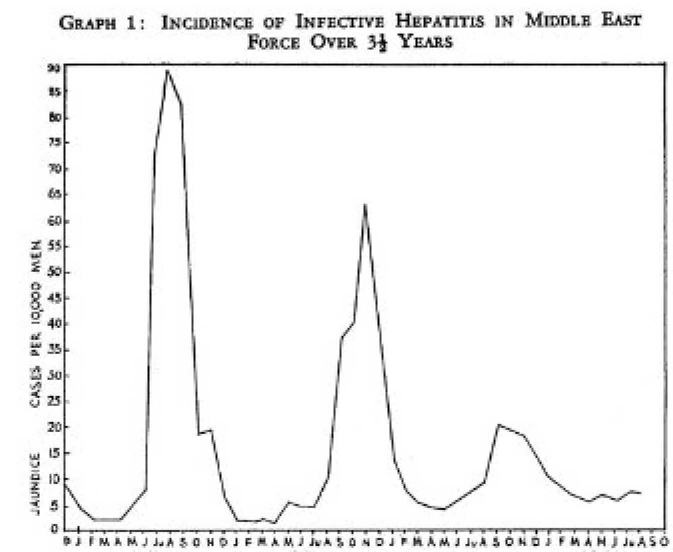
Annual Incidence

The accompanying graph (1) shows the annual incidence over three and a half years among all troops in the Middle East, and it will be seen that the epidemics recurred each year at the same time but with less intensity, and were associated with, but later than, the fly maximum. Graph 2 shows 2 NZEF incidence from 1942 to 1944. Among New Zealand troops there is not the same falling-off in incidence, due no doubt to such factors as large numbers of reinforcements.

The Middle East is considered an endemic area where jaundice is a common complaint of children but rare in adults, whereas adults coming into the area are readily infected.

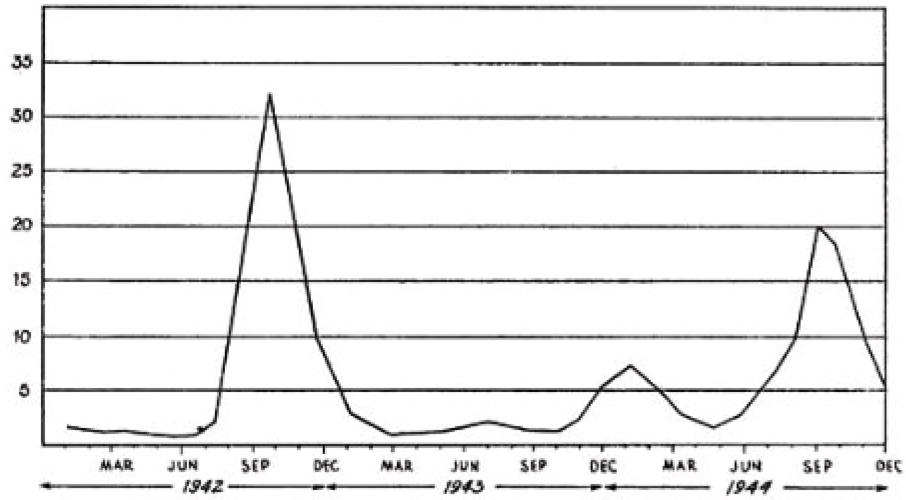
Sub-clinical Attacks

All figures of case incidence are to some extent inaccurate because of the large numbers who had sub-clinical attacks, as will be described later. These being of all grades of severity, many could not be located as they did not report sick. However, it is clear that among New Zealand troops the incidence must have been much higher than is indicated by figures.



Graph 1: Incidence of Infective Hepatitis in Middle East Force Over 3½ Years

GRAPH 2: RATES PER 1000 2 NZEF MONTHLY 1942–44



Graph 2: Rates Per 1000 2 NZEF Monthly 1942–44

Some Inferences

Studies by Van Rooyen and Kirk (1945) conclude that the virus is distributed widely throughout the Mediterranean and that the local adult population is immune to attack due to resistance acquired in childhood, either from the disease or by consuming food contaminated by the virus. Thus, in troops occupying an infected locality, the mechanism of their response to infection resembles that of the local children. By patronising cafés and eating-houses, every man would soon ingest infected material. Some acquired the disease and some eventually an immunity. However, in the case of the epidemic at Alamein, the doses of virus were probably so intense that many with moderate degrees of resistance would be infected. This may account for the mildness of many cases.

Susceptibility of Officers

Spooner (1943) noted that British officers were 4.7 times as prone to infection as other ranks. This did not apply to the same extent among New Zealand officers, but the incidence was higher than among the men. This is explained by the fact that an officer lives a more protected life than the soldier and enjoys better conditions all round in base camps, the contrast being greater in the British Army, where the susceptibility in an epidemic was higher and the incidence higher. The contrast did exist in the 2 NZEF in base units, but to a lesser extent. Officers in the field, of course, ran the same risk of infection as the men, and the incidence depended on the resistance gained during residence in the country while in base camps, etc.

British troops showed the greatest susceptibility to hepatitis of all troops in the Middle East, while New Zealand troops came next, whereas Indians and Maoris showed the least susceptibility. This latter statement is so far unexplained, but was a very noticeable feature.

Prevention of Hepatitis

Studies of the virus show that it is extremely resistant. It has comparable qualities to the virus of serum jaundice (Havens, 1945), which will traverse bacteriological filters of the Seitz and Berkefeld types, it withstands equal volumes of phenol and ether of a 5 per cent concentration for many months, and resists heating at 50 degrees C. for an hour or freezing or drying for several weeks (Memorandum, 1943).

As little as 0.1 c.c. of serum or the prick of an infected needle has been known to convey the infection (Bradley, Loutit and Maunsell, 1944; Salamen, King, Williams and Nicol, 1944).

The hygiene of the 2 NZEF units was excellent, judged by the dysentery and jaundice rate, and if one considered the base camps. Here one can say that hepatitis was controlled. However, in the desert camp areas, in spite of the best that could be done under the conditions, the control failed.

The efforts of sanitation, however, were magnificent under trying conditions (Richmond and Gear, 1945). They could conceivably be improved by attention to all aspects of sanitation and cleanliness, but it is just as well to remember that the highest incidence in the Eighth Army in the desert was 8 per 1000, and it would require many more men than that to advance sanitation closer to perfection than was obtained.

McKinlay and Truelove (1947), in carrying out investigations among New Zealand troops in Italy, made important contributions to the knowledge of this disease. They found that among the men who had experienced previous epidemics the initial incidence of infection was highest and gradually decreased, whereas among men recently arrived in the Middle East and Italy the initial incidence began low and rapidly increased.

They also noted the low incidence among Maoris, and commented on the fact, also, that a group which had not previously passed through an epidemic was three times more susceptible than old hands.

Comparison with Poliomyelitis

Modern work has shown that poliomyelitis virus is more easily recovered from stools than from naso-pharyngeal secretions (Trask et al., 1938, 1940, 1943; Kramer et al., 1939; Sabin and Ward, 1941; Paul, Havens and Van Rooyen, 1944).

Before it is possible to appreciate the underlying nature of these two virus diseases one should abandon older ideas which persistently endeavour to explain their epidemiology by case to case contact, oblivious of the existence of powerful immunity effects.

Both infective hepatitis and poliomyelitis are primarily intestinal maladies. The susceptible individual who ingests infective hepatitis virus develops the secondary complication of jaundice more frequently than do those who develop secondary paralytic phenomena after ingestion of poliomyelitis virus.

There have been in the past many adherents to the theory that the spread of infective hepatitis is of a catarrhal nature. One can only say that there is no evidence to support it out of the studies and experience in 2 NZEF, and that the aetiology and means of spread under wartime conditions in Egypt and Italy are clear.

The Pacific

The only figures available are for the latter half of 1943 and the first half of 1944. These, however, are too small to draw any conclusions from, as the last six months of 1943 produced 45 cases and the first six months of 1944 40 cases. However, the maximum incidence occurred in November and December, and again this suggests the heat of summer and the role played by flies in the spread.

Hospitalisation

At first it was thought that some attempts at isolation of cases should be made, but this appeared so impracticable under conditions in Egypt that it was waived and no efforts in this direction were made. It was found convenient to have these cases together, however, for ease of nursing, and this allowed the charge of a ward to be left to a junior member of the staff. Although some cases did not report sick, it became apparent that if men remained in the line the disease was more severe eventually and more protracted, and that the tendency to relapse was greater. Field units were encouraged to evacuate patients as sitting cases to base hospitals so that a full spell in hospital and adequate convalescence could be arranged. It was soon found to be a false economy to discharge men early or to hurry their return to the front line, because of the dangers of relapse, as well as the risk of continued poor health. Only those units who could give a full, unhurried convalescence were encouraged to keep their cases. The policy of having as many as possible of the New Zealand troops evacuated to New Zealand hospitals allowed a better study of the disease, and also allowed more satisfactory treatment as many other hospitals were inclined to discharge patients still jaundiced, because of lack of space, and among these one saw the highest relapse rate.

During the Alamein epidemic 1 NZ General Hospital and 2 NZ General Hospital handled most of the cases, and fresh demands were met by more tents being put up. Even though 1 NZ General Hospital enlarged from 900 to 1300 beds in a few weeks, most of the cases were accommodated in 80-bed tents, and were required to stay in bed except for going to the lavatory and ablutions.

In many cases conditions were not ideal and control was difficult, but the results were satisfactory and the criteria for discharge was disappearance of the jaundice and a clear urine and a few days of getting up gradually.

The routine (after the urine was clear) was 1 hour up first day, 2 hours up second day, 4 hours third day, 6 hours fourth day, and then off to a convalescent camp, where individual progress was watched and each case judged on its merits. In many cases livers were still enlarged on discharge, and it is a matter for conjecture whether these cases should not have been held longer.

Medical Officers

It was found that any one MO was able easily to look after 100 to 150 cases of infective hepatitis as well as do other routine duties. This included clinical examinations, writing of notes, and all the appropriate paper work and urine examination.

Immunity

It was noted that no particular physical type of soldier was more liable to become infected, but that the chances decreased with age. Infection in most cases conferred an immunity, but some very slightly infected had infections a second time. The average full infection usually conferred an immunity, but some men failed to develop an immunity at all and had repeated reinfections. Maoris had a strong immunity, which seemed to be a racial characteristic as the chance of infection was greatest in those who had a marked admixture of white blood.

Clinical

Non-icteric Cases: These cases at first seemed somewhat of a mystery and were inclined to be classed with the dyspepsias. They represented the purest form of infection with the virus and the gastro-intestinal infection, and yet it is hard to account for the fact that many had enlarged livers with no jaundice. It is best to consider cases of all grades beginning with (a) those where the infection was essentially gastro-intestinal in type and of short duration, (b) those in which the gastro-intestinal infection was associated with an enlarged liver and no jaundice, (c) those in which the gastro-intestinal infection was negligible clinically and the enlarged liver was found to account for some degree of ill-health but still no jaundice, and then (d) those with gastro-intestinal symptoms and jaundice of varying degrees.

It is impossible to say how many of the non-icteric cases occurred as these rarely came to hospital; but it is considered that there were very many of them. Eventually we came to the conclusion that a lot of persistent dyspepsia was probably originally due to the infection with the virus, and also one saw many who had gastrointestinal infections of four to five days' duration only, who had all the characteristics of virus infection.

Clinical Review of 1942 Epidemic

At the onset of epidemics the cases were milder than those seen in previous years and had fewer complications, but as time went on they became more severe, the icterus lasted longer, debility was greater, and relapses more frequent. As the greatest number were mild they form the basis of this description, but there were, during the later stages, all types, as will be seen in the text. Although it is recognised that icterus is only one symptom of this disease, it is convenient to divide it into two stages, the pre-icteric and the icteric.

Pre-icteric Stage: In all epidemics in the 2 NZEF this was the period of greatest malaise and discomfort, and was the one most often spent outside hospital. Many examples, however, were able to be studied in the wards, and the briefest statement to cover this stage would be that it was usually pyrexial illness associated with acute gastritis. That acute gastritis is present was proved at post-mortem in one case, and in another, when an ulcer in a Meckels diverticulum perforating the mucous membrane showed the typical changes on the third day of the pre-icteric stage.

The onset was usually sudden with a close resemblance to sandfly fever, presenting a mild shivering attack, temperature 102–103, headache, generalised aches and pains, backache, and considerable mental depression. Some cases were apyrexial or had a mild fever only. Two presented as initial symptoms a generalised urticaria which cleared and recurred during the first three days of the illness. The icteric tinge of the skin was readily seen in urticarial wheels. Whatever opened the train of symptoms, be it fever or just malaise, within twenty-four hours the classical features of this stage appeared, dyspepsia and anorexia, which were almost universally present and were the most striking and most complained of symptoms and the greatest cause of discomfort to the patient. No matter if fever were present or not, loss of appetite, nausea, lassitude, general malaise, and indigestion were always regarded with suspicion, and jaundice expected and waited for.

Anorexia was frequently complete and associated with nausea, occasional vomiting, and, in a few instances, persistent hiccough. Dyspepsia was persistent, severe, aggravated by food, and failed to respond to alkalies. Constipation was common and diarrhoea rare, the tongue was clean and moist. Fat intolerance was seen early, and any appetite that was present was capricious. This pre-icteric stage lasted five to seven days, but varied from none to twenty-one days. The dyspeptic symptoms usually became steadily more severe and the pyrexia followed no uniform pattern, but varied between a chart persistent at 101 or 102, one with a daily swing between normal and 102 and 103, a completely irregular picture, a low fever of 99 or 100, or one that settled to normal within two or three days and stayed there.

From the first or second day there was pain under the right costal margin, both at rest and on movement, tenderness on pressure in this region, and a liver edge palpable one inch below the rib edge. Although the liver was enlarged in practically all cases, it was the exception to feel a spleen, the fauces were normal, the breath not offensive and the facies unchanged, but the patients felt ill and miserable, were unable to concentrate, and difficult to satisfy.

General physical weakness was felt by many of those whose pyrexia and dyspepsia were not of sufficient severity to require evacuation to hospital, and that, combined with a loss of interest and inability to concentrate, eventually decided many to report sick.

Rashes: Two cases were seen who presented a rash typical of typhus fever during this stage, but because of the mildness of the illness and the presence of all other typical signs of hepatitis were accepted as such.

This pre-icteric stage, which proved a source of humiliation to many medical officers in the early days of the epidemic and soon became easily recognised, passed insensibly into the icteric stage.

Icteric Stage: The full development of jaundice normally occupied five to seven days, but was noticed to be as short as three days or, in the severe cases, to deepen steadily for as long as three weeks. At first the urine was noticed to be getting dark, and it was surprising how many of the milder cases continued at work until this stage. Two days later a tinge of yellow was visible in the conjunctival folds of the lower lid, which spread concentrically towards the pupil, and on the fifth day the conjunctiva was evenly and deeply stained, the urine mahogany in colour, and the skin evenly and faintly yellow. In the majority of cases this stage of icterus was obvious but not severe, and reached its full intensity in five to seven days or less.

The length of the disease could normally be estimated from the depth of jaundice after one week. Some mild cases were already beginning to clear or had reached a stationary stage by the fifth day, whereas the more severe and prolonged cases were still deepening in colour. It followed in most cases that the degree of icterus reached by then indicated the rapidity with which it would clear and the extent of the resulting debility. A few exceptions to this occurred, in which cases a sudden increase in the severity indicated a more prolonged and severe illness.

The temperature if not already normal at the onset of the icterus became so very soon, settling by lysis, and only rarely did pyrexia remain without heralding the presence of some complication or intercurrent infection. The dyspepsia and anorexia commenced to improve once jaundice appeared, and in 90 per cent of cases was completely gone when the jaundice was fully developed. As the dyspepsia vanished the appetite became enormous, and in some cases most capricious, being only satisfied by large quantities of tomatoes, cucumbers, or oysters. A certain fat intolerance remained in some and lasted for several weeks.

In the mildest type of case (in this series over 50 per cent) jaundice began to fade very soon after it was fully developed, that is, from the fifth to the seventh day. The fading was normally rapid and was almost gone about the fourteenth day after its appearance, leaving only a mild staining of the conjunctiva. The fading took place, first from the skin, then from the conjunctiva and lastly from the urine, which usually showed a trace of bile on testing for several days after all else appeared normal.

In a considerable number, however, the jaundice remained stationary with daily fluctuations for about seven days and cleared in a further seven to ten days, whereas the most severe continued with deep icterus up to a period of six weeks or more before clearing. The longest case of icterus in this series was eight weeks.

During the stage of clearing all symptoms had usually gone except those of weakness and lassitude. The stools darkened early and the urine became paler early but was the last to clear completely, as determined by laboratory tests.

During the stage of fully developed icterus the liver could be felt one to one and a half inches below the costal margin. In cases of prolonged or deepening icterus it would enlarge still further up to 2.inches or even more, but once the jaundice began to fade in nearly all cases it returned to normal size with rapidity.

In the majority of cases in fourteen to twenty-one days after the onset of jaundice the patient would be quite clear again with a liver of normal size and would commence to get up. This was taken slowly and a week allowed to reach the stage of being up all day before going to a convalescent depot for a further two or three weeks.

In the more severe cases, which were rarely seen early in the epidemic, but formed a large proportion of those at the end, the pre-icteric stage presented no unusual features, but the onset of the icterus was not always accompanied by fall in temperature and return of appetite.

The jaundice gradually increased, or did so in a series of exacerbations, while the irregular fever persisted for seven to ten days and the dyspepsia diminished only gradually, and did not vanish. Malaise and lassitude became more evident and sleeplessness the rule, the skin became deeply yellow, and in those whose jaundice lasted four to eight weeks pruritis was severe, haemorrhages frequent, and loss of weight alarming.

No particular type of patient or one belonging to any particular age group was more affected in this way than any other, and in this series no deaths occurred in the later stages no matter what the extent or severity of the jaundice.

Persistent Pyrexia: Where this occurred and lasted one or two weeks during the icteric stage, in the absence of any recognisable complications it indicated a severe and prolonged illness. It was an infrequent complication.

Distended Abdomen: This was seen in several cases, and if associated with fever suggested an accompanying typhoid infection. Although a few cases did have this as a superadded infection, the majority of cases did not, and the disorder vanished without therapy.

Pruritis: This was a distressing accompaniment of some of those cases in which icterus was prolonged and deep. It became worse towards evening and at night, was generalised and difficult to relieve. One case only responded brilliantly to ephedrine gr.½, whereas others received temporary relief from luminal, and calamine and phenol lotion.

Haemorrhage: Cases severe enough to show pruritis often showed signs of a haemorrhagic tendency in areas subjected to scratching and other mild traumata. This was usually an indication of more severe haemorrhages to come from lips, gums, nose, stomach, bladder, and rectum, but prompt exhibition of vitamin K intramuscularly prevented any of these becoming of serious importance.

Recurrent Icterus: A recurrence of a fading icterus was not infrequent. In some cases it developed when the original icterus had almost faded. It only increased the time of the illness and the convalescence necessary. In many cases it seemed to be related to indiscretions such as getting out of bed without permission or unwarranted exercise in the earliest stages of getting up.

Relapses: These were of two types:

1. With Icterus: Presenting a complete picture of the whole disease, usually much more severe and prolonged than the original illness. These relapses occurred three to four weeks after the complete subsidence of the original infection, and in a few cases second relapses also occurred.
2. Without Icterus: These cases presented a picture of acute gastritis and were recognised by the patient as being identical with his original symptoms, were associated with a slight enlargement of the liver, and took three to four weeks to recover. There is no evidence that these relapses were related to the taking of alcohol. It is estimated that the relapse rate was 3 to 4 per cent.

Persistent Liver Enlargement: Mild cases of hepatitis usually had normal livers on discharge from hospital, but in the more severe and relapsed cases enlargement tended to persist and was associated with recurrent dyspepsia and malaise. Enlarged livers have been found three or four months after the recovery from icterus. These patients were far from well and required regrading. The future of these men is uncertain at present, but some, seen six years later, have normally sized livers and no symptoms.

Mental Symptoms: Examples of mild depression were often seen, but in prolonged icterus confusional states, which recovered completely during convalescence, were common.

Treatment

All cases were confined to bed except for a daily bath and visits to the lavatory, but even this was forbidden in any but the milder type of case. It was noticed that rest in bed had an appreciable effect on the rapidity of recovery.

Diet

Fat-free diet was given until the appetite returned. After that no restrictions were made. Glucose was given in the form of drinks or barley sugar in as large quantities as possible. Fluids were forced during the whole illness.

Medicine

Sod. Sulph. was given each morning. Alcohol was forbidden during the illness and for one month after

Severe Cases

These cases were a great anxiety because of the mental changes, tendency to bleed, and the difficulty in getting in sufficient fluids.

Intravenous fluids and glucose were given early in all severe cases.

The fluid intake was kept at 6 pints a day and 100 grammes of glucose or more was given.

Vitamin K was given to prevent haemorrhage; vitamin B to prevent peripheral neuritis.

Occasional blood transfusions were resorted to as necessary.

Amoebae

In Italy, during treatment of hepatitis, it was found that many cases had persistent diarrhoea. On investigation this was found to be due to amoebic infection, no doubt introduced by the fly as was the virus of infective hepatitis.

Pensions Aspect

An opinion expressed by Dr D. Macdonald Wilson of the War Pensions Department in 1952 was that infective hepatitis had not resulted in any pensions liability. In a few cases only were some vague dyspeptic symptoms associated with some slight enlargement of the liver ascribed to a previous attack of hepatitis.

Statistics

The importance of infective hepatitis in its effect on 2 NZEF in the Middle East and Italy is shown by the following statistics:

Admissions to medical units July 1941 to December 1945 were 7051. (These represented nearly 9 per cent of all admissions and the total was greater than that for any other disease, and the length of stay in hospital and convalescent depot was second only to pneumonia.)

Deaths from hepatitis were 6 out of a total of 190 for all diseases.

Cases evacuated to New Zealand numbered 124.

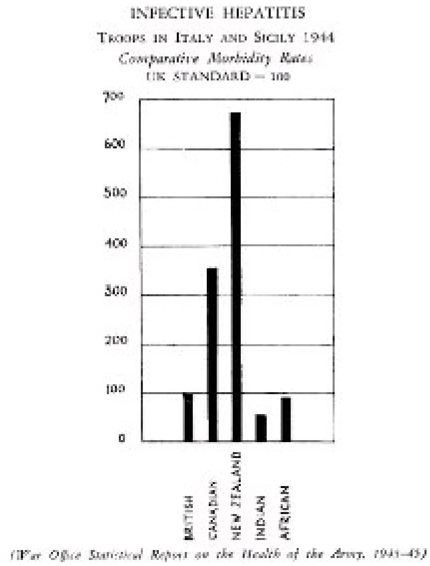
In 2 NZEF (IP) there were only 85 hepatitis cases in the total of 6248 admissions to medical units.

INFECTIVE HEPATITIS

Troops in Italy and Sicily 1944

Comparative Morbidity Rates

UK STANDARD = 100



(War Office 'Statistical Report on the Health of the Army, 1943–45)

Infective Hepatitis and Serum Jaundice

The relationship of infective hepatitis to serum jaundice, postarsenical, and post-yellow-fever-vaccine jaundice remains a mystery. No laboratory animal has been found susceptible to infection with any of these varieties of jaundice.

Bigger (1943) has demonstrated that jaundice following antisyphilitic treatment was due to faulty sterilisation of syringes and needles contaminated with homologous serum jaundice virus. Sheehan (1944) and Salaman et al. (1944) and others have provided confirmation.

Dible and McMichael (1943) studied the histopathology of liver biopsy tissue from cases of arseno-therapy jaundice, and concluded that the appearances of the organ were more compatible with damage by an agent similar to that causing serum jaundice or epidemic hepatitis.

The relationship of serum jaundice to infective hepatitis presents a conundrum, for if it were eventually proved that the two were identical then the existence of subclinical, silent, blood-borne infective hepatitis would claim fresh significance.

Some believe that they are aetiologically different because infective hepatitis is spread by contact and has an incubation period of twenty-eight to thirty days, whereas clinical serum jaundice is normally caused by parenteral administration of icterogenic serum, and has an incubation period of eighty to a hundred days according to Paul et al. (1945), Steiner (1944), and Beattie and Marshall (1944). The latter also discovered that it was possible to reduce the incubation period of serum jaundice to thirty days by feeding infective serum. Evidence in favour of their identity has been provided by Sheehan (1944), who noticed that infective hepatitis virus may be conveyed from one man to another by unsterile needles and syringes used for aspirating blood, and that the ensuing malady assumed the character of typical serum jaundice after an incubation period of three months. Efforts to isolate virus from the faeces of serum jaundice cases by McCallum (1945) and Neefe, Stokes, and Gellis (1945) have been unsuccessful, and it therefore seems that the intestinal tract contents are not infective in serum jaundice.

Conclusions of the opposite kind have been reported by Paul et al. (1945), who found that three patients who had recovered from serum jaundice six months earlier, later proved susceptible to experimentally induced infective hepatitis. The latter have epitomised the present position by stating that the outstanding difference between serum jaundice and infective hepatitis rested in the length of the incubation period. Neefe, Stokes, and Gellis (1945) have commented that 'Normal persons are much more likely to develop the disease when the agent is administered orally than when it is injected parenterally', a fact which we regard as one of fundamental importance in the establishment of infective hepatitis as a primary pathological affection of the gut.

The two diseases may be closely related in that serum jaundice represents the artificial production of infective hepatitis in a proportion of instances: it cannot yet be said that all serum jaundice belongs to this category. The question of the aetiology of post-arsenical serum jaundice and infective hepatitis bristles with unsolved academic problems and practical obstacles to progress, but the subject is of as much interest in peace as in war and justifies intensive research into the pathogenesis of these icterogenic virus agents.

Clinical Pathology

Blood Picture: In the pre-icteric stage there is leucopenia with an absolute neutropenia and an increase in the large lymphocytes. In the icteric stage the white cells increase again and there is a definite absolute monocytosis, and then a gradual return to normal in about six weeks.

Liver Function Tests: These were rarely carried out among New Zealand patients, and it was considered there was no single test which would differentiate between infective hepatitis, chronic hepatitis, cirrhosis, and obstructive jaundice. Higgins and his colleagues consider that the estimation of bilirubin, phosphatase, albumin, and globulin in the plasma from a given specimen provided as much information as could be got from liver function tests.

Pathology

The changes in hepatitis consist of hepatic cell necrosis and autolysis with a leucocytic and histiocytic reaction and infiltration. In severe cases there is disorganisation of the architecture of the hepatic lobules. The centres of the lobules show the cell necrosis and autolysis most markedly and the cellular infiltration is greatest round the portal tracts. The end stage may be acute or sub-acute necrosis or cirrhosis.

PERIPHERAL LOBULAR NECROSIS IN HEPATITIS

Material and Methods

The material from cases of hepatitis was collected while Major D. T. Stewart was serving as pathologist to 1 NZ General Hospital (2 NZEF) in the Middle East. It consisted of blocks of liver tissue sent by many Middle East pathologists as a result of a directive issued by the Deputy Director of Pathology, Middle East Force. The specimens were derived from fatal cases of infective hepatitis and arsenotherapy jaundice (as it was then called) occurring during the Middle East epidemic of 1942–43, described in papers by McCallum (1943–44), Gordon (1943), and Spooner (1944). In none of the cases used was there a history of yellow-fever inoculation or of previous blood or serum transfusion. No cases of Weil's disease were occurring in the area—Boyd (1943).

As some of the specimens were derived from cases in which a definite diagnosis had not been made, or were not accompanied by adequate clinical details, and because excessive post-mortem change appeared to be present in some, the only material used comprised 37 cases of infective hepatitis and 16 cases of arsenotherapy jaundice, i.e., homologous serum hepatitis arising during or after treatment of syphilis by arsenical drugs given by injection.

For comparison with the type and site of change found in the above material, Major Stewart examined control material from his own series of post-mortem examinations. This material consisted of specimens of liver from 52 cases of 'toxaemia', including 11 cases of burns. The remaining 41 cases were made up of 6 cases of enteric fever, 10 pneumococcal infections, 3 cases of malaria, 3 of diphtheria, 3 of epidemic typhus, 6 staphylococcal infections, 3 cases of suppurative peritonitis, 4 cases of wound sepsis, and 3 pyrexias of unknown origin. Seventeen of the 52 cases had been jaundiced at the termination of their illness.

Finally, material was studied from 19 cases of obstructive 'biliary cirrhosis' in the collection of post-mortem material at the Bland-Sutton Institute of Pathology, Middlesex Hospital, London. There were 9 carcinomas of the head of the pancreas, 8 carcinomas of the common bile duct or ampulla of Vater, and 2 cases of bile duct compression by secondary deposits in lymph nodes.

Findings

Jaundice appeared a variable time after the prodromal symptoms, its intensity varied, but it was usually deep at death. In Indians and South African natives the presence of jaundice was often missed until it became deep. The liver and spleen were not often found to be enlarged and in some cases the liver appeared to shrink. The course varied. In some cases the early symptoms and signs merged into those which presaged death; in others the course appeared to be favourable, but relapse occurred with deepening of jaundice, recurrence of vomiting, etc. The terminal stages were marked by high fever, mental and nervous disturbances, vomiting, haemorrhagic manifestations, deepening jaundice, and coma.

The cases for which an accurate duration was known are shown in the following table, grouped as to duration from the onset of prodromal symptoms to death.

Days from Onset Prodromal Symptoms to Death	Epidemic Hepatitis	Arsenotberapy Jaundice
1–5	4	2
6–10	13	3

11–15	8	2
16–20	2	0
21–25	3	1
26–30	0	5
31–35	0	1
	—	—
Total	30	14

Conclusions

1. Peripheral lobular necrosis was found to occur in hepatitis as commonly and to as great an extent as the central necrosis usually described.
2. The enlargement of portal tracts and the hyperplasia of small bile ducts in the portal tracts (both points noted by some previous workers) are presumptive evidence of the existence of peripheral lobular necrosis.
3. Peripheral lobular necrosis is not a feature in livers damaged by toxaemia and is only of slight extent in biliary cirrhosis.
4. It was concluded that peripheral lobular necrosis in hepatitis plays an important part in the sequence of liver change and the pathogenesis of central and complete necrosis in the acute stage of the disease. In later stages peripheral lobular necrosis is the probable cause of persistent jaundice of obstructive type. Finally, it was concluded that peripheral necrosis might underlie the occasional sequela of unilobular cirrhosis.

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[SECTION]

INFECTIVE hepatitis has for a long time been accepted as an illness common to soldiers on military operations. Cases have been recorded as occurring in all recent wars, and the clinical picture has been well known. The disease is world-wide in distribution, but the Mediterranean littoral has been one of high epidemicity. From October to November 1915 some 25 per cent of a section of British troops on Gallipoli and in Alexandria were affected (Martin, 1917). New Zealand troops were also affected severely, and it was found that the highest incidence was in the winter months of 1915 and 1916, whereas other gastro-intestinal infections reached their height in the summer. Efforts to discover the mode of transmission failed, and Wilcox (1916) concluded that the disease started as a gastro-intestinal infection (see Martin, 1917); but all bacteriological investigations were negative (Hunter, 1922). Kartulis (1916) declared that the pathogenic agent was intimately related to sewers and sea water, because of the decrease in incidence in Alexandria from 1898 to 1916 with the introduction of modern drainage.

At the onset of the Second World War the disease was not considered very seriously. It was thought to be a catarrhal infection with no known methods of treatment or prevention. With the arrival of New Zealand troops in Egypt in 1940 sanitation in base camps was kept at a very high level and very few cases were noted. As 1940 wore on and troops moved to the desert, a few more cases appeared in the late summer and autumn, which time, it was found later, is the time of greatest incidence. This is usually a month after the height of the dysentery epidemic.

It is noteworthy that practically no cases occurred while the Division was on active service in Greece and Crete in 1941, but later in the year 4 Brigade, which had been in Egypt since February 1940, produced cases.

From July to August 1941, 79 cases were notified from New Zealand troops; they were widely scattered and mild—mostly from those in forward areas.

At this stage it was widely accepted that the infection was due to a virus, but the method of spread was disputed. Prior to this Adler, working in Jerusalem, had failed to isolate any organism or infect any available animal. This work was supported by Van Rooyen and Gordon (1942), but Cameron interjected six human volunteers intravenously with blood from hepatitis cases and produced the disease, thus proving the communicability of the infection.

The first major epidemic among New Zealand troops occurred in 1942 and began in July and August in the Western Desert—again about a month after the height of the dysentery wave.

Between August 1942 and January 1943, 2500 cases occurred among 30,000 New Zealand troops. During September and October 1942 there were 1137 cases, of which 1059 occurred among 7500 men in the Alamein Line and 78 cases among 3900 men in the rear areas within 10 miles of the line.

This epidemic presented several problems:

1. Manpower: Nearly all cases required a month before returning to duty, and many some weeks more; a few required eventual evacuation to New Zealand. It is easy to see how serious was this problem.
2. Hospitalisation: Practically all cases were evacuated by ambulance direct to 1 New Zealand General Hospital, which was over 100 miles away. Others found their way to other New Zealand hospitals in the area. No. 1 New Zealand General Hospital, a 900-bed hospital, found it necessary to expand rapidly, and rose from 900 beds to 1300 in a few weeks, without having extra available staff to meet the situation.
3. The Study of the Epidemic: An initial survey of the cases arriving at 1 NZ General Hospital soon showed a pattern, and it was decided that there was a possibility of studying the epidemiology and mode of spread of this disease with a reasonable chance of success. This work was undertaken forthwith by Kirk and was eventually published in the Lancet (1945).

It was apparent that most of the cases were coming from units who had been in the New Zealand Box in the Alamein Line a month previously, whereas very few cases came from units in base areas five to ten miles away. This concentrated attention on the site, as the front-line troops occupied an area of five miles square and all units who spent thirty-five to forty days there before the start of the epidemic were involved—units withdrawn after a shorter stay than the remainder were less affected. After the front-line troops left this area the epidemic began to subside. No other troops in the Alamein Line were involved at this time, so that if the site were to be incriminated it had to be different from the rest of the front line at Alamein. Common factors to all at Alamein were food, water, living conditions, heat, and fatigue, so these could not account for the localised epidemic among New Zealand troops. It is to be noted that New Zealand troops have not at any time exhibited an undue susceptibility to this malady.

Firstly, the possibility of an unknown vector was ruled out. Secondly, spread by droplet infection was unlikely in the front-line units as they were living in dispersed formation with little close contact and no tents or messes. On the contrary the well troops in the rear areas were living in a more congested state, and although the incidence of catarrhal infection was low, opportunities for droplet spread were numerous.

The third possibility, and the one of choice, was that the disease was fly-borne; flies were present in millions everywhere in Alamein, both in front and rear areas, and as the site seemed to be responsible it was thought that in the forward area the insects were infected locally. The New Zealand ground was one of the few parts recently captured from the enemy. It was filthy with excreta and imperfectly buried German and Italian corpses, and it was learned from patrols and prisoners that the enemy were themselves experiencing an outbreak of infective hepatitis.

Thus the epidemic was attributed to local contamination of flies arising from the faeces and cadavers strewn over the battlefield, where food, hands, and mess tins could not be efficiently protected.

This theory of gastro-intestinal infection and spread by excreta explained why the disease did not spread in hospitals to the staff, as all men used well-protected latrines, and why it did not spread in base camps and prisoner-of-war cages where the same conditions existed.

Proof of this theory can be found in publications of work done in America by Havens et al. (1945), and Paul, Havens, Sabin, and Philip (1945); in England by McCallum and Bradley (1944); and in West Africa by Findlay and Willcox (1945).

Of the American work the following quotation summarises the results:

When faecal material from patients with the naturally occurring disease was fed to human volunteers, two out of three contracted the disease in 20 and 22 days respectively. Serum obtained from these two patients in the pre-icteric stage was filtered (Chamberlain 2) and immediately afterwards heated (56 deg. C. for 30 minutes). This heated serum filtrate (M.K.) produced infective hepatitis when fed to 4 out of 5 volunteers with an incubation period ranging from 20 to 31 days. Some of the latter group of volunteers had recovered some months before from serum jaundice, but it did not protect them against an attack of Infective Hepatitis.

Thus, employing one strain of infective hepatitis virus, jaundice was produced in 6 out of 11 subjects when serum was inoculated, 4 out of 5 when serum was fed, and in 2 out of 3 when faeces were fed, and the incubation period was invariably less than thirty-four days in these experiments. It can therefore be said that the virus of infective hepatitis is both present in faeces and possesses powers of viability to enable it to be transmitted by excreta.

Although this fact now is proved, it is not necessarily certain that this is the only means of transmission, but further information may be available in the future. The epidemiological investigations carried out in the Middle East were unable to satisfy all the anomalies that occurred; but it is certain that in the 1942 epidemic among the New Zealand troops the virus was spread by flies from excreta. During 1943 the case incidence dropped during the summer months and did not rise to the expected heights at the end of the year. The 2nd NZEF was in Italy during the winter of 1943–44 and had not received many reinforcements, which may have had some bearing on the number of susceptibles available; however, the greatest incidence was 3·2 per 1000 in October 1943, rising to 6·15 per 1000 in January 1944.

During this time there was little difference in the incidence between forward and base troops. There was a fall in numbers again in 1944, and during this time the Division was moving north in Italy; but by July cases increased, mostly among the divisional troops, and reached 11.15 per 1000. From August 1944 to February 1945, except for a rest period in November, the Division was in the Rimini- Faenza area, and the incidence reached a maximum of 14·55 per 1000 in October to December, 1944. From June 1944 onwards there was considerable movement of locations and the men were living under all types of-conditions. Flies were prevalent in the initial stages of the epidemic, and the sanitation of the local inhabitants, being of a very low standard, made any unit control of little value. There is little doubt that the mode of spread was the same as in the desert, but study in an area of towns and villages made any definite conclusions impossible.

It is significant, however, that in Italy during hepatitis epidemics there was no appreciable incidence among the local population. This is the same as was noticed in Egypt and indicates that the Mediterranean region is an endemic area with a largely immune local population.

In the epidemic in Italy, where 2461 cases occurred from July 1944 to January 1945 among 30,000 men, most of the cases came from front-line troops, and the problems of hospitalisation were again difficult. However, with the 2 NZ General Hospital in the Naples area and 1 NZ General Hospital on the Adriatic coast at Senigallia, and 3 NZ General Hospital at Bari in the south, lines of evacuation were arranged and hospital treatment was available.

McKinlay and Truelove (1945) carried out detailed investigations of some aspects of epidemiology among New Zealand and Canadian troops in Italy in the 1944 epidemic and their conclusions are as follows:

1. Infective hepatitis displays striking seasonal variations, incidence being highest in autumn and winter and lowest in spring and summer.
2. Age exerts great influence on liability to the infection. Within the age limits of an army population, liability decreases progressively with age.
3. A group which has passed through a major epidemic is less susceptible than a group which has not.
4. Age standardised incidence rates show that officers are more susceptible than other ranks. British officers showed an incidence of 400 per cent over ORs, whereas New Zealand officers were only 62 per cent.
5. Since forward troops are much more susceptible than base troops, droplet spread would not appear to be the most important method of transmission in major epidemics.
6. Though Italian troops suffered heavily from the disease in the Western Desert in 1942, the Italian civil population appears to have been free from any large-scale outbreak, while Allied troops were experiencing major epidemics.

ANNUAL INCIDENCE

Annual Incidence

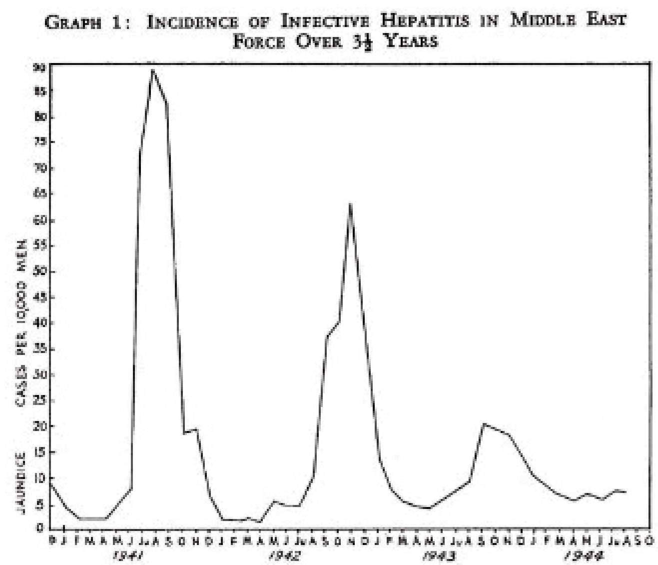
The accompanying graph (1) shows the annual incidence over three and a half years among all troops in the Middle East, and it will be seen that the epidemics recurred each year at the same time but with less intensity, and were associated with, but later than, the fly maximum. Graph 2 shows 2 NZEF incidence from 1942 to 1944. Among New Zealand troops there is not the same falling-off in incidence, due no doubt to such factors as large numbers of reinforcements.

The Middle East is considered an endemic area where jaundice is a common complaint of children but rare in adults, whereas adults coming into the area are readily infected.

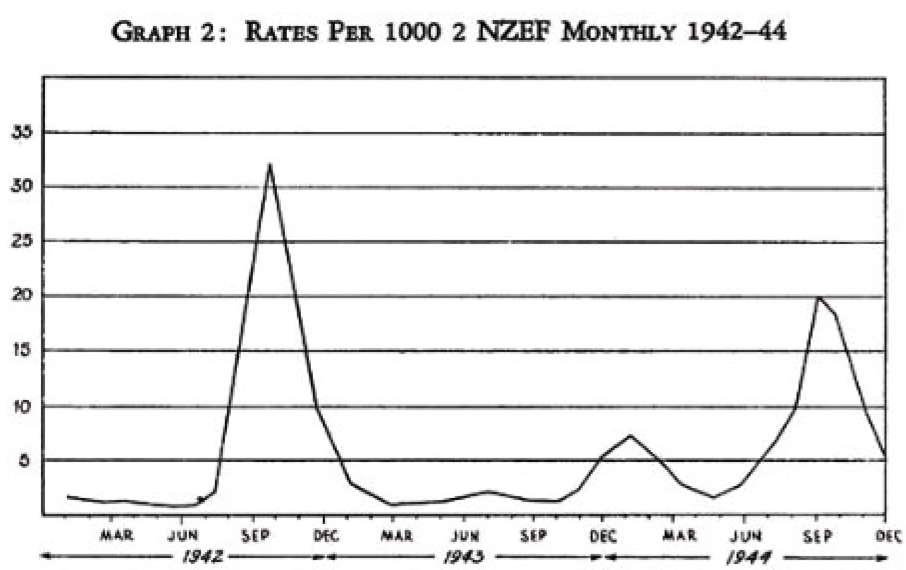
SUB-CLINICAL ATTACKS

Sub-clinical Attacks

All figures of case incidence are to some extent inaccurate because of the large numbers who had sub-clinical attacks, as will be described later. These being of all grades of severity, many could not be located as they did not report sick. However, it is clear that among New Zealand troops the incidence must have been much higher than is indicated by figures.



Graph 1: Incidence of Infective Hepatitis in Middle East Force Over 3½ Years



Graph 2: Rates Per 1000 2 NZEF Monthly 1942–44

Some Inferences

Studies by Van Rooyen and Kirk (1945) conclude that the virus is distributed widely throughout the Mediterranean and that the local adult population is immune to attack due to resistance acquired in childhood, either from the disease or by consuming food contaminated by the virus. Thus, in troops occupying an infected locality, the mechanism of their response to infection resembles that of the local children. By patronising cafés and eating-houses, every man would soon ingest infected material. Some acquired the disease and some eventually an immunity. However, in the case of the epidemic at Alamein, the doses of virus were probably so intense that many with moderate degrees of resistance would be infected. This may account for the mildness of many cases.

SUSCEPTIBILITY OF OFFICERS

Susceptibility of Officers

Spooner (1943) noted that British officers were 4.7 times as prone to infection as other ranks. This did not apply to the same extent among New Zealand officers, but the incidence was higher than among the men. This is explained by the fact that an officer lives a more protected life than the soldier and enjoys better conditions all round in base camps, the contrast being greater in the British Army, where the susceptibility in an epidemic was higher and the incidence higher. The contrast did exist in the 2 NZEF in base units, but to a lesser extent. Officers in the field, of course, ran the same risk of infection as the men, and the incidence depended on the resistance gained during residence in the country while in base camps, etc.

British troops showed the greatest susceptibility to hepatitis of all troops in the Middle East, while New Zealand troops came next, whereas Indians and Maoris showed the least susceptibility. This latter statement is so far unexplained, but was a very noticeable feature.

PREVENTION OF HEPATITIS

Prevention of Hepatitis

Studies of the virus show that it is extremely resistant. It has comparable qualities to the virus of serum jaundice (Havens, 1945), which will traverse bacteriological filters of the Seitz and Berkefeld types, it withstands equal volumes of phenol and ether of a 5 per cent concentration for many months, and resists heating at 50 degrees C. for an hour or freezing or drying for several weeks (Memorandum, 1943).

As little as 0.1 c.c. of serum or the prick of an infected needle has been known to convey the infection (Bradley, Loutit and Maunsell, 1944; Salamen, King, Williams and Nicol, 1944).

The hygiene of the 2 NZEF units was excellent, judged by the dysentery and jaundice rate, and if one considered the base camps. Here one can say that hepatitis was controlled. However, in the desert camp areas, in spite of the best that could be done under the conditions, the control failed.

The efforts of sanitation, however, were magnificent under trying conditions (Richmond and Gear, 1945). They could conceivably be improved by attention to all aspects of sanitation and cleanliness, but it is just as well to remember that the highest incidence in the Eighth Army in the desert was 8 per 1000, and it would require many more men than that to advance sanitation closer to perfection than was obtained.

McKinlay and Truelove (1947), in carrying out investigations among New Zealand troops in Italy, made important contributions to the knowledge of this disease. They found that among the men who had experienced previous epidemics the initial incidence of infection was highest and gradually decreased, whereas among men recently arrived in the Middle East and Italy the initial incidence began low and rapidly increased.

They also noted the low incidence among Maoris, and commented on the fact, also, that a group which had not previously passed through an epidemic was three times more susceptible than old hands.

COMPARISON WITH POLIOMYELITIS

Comparison with Poliomyelitis

Modern work has shown that poliomyelitis virus is more easily recovered from stools than from naso-pharyngeal secretions (Trask et al., 1938, 1940, 1943; Kramer et al., 1939; Sabin and Ward, 1941; Paul, Havens and Van Rooyen, 1944).

Before it is possible to appreciate the underlying nature of these two virus diseases one should abandon older ideas which persistently endeavour to explain their epidemiology by case to case contact, oblivious of the existence of powerful immunity effects.

Both infective hepatitis and poliomyelitis are primarily intestinal maladies. The susceptible individual who ingests infective hepatitis virus develops the secondary complication of jaundice more frequently than do those who develop secondary paralytic phenomena after ingestion of poliomyelitis virus.

There have been in the past many adherents to the theory that the spread of infective hepatitis is of a catarrhal nature. One can only say that there is no evidence to support it out of the studies and experience in 2 NZEF, and that the aetiology and means of spread under wartime conditions in Egypt and Italy are clear.

The Pacific

The only figures available are for the latter half of 1943 and the first half of 1944. These, however, are too small to draw any conclusions from, as the last six months of 1943 produced 45 cases and the first six months of 1944 40 cases. However, the maximum incidence occurred in November and December, and again this suggests the heat of summer and the role played by flies in the spread.

HOSPITALISATION

Hospitalisation

At first it was thought that some attempts at isolation of cases should be made, but this appeared so impracticable under conditions in Egypt that it was waived and no efforts in this direction were made. It was found convenient to have these cases together, however, for ease of nursing, and this allowed the charge of a ward to be left to a junior member of the staff. Although some cases did not report sick, it became apparent that if men remained in the line the disease was more severe eventually and more protracted, and that the tendency to relapse was greater. Field units were encouraged to evacuate patients as sitting cases to base hospitals so that a full spell in hospital and adequate convalescence could be arranged. It was soon found to be a false economy to discharge men early or to hurry their return to the front line, because of the dangers of relapse, as well as the risk of continued poor health. Only those units who could give a full, unhurried convalescence were encouraged to keep their cases. The policy of having as many as possible of the New Zealand troops evacuated to New Zealand hospitals allowed a better study of the disease, and also allowed more satisfactory treatment as many other hospitals were inclined to discharge patients still jaundiced, because of lack of space, and among these one saw the highest relapse rate.

During the Alamein epidemic 1 NZ General Hospital and 2 NZ General Hospital handled most of the cases, and fresh demands were met by more tents being put up. Even though 1 NZ General Hospital enlarged from 900 to 1300 beds in a few weeks, most of the cases were accommodated in 80-bed tents, and were required to stay in bed except for going to the lavatory and ablutions.

In many cases conditions were not ideal and control was difficult, but the results were satisfactory and the criteria for discharge was disappearance of the jaundice and a clear urine and a few days of getting up gradually.

The routine (after the urine was clear) was 1 hour up first day, 2 hours up second day, 4 hours third day, 6 hours fourth day, and then off to a convalescent camp, where individual progress was watched and each case judged on its merits. In many cases livers were still enlarged on discharge, and it is a matter for conjecture whether these cases should not have been held longer.

MEDICAL OFFICERS

Medical Officers

It was found that any one MO was able easily to look after 100 to 150 cases of infective hepatitis as well as do other routine duties. This included clinical examinations, writing of notes, and all the appropriate paper work and urine examination.

IMMUNITY

Immunity

It was noted that no particular physical type of soldier was more liable to become infected, but that the chances decreased with age. Infection in most cases conferred an immunity, but some very slightly infected had infections a second time. The average full infection usually conferred an immunity, but some men failed to develop an immunity at all and had repeated reinfections. Maoris had a strong immunity, which seemed to be a racial characteristic as the chance of infection was greatest in those who had a marked admixture of white blood.

Clinical

Non-icteric Cases: These cases at first seemed somewhat of a mystery and were inclined to be classed with the dyspepsias. They represented the purest form of infection with the virus and the gastro-intestinal infection, and yet it is hard to account for the fact that many had enlarged livers with no jaundice. It is best to consider cases of all grades beginning with (a) those where the infection was essentially gastro-intestinal in type and of short duration, (b) those in which the gastro-intestinal infection was associated with an enlarged liver and no jaundice, (c) those in which the gastro-intestinal infection was negligible clinically and the enlarged liver was found to account for some degree of ill-health but still no jaundice, and then (d) those with gastro-intestinal symptoms and jaundice of varying degrees.

It is impossible to say how many of the non-icteric cases occurred as these rarely came to hospital; but it is considered that there were very many of them. Eventually we came to the conclusion that a lot of persistent dyspepsia was probably originally due to the infection with the virus, and also one saw many who had gastrointestinal infections of four to five days' duration only, who had all the characteristics of virus infection.

Clinical Review of 1942 Epidemic

At the onset of epidemics the cases were milder than those seen in previous years and had fewer complications, but as time went on they became more severe, the icterus lasted longer, debility was greater, and relapses more frequent. As the greatest number were mild they form the basis of this description, but there were, during the later stages, all types, as will be seen in the text. Although it is recognised that icterus is only one symptom of this disease, it is convenient to divide it into two stages, the pre-icteric and the icteric.

Pre-icteric Stage: In all epidemics in the 2 NZEF this was the period of greatest malaise and discomfort, and was the one most often spent outside hospital. Many examples, however, were able to be studied in the wards, and the briefest statement to cover this stage would be that it was usually pyrexial illness associated with acute gastritis. That acute gastritis is present was proved at post-mortem in one case, and in another, when an ulcer in a Meckels diverticulum perforating the mucous membrane showed the typical changes on the third day of the pre-icteric stage.

The onset was usually sudden with a close resemblance to sandfly fever, presenting a mild shivering attack, temperature 102–103, headache, generalised aches and pains, backache, and considerable mental depression. Some cases were apyrexial or had a mild fever only. Two presented as initial symptoms a generalised urticaria which cleared and recurred during the first three days of the illness. The icteric tinge of the skin was readily seen in urticarial wheels. Whatever opened the train of symptoms, be it fever or just malaise, within twenty-four hours the classical features of this stage appeared, dyspepsia and anorexia, which were almost universally present and were the most striking and most complained of symptoms and the greatest cause of discomfort to the patient. No matter if fever were present or not, loss of appetite, nausea, lassitude, general malaise, and indigestion were always regarded with suspicion, and jaundice expected and waited for.

Anorexia was frequently complete and associated with nausea, occasional vomiting, and, in a few instances, persistent hiccough. Dyspepsia was persistent, severe, aggravated by food, and failed to respond to alkalies. Constipation was common and diarrhoea rare, the tongue was clean and moist. Fat intolerance was seen early, and any appetite that was present was capricious. This pre-icteric stage lasted five to seven days, but varied from none to twenty-one days. The dyspeptic symptoms usually became steadily more severe and the pyrexia followed no uniform pattern, but varied between a chart persistent at 101 or 102, one with a daily swing between normal and 102 and 103, a completely irregular picture, a low fever of 99 or 100, or one that settled to normal within two or three days and stayed there.

From the first or second day there was pain under the right costal margin, both at rest and on movement, tenderness on pressure in this region, and a liver edge palpable one inch below the rib edge. Although the liver was enlarged in practically all cases, it was the exception to feel a spleen, the fauces were normal, the breath not offensive and the facies unchanged, but the patients felt ill and miserable, were unable to concentrate, and difficult to satisfy.

General physical weakness was felt by many of those whose pyrexia and dyspepsia were not of sufficient severity to require evacuation to hospital, and that, combined with a loss of interest and inability to concentrate, eventually decided many to report sick.

Rashes: Two cases were seen who presented a rash typical of typhus fever during this stage, but because of the mildness of the illness and the presence of all other typical signs of hepatitis were accepted as such.

This pre-icteric stage, which proved a source of humiliation to many medical officers in the early days of the epidemic and soon became easily recognised, passed insensibly into the icteric stage.

Icteric Stage: The full development of jaundice normally occupied five to seven days, but was noticed to be as short as three days or, in the severe cases, to deepen steadily for as long as three weeks. At first the urine was noticed to be getting dark, and it was surprising how many of the milder cases continued at work until this stage. Two days later a tinge of yellow was visible in the conjunctival folds of the lower lid, which spread concentrically towards the pupil, and on the fifth day the conjunctiva was evenly and deeply stained, the urine mahogany in colour, and the skin evenly and faintly yellow. In the majority of cases this stage of icterus was obvious but not severe, and reached its full intensity in five to seven days or less. The length of the disease could normally be estimated from the depth of jaundice after one week. Some mild cases were already beginning to clear or had reached a stationary stage by the fifth day, whereas the more severe and prolonged cases were still deepening in colour. It followed in most cases that the degree of icterus reached by then indicated the rapidity with which it would clear and the extent of the resulting debility. A few exceptions to this occurred, in which cases a sudden increase in the severity indicated a more prolonged and severe illness.

The temperature if not already normal at the onset of the icterus became so very soon, settling by lysis, and only rarely did pyrexia remain without heralding the presence of some complication or intercurrent infection. The dyspepsia and anorexia commenced to improve once jaundice appeared, and in 90 per cent of cases was completely gone when the jaundice was fully developed. As the dyspepsia vanished the appetite became enormous, and in some cases most capricious, being only satisfied by large quantities of tomatoes, cucumbers, or oysters. A certain fat intolerance remained in some and lasted for several weeks.

In the mildest type of case (in this series over 50 per cent) jaundice began to fade very soon after it was fully developed, that is, from the fifth to the seventh day. The fading was normally rapid and was almost gone about the fourteenth day after its appearance, leaving only a mild staining of the conjunctiva. The fading took place, first from the skin, then from the conjunctiva and lastly from the urine, which usually showed a trace of bile on testing for several days after all else appeared normal.

In a considerable number, however, the jaundice remained stationary with daily fluctuations for about seven days and cleared in a further seven to ten days, whereas the most severe continued with deep icterus up to a period of six weeks or more before clearing. The longest case of icterus in this series was eight weeks.

During the stage of clearing all symptoms had usually gone except those of weakness and lassitude. The stools darkened early and the urine became paler early but was the last to clear completely, as determined by laboratory tests.

During the stage of fully developed icterus the liver could be felt one to one and a half inches below the costal margin. In cases of prolonged or deepening icterus it would enlarge still further up to 2.inches or even more, but once the jaundice began to fade in nearly all cases it returned to normal size with rapidity.

In the majority of cases in fourteen to twenty-one days after the onset of jaundice the patient would be quite clear again with a liver of normal size and would commence to get up. This was taken slowly and a week allowed to reach the stage of being up all day before going to a convalescent depot for a further two or three weeks.

In the more severe cases, which were rarely seen early in the epidemic, but formed a large proportion of those at the end, the pre-icteric stage presented no unusual features, but the onset of the icterus was not always accompanied by fall in temperature and return of appetite.

The jaundice gradually increased, or did so in a series of exacerbations, while the irregular fever persisted for seven to ten days and the dyspepsia diminished only gradually, and did not vanish. Malaise and lassitude became more evident and sleeplessness the rule, the skin became deeply yellow, and in those whose jaundice lasted four to eight weeks pruritis was severe, haemorrhages frequent, and loss of weight alarming.

No particular type of patient or one belonging to any particular age group was more affected in this way than any other, and in this series no deaths occurred in the later stages no matter what the extent or severity of the jaundice.

Persistent Pyrexia: Where this occurred and lasted one or two weeks during the icteric stage, in the absence of any recognisable complications it indicated a severe and prolonged illness. It was an infrequent complication.

Distended Abdomen: This was seen in several cases, and if associated with fever suggested an accompanying typhoid infection. Although a few cases did have this as a superadded infection, the majority of cases did not, and the disorder vanished without therapy.

Pruritis: This was a distressing accompaniment of some of those cases in which icterus was prolonged and deep. It became worse towards evening and at night, was generalised and difficult to relieve. One case only responded brilliantly to ephedrine gr.½, whereas others received temporary relief from luminal, and calamine and phenol lotion.

Haemorrhage: Cases severe enough to show pruritis often showed signs of a haemorrhagic tendency in areas subjected to scratching and other mild traumata. This was usually an indication of more severe haemorrhages to come from lips, gums, nose, stomach, bladder, and rectum, but prompt exhibition of vitamin K intramuscularly prevented any of these becoming of serious importance.

Recurrent Icterus: A recurrence of a fading icterus was not infrequent. In some cases it developed when the original icterus had almost faded. It only increased the time of the illness and the convalescence necessary. In many cases it seemed to be related to indiscretions such as getting out of bed without permission or unwarranted exercise in the earliest stages of getting up.

Relapses: These were of two types:

1. With Icterus: Presenting a complete picture of the whole disease, usually much more severe and prolonged than the original illness. These relapses occurred three to four weeks after the complete subsidence of the original infection, and in a few cases second relapses also occurred.
2. Without Icterus: These cases presented a picture of acute gastritis and were recognised by the patient as being identical with his original symptoms, were associated with a slight enlargement of the liver, and took three to four weeks to recover. There is no evidence that these relapses were related to the taking of alcohol. It is estimated that the relapse rate was 3 to 4 per cent.

Persistent Liver Enlargement: Mild cases of hepatitis usually had normal livers on discharge from hospital, but in the more severe and relapsed cases enlargement tended to persist and was associated with recurrent dyspepsia and malaise. Enlarged livers have been found three or four months after the recovery from icterus. These patients were far from well and required regrading. The future of these men is uncertain at present, but some, seen six years later, have normally sized livers and no symptoms.

Mental Symptoms: Examples of mild depression were often seen, but in prolonged icterus confusional states, which recovered completely during convalescence, were common.

TREATMENT

Treatment

All cases were confined to bed except for a daily bath and visits to the lavatory, but even this was forbidden in any but the milder type of case. It was noticed that rest in bed had an appreciable effect on the rapidity of recovery.

DIET

Diet

Fat-free diet was given until the appetite returned. After that no restrictions were made. Glucose was given in the form of drinks or barley sugar in as large quantities as possible. Fluids were forced during the whole illness.

MEDICINE

Medicine

Sod. Sulph. was given each morning. Alcohol was forbidden during the illness and for one month after

SEVERE CASES

Severe Cases

These cases were a great anxiety because of the mental changes, tendency to bleed, and the difficulty in getting in sufficient fluids.

Intravenous fluids and glucose were given early in all severe cases.

The fluid intake was kept at 6 pints a day and 100 grammes of glucose or more was given.

Vitamin K was given to prevent haemorrhage; vitamin B to prevent peripheral neuritis.

Occasional blood transfusions were resorted to as necessary.

AMOEBAE

Amoebae

In Italy, during treatment of hepatitis, it was found that many cases had persistent diarrhoea. On investigation this was found to be due to amoebic infection, no doubt introduced by the fly as was the virus of infective hepatitis.

PENSIONS ASPECT

Pensions Aspect

An opinion expressed by Dr D. Macdonald Wilson of the War Pensions Department in 1952 was that infective hepatitis had not resulted in any pensions liability. In a few cases only were some vague dyspeptic symptoms associated with some slight enlargement of the liver ascribed to a previous attack of hepatitis.

STATISTICS

Statistics

The importance of infective hepatitis in its effect on 2 NZEF in the Middle East and Italy is shown by the following statistics:

Admissions to medical units July 1941 to December 1945 were 7051. (These represented nearly 9 per cent of all admissions and the total was greater than that for any other disease, and the length of stay in hospital and convalescent depot was second only to pneumonia.)

Deaths from hepatitis were 6 out of a total of 190 for all diseases.

Cases evacuated to New Zealand numbered 124.

In 2 NZEF (IP) there were only 85 hepatitis cases in the total of 6248 admissions to medical units.

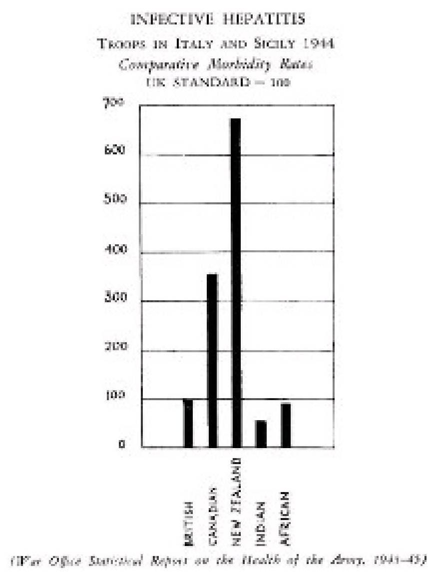
INFECTIVE HEPATITIS

INFECTIVE HEPATITIS

Troops in Italy and Sicily 1944

Comparative Morbidity Rates

UK STANDARD = 100



(War Office 'Statistical Report on the Health of the Army, 1943–45)

INFECTIVE HEPATITIS AND SERUM JAUNDICE

Infective Hepatitis and Serum Jaundice

The relationship of infective hepatitis to serum jaundice, postarsenical, and post-yellow-fever-vaccine jaundice remains a mystery. No laboratory animal has been found susceptible to infection with any of these varieties of jaundice.

Bigger (1943) has demonstrated that jaundice following antisyphilitic treatment was due to faulty sterilisation of syringes and needles contaminated with homologous serum jaundice virus. Sheehan (1944) and Salaman et al. (1944) and others have provided confirmation.

Dible and McMichael (1943) studied the histopathology of liver biopsy tissue from cases of arseno-therapy jaundice, and concluded that the appearances of the organ were more compatible with damage by an agent similar to that causing serum jaundice or epidemic hepatitis.

The relationship of serum jaundice to infective hepatitis presents a conundrum, for if it were eventually proved that the two were identical then the existence of subclinical, silent, blood-borne infective hepatitis would claim fresh significance.

Some believe that they are aetiologically different because infective hepatitis is spread by contact and has an incubation period of twenty-eight to thirty days, whereas clinical serum jaundice is normally caused by parenteral administration of icterogenic serum, and has an incubation period of eighty to a hundred days according to Paul et al. (1945), Steiner (1944), and Beattie and Marshall (1944). The latter also discovered that it was possible to reduce the incubation period of serum jaundice to thirty days by feeding infective serum. Evidence in favour of their identity has been provided by Sheehan (1944), who noticed that infective hepatitis virus may be conveyed from one man to another by unsterile needles and syringes used for aspirating blood, and that the ensuing malady assumed the character of typical serum jaundice after an incubation period of three months. Efforts to isolate virus from the faeces of serum jaundice cases by McCallum (1945) and Neefe, Stokes, and

Gellis (1945) have been unsuccessful, and it therefore seems that the intestinal tract contents are not infective in serum jaundice.

Conclusions of the opposite kind have been reported by Paul et al. (1945), who found that three patients who had recovered from serum jaundice six months earlier, later proved susceptible to experimentally induced infective hepatitis. The latter have epitomised the present position by stating that the outstanding difference between serum jaundice and infective hepatitis rested in the length of the incubation period. Neefe, Stokes, and Gellis (1945) have commented that 'Normal persons are much more likely to develop the disease when the agent is administered orally than when it is injected parenterally', a fact which we regard as one of fundamental importance in the establishment of infective hepatitis as a primary pathological affection of the gut.

The two diseases may be closely related in that serum jaundice represents the artificial production of infective hepatitis in a proportion of instances: it cannot yet be said that all serum jaundice belongs to this category. The question of the aetiology of post-arsenical serum jaundice and infective hepatitis bristles with unsolved academic problems and practical obstacles to progress, but the subject is of as much interest in peace as in war and justifies intensive research into the pathogenesis of these icterogenic virus agents.

Clinical Pathology

Blood Picture: In the pre-icteric stage there is leucopenia with an absolute neutropenia and an increase in the large lymphocytes. In the icteric stage the white cells increase again and there is a definite absolute monocytosis, and then a gradual return to normal in about six weeks.

Liver Function Tests: These were rarely carried out among New Zealand patients, and it was considered there was no single test which would differentiate between infective hepatitis, chronic hepatitis, cirrhosis, and obstructive jaundice. Higgins and his colleagues consider that the estimation of bilirubin, phosphatase, albumin, and globulin in the plasma from a given specimen provided as much information as could be got from liver function tests.

PATHOLOGY

Pathology

The changes in hepatitis consist of hepatic cell necrosis and autolysis with a leucocytic and histiocytic reaction and infiltration. In severe cases there is disorganisation of the architecture of the hepatic lobules. The centres of the lobules show the cell necrosis and autolysis most markedly and the cellular infiltration is greatest round the portal tracts. The end stage may be acute or sub-acute necrosis or cirrhosis.

PERIPHERAL LOBULAR NECROSIS IN HEPATITIS

PERIPHERAL LOBULAR NECROSIS IN HEPATITIS

Material and Methods

The material from cases of hepatitis was collected while Major D. T. Stewart was serving as pathologist to 1 NZ General Hospital (2 NZEF) in the Middle East. It consisted of blocks of liver tissue sent by many Middle East pathologists as a result of a directive issued by the Deputy Director of Pathology, Middle East Force. The specimens were derived from fatal cases of infective hepatitis and arsenotherapy jaundice (as it was then called) occurring during the Middle East epidemic of 1942–43, described in papers by McCallum (1943–44), Gordon (1943), and Spooner (1944). In none of the cases used was there a history of yellow-fever inoculation or of previous blood or serum transfusion. No cases of Weil's disease were occurring in the area—Boyd (1943).

As some of the specimens were derived from cases in which a definite diagnosis had not been made, or were not accompanied by adequate clinical details, and because excessive post-mortem change appeared to be present in some, the only material used comprised 37 cases of infective hepatitis and 16 cases of arsenotherapy jaundice, i.e., homologous serum hepatitis arising during or after treatment of syphilis by arsenical drugs given by injection.

For comparison with the type and site of change found in the above material, Major Stewart examined control material from his own series of post-mortem examinations. This material consisted of specimens of liver from 52 cases of ‘toxaemia’, including 11 cases of burns. The remaining 41 cases were made up of 6 cases of enteric fever, 10 pneumococcal infections, 3 cases of malaria, 3 of diphtheria, 3 of epidemic typhus, 6 staphylococcal infections, 3 cases of suppurative peritonitis, 4 cases of wound sepsis, and 3 pyrexias of unknown origin. Seventeen of the 52 cases had been jaundiced at the termination of their illness.

Finally, material was studied from 19 cases of obstructive ‘biliary cirrhosis’ in the collection of post-mortem material at the Bland-Sutton Institute of Pathology, Middlesex Hospital, London. There were 9 carcinomas of the head of the pancreas, 8 carcinomas of the common bile duct or ampulla of Vater, and 2 cases of bile duct compression by secondary deposits in lymph nodes.

Findings

Jaundice appeared a variable time after the prodromal symptoms, its intensity varied, but it was usually deep at death. In Indians and South African natives the presence of jaundice was often missed until it became deep. The liver and spleen were not often found to be enlarged and in some cases the liver appeared to shrink. The course varied. In some cases the early symptoms and signs merged into those which presaged death; in others the course appeared to be favourable, but relapse occurred with deepening of jaundice, recurrence of vomiting, etc. The terminal stages were marked by high fever, mental and nervous disturbances, vomiting, haemorrhagic manifestations, deepening jaundice, and coma.

The cases for which an accurate duration was known are shown in the following table, grouped as to duration from the onset of prodromal symptoms to death.

Days from Onset Prodromal Symptoms to Death	Epidemic Hepatitis	Arsenotberapy Jaundice
1–5	4	2
6–10	13	3
11–15	8	2
16–20	2	0
21–25	3	1
26–30	0	5
31–35	0	1
	—	—
Total	30	14

Conclusions

1. Peripheral lobular necrosis was found to occur in hepatitis as commonly and to as great an extent as the central necrosis usually described.
2. The enlargement of portal tracts and the hyperplasia of small bile ducts in the

portal tracts (both points noted by some previous workers) are presumptive evidence of the existence of peripheral lobular necrosis.

3. Peripheral lobular necrosis is not a feature in livers damaged by toxaemia and is only of slight extent in biliary cirrhosis.
4. It was concluded that peripheral lobular necrosis in hepatitis plays an important part in the sequence of liver change and the pathogenesis of central and complete necrosis in the acute stage of the disease. In later stages peripheral lobular necrosis is the probable cause of persistent jaundice of obstructive type. Finally, it was concluded that peripheral necrosis might underlie the occasional sequela of unilobular cirrhosis.

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CHAPTER 4 — MALARIA

Contents

WAR SURGERY AND MEDICINE

[SECTION]

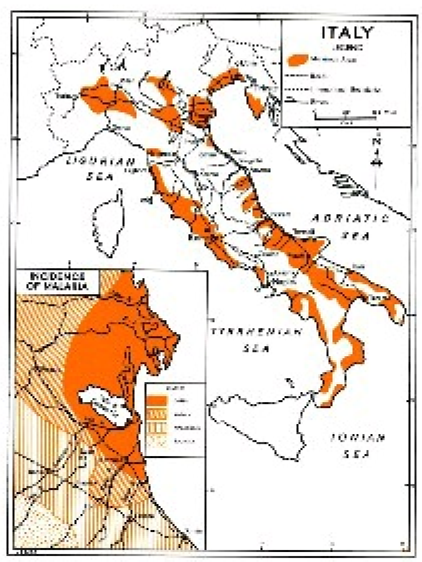
MALARIA has had a powerful effect on the fate of armies throughout history. The Gauls were forced to retreat in disorder from the siege of Rome owing to the depletion of their ranks by this disease. In the Crimea malaria was the cause of a huge wastage of manpower. The British Army in Macedonia in the years 1916–18 had an unfortunate experience. In 1917 alone there were 72,413 admissions to hospital for malaria in a force of about 200,000. In 1918 about 25,000 cases of chronic malaria were invalided to the United Kingdom.

The Anzac Mounted Division in Palestine, fighting against the Turks from 1916 to 1918, had to wage a battle against malaria. In the Jordan valley the disease was held in check by anti-malaria measures. According to Major Hercus, NZMC, DADMS New Zealand Mounted Brigade, 'Such success as we achieved was in the main due to the high standard of intelligence and discipline of the troops rather than to any novel method of control. Our principal weapon was education and effective co-operation of all ranks.' When the Division left a protected area in September 1918 in its final attack, without being on quinine prophylaxis, it advanced through malarious mosquito-ridden country. Cases of malaria began to develop in large numbers, but fortunately the Turks were defeated within the incubation period of malaria. The campaign was won by troops who were incubating malignant tertian malaria, and had they been held up after their initial advance for only two weeks a victory might well have been replaced by a disaster. During the period of the final operations the Anzac Division alone had 2827 cases, and the whole of Chaytor's force suffered a loss of 4543 by malaria. Again, as Major Hercus said, 'We found it difficult to get enough fit men to water the horses. … The devastating effect of the parasite on a force of well-trained and seasoned troops had to be seen to be realised.'

In 1 NZEF overseas there were 61 deaths from malaria.

Malaria in 2 NZEF

At no stage in the history of 2 NZEF in the Middle East and Italy did the number of malaria cases give cause for alarm or affect in any major degree the efficiency of the Force. The average monthly incidence was approximately 2 per 1000 during the malaria seasons over the whole force, with base and field units both included. When the Division was in highly malarious areas such as Syria and parts of Italy the incidence differed little from that of the troops in Egypt, which was classed as only mildly malarious. The creditably low figures for the malarious areas must be ascribed to good anti-malaria work within the Division itself, and within the army of which it was part, usually the Eighth Army. The large measure of success in Italy was due to the discovery of DDT and the use of it and other insecticides in power sprayers by malaria control companies, supported by larval control on the ground and eventually from the air. Added to this was education of the troops, the adoption of personal precautions, and the regular taking of the newly-developed mepacrine tablets (the synthesised substitute for quinine) during the malarial seasons.



ITALY

When the Division arrived in Egypt in 1940 anti-malaria measures were possible only on a limited scale. Following the occurrence of twelve cases of malaria in

August 1940, the use of mosquito nets was enforced and personal precautions in the way of the turning down of sleeves and the wearing of long trousers between sunset and sunrise were ordered in malarious areas such as Moascar and Helwan. The 4th Field Hygiene Section undertook what control measures were possible in the spraying of breeding places in the Maadi Camp environs, notably the water-holes at the Maadi golf course, where the unit had surprised the local authorities by finding Anopheles pharoensis, the chief carrier of malaria in Egypt. The annual flooding of the Nile in August and September and the methods of irrigation on its banks produced breeding places for mosquitoes, some of which were anopheline, and the camp plateaux at Maadi, and at Helwan in 1941, were within a few miles of the irrigation areas. In the circumstances complete malaria control by military units alone was impossible, although the Field Hygiene Section extended its activities as far as practicable.

In the first summer the total number of cases was only 73 for the portion of the force then in Egypt, the highest incidence being in September, when it was 2.3 per 1000. In the spring of 1941, however, the Division moved to Greece, a country which was highly malarious. Colonel N. Hamilton Fairley, AAMC, acting Consultant in Tropical Diseases, MEF, had made a report in January 1941 on the danger of malaria in South-east Europe and Asia Minor, stating that during the months June to September inclusive the employment of unseasoned troops in hyperendemic areas could lead to appalling wastage of manpower similar to that which occurred in Macedonia in the First World War.

Prior to the move to Greece the ADMS 2 NZ Division, in February 1941, endeavoured to educate the whole of the Division to realise the importance of anti-malaria precautions. With this end in view a medical administrative instruction dealing with the subject was issued to all RMOs and Field Ambulances. Notes on malaria were drawn up to form the basis of a lecture for combatant officers. Some medical officers attended courses of instruction at No. 1 Malaria Field Laboratory, and malaria diagnostic panniers were obtained and issued to field ambulances.

Greece

The low-lying and boggy plains of Greece have long been notorious as centres of malarial infection. During the First World War British troops stationed in the hinterland of Salonika suffered severely from this disease, in spite of precautionary measures.

The lesson was not forgotten, and the New Zealand Division, as well as the rest of Lustre Force, had made preparations to cope with the problem before arrival in Greece. Up-to-date information on the subject, lectures, and training in malaria control work had been given to medical units. Medical officers were charged with instructing all units in the essentials of malaria control discipline and in the practical application of prophylactic measures. The Divisional Hygiene Section was fully alive to the problem and looked upon it as its main task. Bush mosquito nets, head and hand nets, and repellent were arranged for, and full instruction as to their use given in routine orders and enforced from 10 April. In addition small anti-malaria squads were formed in each unit to work under the medical officer. As far as the New Zealand forces were concerned, 4 Field Hygiene Section at once began anti-malaria measures, carrying out a careful investigation of the battle areas. Contact was at once made with local medical practitioners and information obtained as to the local incidence of the disease. Even spleen surveys were carried out on children in these areas, and the spleen rate was determined to be 40 to 50 per cent in the villages. These surveys disclosed a relatively high incidence of malaria, higher than the figures previously available. The evacuation of children from army areas was recommended as a precaution.

The Hygiene Section proceeded to deal with breeding grounds by drainage and oiling, and to arrange for unit anti-malaria squads to be formed to deal more intensively with the problem. Advice was also given to combatant units as to the relative safety of areas as far as malaria was concerned. The Force itself contained a malaria officer who had organised 40 Greek foremen, each with a gang of 23 labourers, to deal with the problem from an Army level. Arrangements had been made for equipping three of these for the New Zealand Division.

(Fortunately, as far as this campaign was concerned, only three cases of malaria were reported, as seasonal infection did not occur until May at the earliest, with the main incidence in July, August, and September. Training in malaria control was, however, valuable for the future.)

CRETE

Crete

The Force was evacuated from Greece to Crete before the malaria season had properly begun. Nets were available in Greece and personal precautions in force. In Crete no nets, repellent, or sprays were available and no personal precautions possible, and the fact that so few cases of malaria occurred was probably due to the excellent field malaria control work that had been carried out since February 1941 by an RAMC officer with civilian squads in the greater part of the area occupied by troops. The 4th Field Hygiene Section assisted in the work in May.

The number of cases notified as infected in Greece or Crete was only 11.

Egypt

Back in Egypt for the most important period of the malaria season in 1941, the Division contracted malaria at a rate comparable with that of the previous summer in similar circumstances and with similar precautions, although only a small proportion of troops in camps could be supplied with mosquito nets.

There were 311 cases between June and November, the highest incidence of 3.5 per 1000 being in September. The incidence was almost equally divided between divisional and non-divisional troops, and Maadi and Helwan camps provided a similar proportion of cases.

MALARIA IN SYRIA

Malaria in Syria

Before the onset of the malaria season in 1942 the Division moved up into Syria, with the base troops remaining in Egypt.

Malaria was endemic in Syria, with high spleen rates among the inhabitants of many villages. With many rivers and numerous swamps lying between the Lebanon and Ante- Lebanon ranges, and especially with the melting snows and swollen rivers following the severe winter, the stage was set for a high incidence of malaria among New Zealand troops unless energetic measures were taken to combat the disease. To meet the situation a complete anti-malaria organisation was set up within the Division.

Equipment on the approved scale for personal protection was available, and mosquito nets, veils, gloves, anti-mosquito cream, sprays and Flysol were issued to all units. An officer of the New Zealand Medical Corps was placed in charge of divisional malaria control and attended a course at No. 2 Malaria Field Laboratory, Beirut. Two Anti-Malaria Control Units of 1 officer, 1 sergeant, and 5 other ranks were formed within the Division, and members from each unit also attended the Malaria Field Laboratory for training. Ten anti-malaria sections, with a civilian staff of 1 foreman and 23 labourers, worked under the supervision of, first, 4 Field Hygiene Section, and, later, of 4 and 6 NZ AMCUs at Baalbek and Aleppo respectively. They drained swamps and sprayed potential mosquito-breeding grounds. In addition unit squads, consisting of an NCO and three men, worked under the control of each RMO.

As a result of these measures malaria in the New Zealand Division was kept within moderate limits (5 per 1000), although the troops did not remain in Syria during the height of the malaria season.

While the Division was in Syria from March to July 1942 there were 261 cases of malaria, almost equalling the total (323) for all 2 NZEF in Egypt in the 1942 season. However, of this total nearly half (127) was provided by two battalions alone (22 and 24 Battalions), suggesting that an improvement in malaria control in these units would have resulted in remarkably low figures for the nature of the area. The high incidence in these two battalions may have been due to inadequate precautions against mosquitoes wind-borne from over the Turkish border, where no malaria control was exercised. [1]

There were 72 relapses in these Syrian cases, giving a relapse rate of 27.5 per cent, while there were 52 relapses in a group of 244 cases from Egypt from July 1941 to March 1943, giving a relapse rate of 21.3 per cent. (These figures are only approximate, as some men had one and some two or more relapses.) Only 24 out of 505 cases were malignant tertian.

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[1] Some of the cases from 24 Battalion arose among men who were guarding a tunnel and who neglected to observe the usual after-dusk precautions in the semi-darkness of the tunnel during the day, when the mosquitoes were still active.

North Africa and Sicily

Back in Egypt the incidence was similar to previous seasons.

By the spring of 1943 the Division had advanced with the Eighth Army across North Africa to Tunisia, which was highly malarious, especially around the coastal regions. Anti-malaria preparations were begun in March, a divisional malaria officer was appointed, and at the beginning of April 1 NZ AMCU was formed at Advanced Base, received training at 8 Field Malaria Laboratory and commenced work in the divisional area near the end of April. It had limited equipment as a consignment of anti-malaria equipment for Eighth Army was lost at sea. Unit anti-malaria squads were formed and personal precautions were enforced from late in April. Bush nets were issued and used, but the type of repellent cream issued was found to be ineffective against the culicine mosquito which abounded in the divisional area near Enfidaville. Surveys did not bring to light any anopheline mosquitoes in the divisional area up till the time the Division left for Egypt on 15 May. According to reports few malaria cases normally occurred in the civilian population in Tunisia before June, and by that time the Division was back in Maadi Camp with few, if any, cases of malaria developed during the short sojourn in Tunisia.

The incidence among the troops in Egypt in the summer of 1943 was rather less than that of the two preceding years, notwithstanding the fact that divisional troops proceeded to all parts of the Middle East on leave. The highest incidence of just over 2 per 1000 occurred in October.

In the campaign in Sicily in 1943 there was a large outbreak of malaria, and casualties due to this disease exceeded battle casualties. The reasons for this were shown to be slackness in mepacrine administration, failure of MCUs to arrive early, and lack of appreciation by the troops of personal protection methods. If all precautions had been taken and medical advice followed, it was estimated that the rate would not have exceeded 40 per 1000 per annum. This estimate was more than upheld by the experience of 2 NZEF in Italy in 1944 and 1945, when its rate was only

8 per 1000 per annum.

INCIDENCE IN ITALY

Incidence in Italy

No large area in Italy was free from malaria, and, as always, this mosquito-borne infection was unevenly distributed geographically, seasonally, and from year to year. Malaria was generally found below 2000 feet altitude and in rural rather than urban areas. Such cities as Naples and Rome were not malarious, although the disease might approach the city limits and occasionally penetrate them. It was generally correct to assume that the communities of Italians farming the plains, river tracts, and marsh areas were the reservoirs of malaria. The seasonal upswing due to new infections made its appearance in May and the curve climbed steeply in June and July, reaching a peak in late July or in August. Thereafter it declined in September, though some areas showed a modest secondary peak in October (following September rains) and then fell sharply.

While at Burg el Arab prior to embarking for Italy the Division was provided with dual containers holding mepacrine tablets and Mark II anti-mosquito cream. Mepacrine was to be taken at the rate of one tablet a day for six days of the week; at evening mess was the best time. Mosquito-proof tentage and nets were also issued. Mepacrine was the synthesised substitute for quinine, the sources of supply of which in the East Indies had been lost to the Japanese.

The arrival of the earlier formations in Italy on 9 October was attended by some disorganisation, mainly through lack of transport. This resulted in troops being without mosquito nets, mosquito-proof tentage, or even slacks during the first night. The units were then camped in a malarious district close to Taranto. This unfortunate breakdown, repeating on a minor scale some of the events of the invasion of Sicily, occasioned the main part of the divisional incidence of malaria for the later part of 1943 and some of the first cases of 1944.

Flysol was at first difficult to obtain, the supply of hand pumps for spraying was poor, while no power sprayers were available. In view of these shortages, the decision to avoid buildings for billeting for the first few weeks of the campaign, at the end of the malaria season, was a wise one. The risk of contact with the anopheline mosquitoes, which tended to hibernate in buildings, was thus reduced. The onset of winter in the Sangro area ended another malaria season.

With the example of Sicily fresh in their memories, army authorities set out as early as February 1944 to prosecute the anti-malaria campaign. The New Zealand Corps was in being at this time in the Cassino area, and a conference of officers was held on 1 March to implement a policy for the prevention of malaria. The Corps was not totally ignorant of the principles of malaria control, but although many officers and men had had prior experience of malarial conditions, many had not. It was agreed that all endeavours had to be made to establish a regime of strict and efficient malaria control. A Corps Malaria Committee was formed and proceeded to elaborate the desired programme. All personal precautions were enforced from 1 May. Unit squads were responsible for controlling their own unit area extending to two kilometres beyond the unit circumference. A Divisional Malaria School was conducted by OC 4 Field Hygiene Section.

The first supplies of DDT became available at this time and also the first of the power sprayers, but 2 NZ Division did not receive any DDT until July, when it had joined up with the Eighth Army again, and power sprayers (some made by 2 NZ Division workshops) were not in good supply until September. The two NZ MCUs had continued to use Flysol, which was found to be preferable even when DDT came to hand as its much easier application enabled more ground to be covered, and it had immediate effect on the mosquito. DDT was found preferable for the spraying of buildings occupied by troops for any length of time.

During the 1944 season the Division was not in any particularly malarious area as its operations were mainly in inland areas away from the malarious coastal regions, especially the Pontine Marshes. When it moved across to the Adriatic coast in September to engage in operations at Rimini and north of that town it came within a highly malarious area again. Under peace conditions the highest incidence of malaria in the Po valley occurred in the coastal belt from Rimini to Trieste, especially the marshes north of Ravenna. Again the Division was fortunate as the malaria season was nearing its end, though sufficient time remained for the enforcement of precautions to be vitally necessary. In July 1944 the two malaria control units were incorporated as sections of 4 Field Hygiene Section, and this change enabled a more complete measure of malaria control to be exerted.

The beginning of the 1945 malaria season found the Division in the Trieste and Monfalcone areas after a lightning advance across the highly malarious area of the Po valley. Trieste was non-malarious, but the Monfalcone area was malarious. The taking of mepacrine tablets had begun on 7 April, and personal precautions were ordered to be enforced from 1 May. With the reaction following the cessation of hostilities, malaria discipline tended to become lax. There was a sad lack of co-operation among certain units, who were inclined to ignore expert advice and form their own appreciation of the mosquito menace. The units took the mepacrine tablets, but the use of the repellent (now changed to DMP—dimethyl phthalate) had never found favour. However, the coverage by anti-malaria squads and malaria control sections with power sprayers and Flysol and DDT, coupled with the general Eighth Army offensive on adult mosquitoes and larvae, was such that the incidence of malaria in the Division was lower than that of the previous, or any other, season.

When the Division moved to Lake Trasimene in Central Italy at the end of July, it came into an almost non-malarious area. Personal precautions were continued, but large-scale spraying was not necessary. With the move to the non-malarious city of Florence, precautions ceased at the end of September.

Persistent educational campaigns originated in the Medical Corps had made the Division malaria-minded, but troops had never had first-hand knowledge of a malaria epidemic to lead them to apply personal precautions to the fullest detail. The activities of the Hygiene Company and malaria control sections were an important factor in keeping the divisional malaria figures down to a level which equalled those of base camps. It could be claimed that divisional troops were more malaria-minded than those in base camps where the threat of the disease was never great, but where there were victims each season.

Altogether the incidence of malaria in 2 NZEF was low, partly because no troops were in a highly malarious area throughout a season, although preparations had been made regularly for such an eventuality. There were only two deaths from malaria in the Force.

RECOMMENDATIONS FOR TREATMENT — ISSUED BY CONSULTANT PHYSICIAN 2 NZEF IN JULY 1943

RECOMMENDATIONS FOR TREATMENT
Issued by Consultant Physician 2 NZEF in July 1943

MALARIA

For the first 3 days—Quinine grs. 10 t.d.s. In bed.

For the next 5 days—Atebrin gm. 0.1, t.d.s. In bed.

Interval—no treatment—3 days—begin to get up. Then for 5 days Plasmoquine gm. 0.01 twice daily, or t.i.d. for 3 days.

Plasmoquine must always be given after meals.

An alkali mixture should be given during and for some days after the Q.A.P. course.

During the Plasmoquine course and for some days after, a lot of carbohydrate should be taken, preferably as sugar or sweet fruit drinks. If toxic symptoms occur, e.g., cyanosis, epigastric pain, stop the plasmoquine at once.

Quinine may be given as the sulphate, bisulphate or bihydrochloride, and when possible should always be given in a mixture, e.g., 'Quin Sulph grs. 10 Ac Sulph Dil M 10 Aq Chloroformi ad 1 oz.'

Atebrin and Plasmoquine are in tablet form:

Tab Atebrin contains 0.1 gramme Care must be taken to see that the correct dose is given.

Tab Plasmoquine contains 0.01 gramme the correct dose is given.

Quinine may have to be given intramuscularly, e.g., in severe M.T. infections or where oral quinine is not absorbed, as in cases with vomiting.

The bihydrochloride is used, grs. 10 in 4 c.c. sterile water. In grave emergencies, e.g., cerebral malaria, the quinine has to be given intravenously. Use Quin Bihydrochloride grs. 10 in 20 c.c. sterile saline sol.

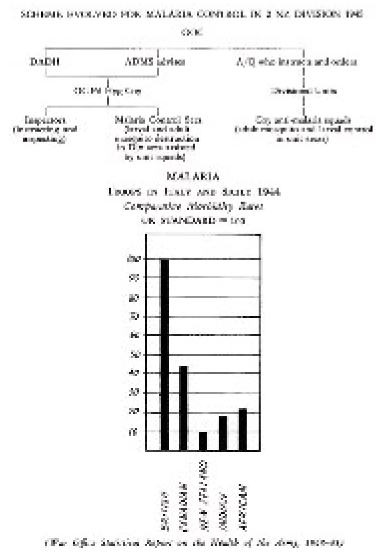
RELAPSING MALARIA

Second or subsequent relapses indicate that the routine Q.A.P. course has not been effective, and the following course should be adopted:

1. Begin with the usual Q.A.P. course but combine with the plasmoquine course, Quinine grs. 10 t.i.d.
2. Give adrenalin 0.5 c.c. once daily during the last 3 days of plasmoquine course.
3. Finish with 3 doses of N.A.B. 0.45 gm., one every 5th day, beginning 3 days after last dose of plasmoquine. During these 3 days and till course of NAB is completed continue alkaline mixture and copious sweet drinks and fruit juice.

SCHEME EVOLVED FOR MALARIA CONTROL IN 2 NZ DIVISION 1945

SCHEME EVOLVED FOR MALARIA CONTROL IN 2 NZ DIVISION 1945



(War Office Statistical Report on the Health of the Army, 1943–45)

MALARIA IN 2 NZEF

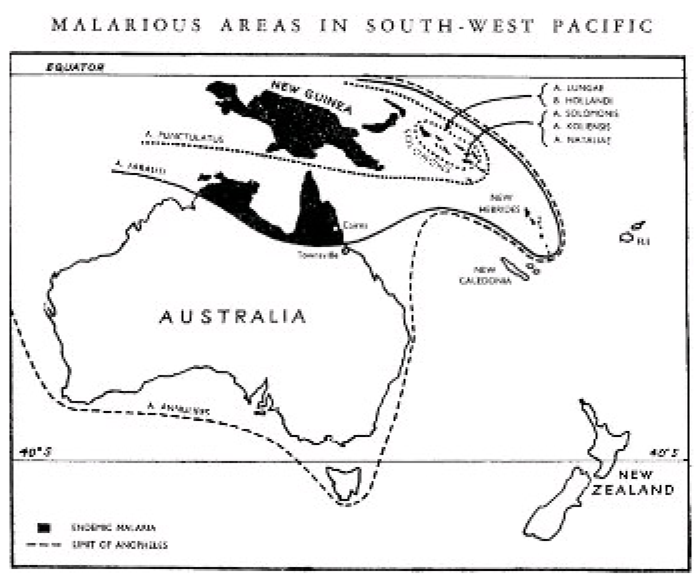
	1940		1941		1942	
	Total	Ratio/1000	Total	Ratio/1000	Total	Ratio/1000
Jan	—	—	—	—	1	0.03
Feb	—	—	1	0.05	1	0.03
Mar	—	—	3	0.1	3	0.09
Apr	—	—	—	—	8	0.20
May	—	—	—	—	12	0.3
Jun	—	—	10	0.3	121	3.7
Jul	3	0.4	39	1.2	159	5.9
Aug	12	1.7	66	2.1	139	4.6
Sep	29	2.3	117	3.5	114	3.9
Oct	21	1.7	71	1.9	99	3.4
Nov	8	0.6	8	0.2	52	1.8
Dec	—	—	8	0.2	19	0.7
	—		—		—	

	73		323		728	
	1943		1944		1945	
	Total	Ratio/1000	Total	Ratio/1000	Total	Ratio/1000
Jan	21	0.6	9	0.3	5	0.1
Feb	25	0.7	9	0.2	9	0.2
Mar	37	1.1	2	0.06	18	0.6
Apr	31	0.9	3	0.09	19	0.6
May	26	0.8	14	0.4	31	0.9
Jun	39	1.4	13	0.3	33	1.0
Jul	39	1.4	70	2.0	32	1.0
Aug	52	1.5	67	1.9	21	0.7
Sep	49	1.5	59	1.8	20	0.9
Oct	72	2.1	30	0.9	7	0.3
Nov	40	1.2	10	0.3	2	0.4
Dec	21	0.6	6	0.1	—	—
	—		—		—	
	452		292		197	

Note: The figures from June 1942 are reliable, comprising all admissions to hospital. Those prior to 1942 must be considered approximate only as they comprise notifications made to DMS 2 NZEF before the proper establishment and functioning of Medical Records Section.

MALARIA IN THE PACIFIC

In the Pacific the conquest of malaria was a fundamental and important problem as malaria was endemic in most of the islands captured by the Japanese. There was no malaria in New Zealand, New Caledonia, or Fiji, but it was highly endemic in the New Hebrides, the Solomons, New Guinea, and the islands of the East Indies. Malaria contributed greatly to the unhappy termination of the courageous defence of Bataan, it being estimated that 85 per cent of the American forces became infected. The rate of malaria in the Japanese troops in the South-West Pacific was close on 100 per cent, often with complications of dysentery and beriberi, and the death rate was high—up to 10 per cent. In New Guinea malaria was the greatest obstacle to successful military operations by both sides. In the Papuan campaign (January 1942 to February 1943) the Australians had 6154 battle casualties and 29,101 casualties from tropical diseases, of whom 21,600 were malaria cases. Probably 80 per cent of the force were actually infected. At this stage it was reported that malaria discipline was poor, suppressive drugs were not taken well, and there was interference either from enemy action or other causes with essential anti-malaria supplies. In subsequent campaigns there was a tremendous improvement in the Australian casualty rate.



MALARIOUS AREAS IN SOUTH-WEST PACIFIC

Early Experience of American Troops

The first contact of the American armed forces with the malaria problem in the South Pacific was when they landed at Efate, in the New Hebrides, on 29 March 1942. These troops were ill-prepared for the conditions obtaining in a malarious country and both combatant and medical officers were inexperienced in malaria control. Taking into consideration all the troops on the island, the incidence of malaria in April 1942 was 2677 per 1000 per annum, the highest figure recorded in the South Pacific area. This is all the more remarkable when it is remembered that there was no combat on the island.

The United States Marines landed on Guadalcanal in August 1942 and were under severe combat conditions from the beginning. Their initial record was good, partly owing to the favourable time of the year and partly owing to the absence of any considerable native population. These factors can be contrasted with the position at Efate, where the season was unfavourable and where there was a large native and Oriental population.

However, by October the rate was 1660 per 1000 per annum and in November 1780 per 1000 per annum. This rate was not permanently reduced below 1000 per 1000 per annum until May 1943. Combat conditions ceased on this island early in February 1943. Both Marine and Army divisions who fought on Guadalcanal showed an infection rate of approximately 80 per cent of total strength on being removed to a non-malarious zone. It will thus be seen that in the early campaigns in the South Pacific area malaria was a formidable enemy—indeed, it was the most serious factor to be reckoned with.

It would appear that when Allied troops first entered the South Pacific area they were quite unprepared for a campaign in a malarious country. There was no malaria control organisation and there was no appreciation of the need for strict anti-malaria discipline. Nets were not always available on landing and atebrin was not well taken. The supply position was unsatisfactory, and on Guadalcanal troops were short of essential anti-malaria drugs. Little faith was placed in atebrin.

Nothing is easier than to be wise after the event, and it must be remembered that many things which became commonplace and well established later were not so well known to the medical and combat staffs of the troops taking part in early campaigns. Take, for example, the whole question of atebrin suppression. We now know that in adequate dosage atebrin will suppress malaria, and we also know that such a dosage is safe and non-toxic. Neither of these facts was known with any degree of certainty in the early days. The correct dosage of atebrin had not been determined.

There is no finer chapter in the history of malaria control than the record of American malaria control in this area. In each new campaign the incidence of malaria progressively decreased. Some of the largest bases, e.g., Espiritu Santo in the New Hebrides, became almost malaria free and it was not necessary for the troops occupying the island to be on suppressive atebrin. In June 1944 the primary rate at Espiritu Santo was only 2.7 per 1000 per annum. This was a most remarkable achievement.

It should be emphasized that control of malaria occurred only when an efficient malaria control organisation came into being.

The pre-war experience and malaria records of Lieutenant-Colonel E. G. Sayers were helpful to the Americans in reducing malaria rates after the conquest of Guadalcanal.

2 NZEF in the Pacific

The 2nd NZEF (IP) was fortunate in that the main base, New Caledonia, was non-malarious. While the New Zealanders were still in New Caledonia malaria reached high proportions among the Americans engaged in operations in the Solomons. During the training period of the New Zealand force the opportunity was taken to send the Consultant in Tropical Diseases, Lieutenant-Colonel Sayers, to Australia and New Guinea. The assistance given by the medical services of the Australian Forces, and by Colonel N. Hamilton Fairley in particular, was invaluable and contributed in no small measure to our success in combating the disease. Lieutenant-Colonel Sayers returned convinced that the solution of the malaria problem was the key to the Pacific war.

From the reports of the United States Marines on Guadalcanal and the early experiences of the Australians in New Guinea, the New Zealand medical services anticipated, and provided for, a malaria incidence of 100 per month per 1000 men in the combat area.

The 3rd New Zealand Division moved up to Guadalcanal in three echelons, the first leaving New Caledonia on 17 August 1943. The main force of just over 11,000 men was assembled in Guadalcanal by mid-September. From the end of October 1943 until the end of April 1944 the total force in the Solomon Islands was over 12,000. The troops took part in three operations—on Vella Lavella, Treasury, and Nissan islands. The combat conditions were soon over in each place and the troops then settled down to static conditions in a garrison role. Their malaria record was good—less than 5 per cent of the troops who entered a malarious area actually developed malaria, and most of these cases occurred in New Caledonia and New Zealand after the cessation of suppressive atebrin.

The low incidence was largely a result of a campaign carefully prepared and painstakingly carried out. Lessons had been learnt from the experience of the Americans, and pre-war data on Guadalcanal, Vella Lavella, and Treasury Islands were available.

PRE-WAR DATA

Pre-war Data

Valuable information was supplied by Lieutenant-Colonel Sayers, who had practised at Munda and Vella Lavella from 1927 to 1934, and this was published in 1943 in a booklet, Malaria in the South Pacific. The Solomon Islands could be classed as a hyperendemic area. Generally speaking spleen rates varied from 51 to 94 per cent on different islands. The only group with a relatively low splenic index was the Treasury Islands. Rates for the three islands on which the New Zealand Division served were: Guadalcanal 77.7, Vella Lavella 67, and Treasury (Mono Island) 14.3.

Studies on the native population had shown that the malaria incidence started to rise during January, reached its peak in June, and fell rapidly during July. The period from August to January was the 'healthy' season from the malaria point of view. The big increase in the number of cases during the first half of the year was due mainly to the large number of Falciparum cases occurring at that time.

The malaria season could be correlated with the wet season although there was a lag of one to two months—the wet season was roughly from December to April, and the malaria season from February to June. Annual rainfall in the Islands varied from 75 to 175 inches. In most cases the distinction between the wet and the dry seasons was well marked, but in certain situations on the larger islands there was not a great deal of variation from month to month. The prevailing winds during the wet season were north-west (November-April), and in the dry season (May–October) south-east, the so-called south-east trade wind. The wet north-west season was also the warmer season. There were no big diurnal variations in temperature, which ranged from a maximum of about 95 degrees F. to a minimum of about 73 degrees F.

Topography had an important bearing on the malaria problem. Practically all the islands, except the atolls and a few volcanic islands, consisted of an elevated centre of igneous or sedimentary rock with terraces of old coral platforms fringing the base. These coral terraces on the coast were frequently the site of coconut plantations. On most islands, with the notable exception of Guadalcanal, there was no great development of alluvial plains. The lowlands, with the exception of coconut plantations, native gardens, and (on Guadalcanal) natural grassland, were under heavy jungle. As a rule the whole of the interior was under heavy jungle.

In general the soils, when undisturbed by working or heavy traffic, were fairly free-draining, and temporary pools did not remain many days unless there was continuous rain. The coastal strips of coral sand were particularly well drained. On the smaller islands large streams were not numerous, but there were frequent springs and seepages and short spring-fed streams. On low atolls such as Nissan streams were absent, though there could be occasional fresh-water ponds.

Under undisturbed conditions on most of the small islands and on many areas of the larger ones, malaria was surprisingly easy to control with relatively small resources of labour and materials. A small number of permanent breeding places near native villages was often sufficient to maintain a high splenic rate. Splenic indices gave no indication of the magnitude of the control problem, which was largely determined by topographical factors. (When military occupation takes place the position alters since the forces largely create their own problem.)

The vector was known to be Anopheles Farauti. There was some obscurity as to which variety was most prevalent. Little was known about the characteristic habits of the species and little had been attempted in the way of systematic malaria control.

The types of parasite found in the New Georgia- Vella Lavella area were: P. falciparum, 43.9 per cent; P. vivax, 32 per cent; P. malariae, 18.3 per cent; and species unidentified, 5.8 per cent. These figures related to the general population, including women and many children.

CONTROL OF MALARIA

Preparations for the control of malaria in our troops can be described under the following headings:

1. Organisation and training of Malaria Control Unit.
2. Training of medical personnel in diagnosis and treatment of malaria.
3. Training of combat officers and other ranks in anti-malaria measures.

NEW ZEALAND MALARIA CONTROL UNIT: ORGANISATION

New Zealand Malaria Control Unit: Organisation

The NZMCU consisted of a headquarters and three brigade sections with a total strength of thirty-six officers and men. The headquarters consisted of two officers (the commanding officer and one entomologist) and ten men, one of whom was trained in the laboratory diagnosis of malaria. Each brigade section consisted of one officer and seven men.

The commanding officer was a medical officer with the rank of major. The senior entomologist was attached to headquarters, and two of the three section commanders were entomologists and the other an engineer. The Division was fortunate in obtaining the services of two exceptionally well-qualified entomologists from the Department of Scientific and Industrial Research, and the engineer was experienced in drainage schemes and airfield construction work. The junior entomologist was a science graduate in biology.

The Malaria Control Unit had excellent preliminary training in the malarious area prior to New Zealand troops going into it. At the end of January 1943 a party of two officers and seven others moved to Efate Island in the New Hebrides and there operated as a malaria control unit at Havannah Harbour, under the United States organisation, until the middle of June. In the meantime the remainder of the unit in New Caledonia carried on with training. A second party replaced the first at Havannah Harbour about mid-June and remained until the end of July. The two officers of the first party proceeded to Russell and Tulagi, where they remained until the end of July, when they rejoined the Division in New Caledonia. The experience so gained was of the utmost value when the MCU subsequently took over responsibility for malaria control in New Zealand areas.

UNIT ANTI-MOSQUITO SQUADS

Unit Anti-Mosquito Squads

Beside the Malaria Control Unit, provision was made for unit anti-mosquito squads.

On the whole, the co-operation of officers in providing personnel for anti-mosquito work was good. In actual practice an NCO from Headquarters usually supervised the work and most of the control work was done by company squads, normally two men per company. On the whole this was satisfactory, and men showed commendable keenness in doing the work required of them.

DUTIES AND RESPONSIBILITIES OF MALARIA CONTROL UNIT

Duties and Responsibilities of Malaria Control Unit

The MCU was responsible for training its own and unit squad personnel. It also observed and reported on breaches of malaria discipline, but could not, and was not expected to, accept responsibility for the policing of malaria discipline within units.

Its main function was mosquito control. As soon as possible one or two representatives went to occupied areas to carry out a reconnaissance survey of the malaria situation. They were followed by the rest of the unit. Maps were constructed and all breeding places marked. Areas were then delimited for each unit and unit anti-mosquito squads taken over their areas and closely supervised.

ADULT MOSQUITOES

Adult Mosquitoes

The destruction of mosquitoes in tents, huts, etc., has always been recognised as a valuable measure of malaria control. At the beginning a kerosene pyrethrum fly spray was used and was effective, but supplies were rarely adequate and the flit guns supplied were far too flimsy for service conditions. Later American freon pyrethrum aerosol bombs became available, and these were most effective and economical in space and weight.

The full benefit of these sprays was not usually obtained under service conditions as huts and tents were not screened and in many cases had open sides. Under such circumstances the vapour was soon dissipated by wind and there was nothing to prevent a fresh influx of mosquitoes.

MOSQUITO LARVAE

Mosquito Larvae

For temporary control oiling with Navy No. 2 diesel oil was widely used, and this was the only method at that time available for a mobile force with little heavy equipment and insufficient labour for permanent control measures. In this campaign all areas occupied were on the coast and all supplies came by sea. In addition, large quantities of diesel oil were required for heavy construction equipment, and so supplies were always available. Breeding places were sprayed once a week with knapsack sprayers, and the quantity used varied from 500 gallons to 1000 gallons per thousand men per month.

DRAINAGE

Drainage

Only simple hand-drainage projects could be undertaken by New Zealand units, although bigger drainage schemes were sometimes carried out by neighbouring American personnel.

AVOIDANCE OF MAN-MADE BREEDING PLACES

Avoidance of Man-made Breeding Places

One of the greatest difficulties encountered was that, owing to the absence of good roads, unofficial tracks, ruts, and deviations occurred in all directions, and such areas were ideal breeding places for Anopheles punctulatus. Much of the time of malaria control units was spent in dealing with this problem. Weekly checks were made of unit areas. The MCU itself also undertook control of larger projects and areas too remote from combatant units to be easily handled by them. Surveys of local natives were often undertaken by the laboratory technician attached to MCU headquarters. The MCU acted as a supply organisation for knapsack sprayers.

RESEARCH

Research

As far as time permitted, research was carried out on the species and habits of anophelines in the area. Captain Dumbleton did some investigations on the possible significance of Bironella hollandi as a malaria vector.

Training of the Division in Anti-Malaria Measures

This was not as thorough as it might have been, but the following measures were taken:

(1) All officers were lectured on anti-malaria measures and an instructional film was shown.

(2) Medical and combatant officers lectured to their troops.

(3) Medical officers of the Division received sound instruction on the diagnosis, clinical features, and treatment of malaria, and certain selected officers attended courses of special laboratory training.

(4) Unit squads attended three-day courses of instruction in New Caledonia. They also attended refresher courses on Guadalcanal, Vella Lavella, and Treasury.

(5) A pamphlet containing advice on malaria precautions was given to every officer.

CLOTHING

Clothing

It was decided that no shorts would be taken into the malarious areas and that 'longs' would be worn by day and by night. Gaiters were to be put on and sleeves rolled down before dusk. (For lack of shorts the men simply wore underpants, so that provision of shorts for wear in the daytime would have been preferable.)

REPELLENT

Repellent

Skat and Everready repellents were issued to each man and instructions given regarding their use.

ATEBRIN

Atebrin

This was commenced on embarkation. The initial dose was 1 tablet (0.1 gm.) daily for six days of the week. On arrival at Guadalcanal the dose was reduced to .05 gm. daily except Sunday, when the dose was 0.1 gm. This was the dosage general in the area at the time. In mid-January 1944 the dose was increased to 0.6 gm. weekly. The order was to give atebrin strictly by roster. During combat this was not always possible and atebrin was then carried by the individual soldier.

DIAGNOSTIC FACILITIES

Diagnostic Facilities

A trained technician was attached to each field ambulance, and at least one medical officer in such units was also trained in thick film technique. Both Giemsa and Field's stains were used. This scheme worked very satisfactorily and provided good parasite diagnosis at advanced dressing stations and hospitals.

RECORD SYSTEM

Record System

A malaria record card was inserted in every man's paybook, and the results of all laboratory investigations for malaria and accounts of clinical attacks were recorded. The dates of entering and leaving malarious areas and the changes in atebrin suppressive dosage were also noted. All medical units sent in to the ADMS a weekly malaria return.

It is considered that this system was very satisfactory and that the records of malaria in the field are accurate.

MALARIA IN 3 NZ DIVISION

There were 120 fresh cases of malaria developed in the Solomons from September 1943 to June 1944 among troops of 3 NZ Division: 43 from Guadalcanal, 44 from Vella Lavella, 11 from the Treasury Group, and 22 from Nissan. It will be noted that a large proportion of the cases occurred on the base island of Guadalcanal, where at no time were New Zealand troops engaged in combat. The high incidence on Vella Lavella is easily understood because on this island the most extensive and prolonged jungle fighting took place. The low rate for the Treasuries appears to have been due to the small native population, limited anopheline breeding, and low endemicity of malaria among the natives. The troops on Nissan had in the main previously served on Vella Lavella, and doubtless some of the cases occurring on the former were contracted on the latter. As men were on suppressive atebrin and were moving from island to island it was manifestly impossible to say with any degree of accuracy where the infection was contracted. Medical officers were asked to take all factors into consideration and say where in their opinion infection occurred.

A Field Park Company which was on Guadalcanal all the time had the highest malaria rate in the Division. The reason was not readily apparent. The unit was camped on the Matanikau river, close to an Allied convalescent camp where mosquito breeding was not well controlled in the early stages, but it seems likely there was a failure in malaria discipline. The battalion which probably had most exposure to malaria during combat on Vella Lavella had 33 cases of malaria, whereas the other two battalions on the island had 6 and 7 cases respectively.

Most of the small amount of fighting took place outside the malaria season of February to June. Nearly all camps were on good sites, and malaria control on all islands was good. Malaria discipline was rather better in the Treasuries and on Nissan than the other two islands. Natives were usually some distance from the camps and not great in number—they were probably of less importance as malaria carriers than the seeded troops who were present.

The highest strengths on the islands were 12,000 on Guadalcanal, 5700 on Vella Lavella, 4600 in the Treasuries, and 6600 on Nissan. The incidence was so small that it would seem to have had no direct relation to the numbers of troops, but rather to lapses of malaria control and discipline in individual units. This would be in common with experience elsewhere.

Just as 2 NZ Division was fortunate in not being kept fighting for any length of time in the most highly malarious areas, so 3 NZ Division had its occupation of malarious islands confined to a short period and most of it outside the real malaria season. With the onset of the season in early 1944 control measures were fairly complete, so that the incidence did not rise.

STATISTICS

	Solomons	Developed in New Caledonia	Developed in New Zealand
Primary attacks	120	250	57
Readmissions	2	55	79
Latent cases	37	—	—
Unknown	—	—	82
	—	—	—
	159	305	218

Latent Cases

The terms ‘primary’ and ‘readmission’ are self-explanatory, but the term ‘latent’ requires explanation. This term is only used in cases where parasites, usually very scanty, were found on routine examination of thick films in the complete absence of pyrexia or other clinical signs of malaria. It was the custom in the CCS and in most Field Ambulances to do routine smears on all patients admitted. Most of the latent cases were picked up in this way. Others were found in surveys of individual units. It is felt that if such patients had been kept on suppressive atebrin and not otherwise treated they would probably not have developed clinical malaria. In point of fact they were all treated as soon as parasites were discovered. In computing malaria rates these cases have not been included.

Incidence by Months and Rates

The following table shows the incidence of malaria in the field by months, including strength figures:

Month 1943	Total Number of Troops in Malarious Area (Average Monthly Strength)	Number of Cases of Malaria Primary	Readmissions	Latent
August	5,590	0	0	0
September	10,259	4	0	0
October	11,985	32	0	0
November	12,200	17	0	11
December	12,430	10	0	5
1944				
January	12,505	15	0	3
February	12,576	14	0	5
March	12,442	13	1	11
April	12,100	8	1	1
May	5,836	5	0	1
June	1,736	2	0	0

The average monthly rate for the whole period was 1 per 1000.

The percentage of primary attacks among men who entered the malarious area was 0.88 per cent.

SPECIES DIAGNOSIS

Species Diagnosis

Species diagnosis was as follows:

primary cases—	
Falciparum	47 cases
Vivax	51 cases
Malariae	1 cases
Species unidentified	17 cases
Clinical	4 cases
	—
Total	120 cases
	—
readmissions—	
Falciparum	— cases
Vivax	1 cases
Malariae	— cases
Species unidentified	1 cases
Clinical	— cases
	—
Total	2 cases
	—
latent cases—	
Falciparum	21 cases
Vivax	8 cases
Malariae	1 cases
Species unidentified	7 cases
Total	37 cases

COMMENTS

Comments

Total Incidence: The low incidence of malaria in the field, 0.8 per cent of the force involved, was very satisfactory. It is infinitely better than we had hoped for. This does not, of course, mean that a much larger group of men were not infected, and many developed attacks after stopping suppressive atebrin.

Readmissions: The low figure of only two readmissions over a period of ten months is noteworthy. It could be ascribed either to the efficiency of the treatment or to the good atebrin discipline following primary attacks. Falciparum malaria does not readily relapse and vivax relapses are easily controlled by relatively low blood levels of atebrin.

SPECIES

Species

The most interesting observation, under this heading is the relatively large proportion of falciparum infections. This can be contrasted with almost complete absence of such infections among troops ceasing atebrin suppression after leaving the endemic area.

When we look into the monthly incidence of the various species of parasite it will be apparent that the big incidence of falciparum malaria was in October (22 cases) and November (10 cases). Nearly all these cases occurred on Vella Lavella during combat.

Allowing for an incubation period of two weeks, most of these infections were probably contracted after troops had been on atebrin for only about four weeks. It is now known that on the dosage of suppressive atebrin used the optimum atebrin blood level is not reached under six weeks. Probably most of these men who developed malaria at this time had an insufficiently high blood atebrin to suppress infection efficiently.

It is also now known that primary falciparum malaria is more difficult to suppress and requires high atebrin blood levels. So it is not surprising that this early predominance of falciparum cases should have occurred. It is significant, too, that most of the latent cases showed falciparum parasites in the blood, and these cases were also much more common in the earlier months. They are regarded as cases of primary falciparum infection in which the clinical symptoms are suppressed completely but not the parasitaemia. The final incidence of falciparum and vivax infections were approximately the same.

QUARTAN MALARIA

Quartan Malaria

The incidence of quartan malaria (1 primary case and 1 latent case) was less than might have been expected from peacetime studies. American investigations among native children confirmed the relatively high incidence of this parasite in certain localties.

Clinical

There were no serious complications from malaria. All responded well to treatment. There were no deaths from malaria. No patient was evacuated from the area because of malaria per se, but all cases were treated and returned to duty on the island where the illness occurred.

Treatment: The treatment used was:

(1) Quinine sulphate, grains 10, in solution thrice daily for three days. (Days, 1–3.)

(2) Atebrin, 0.1 gramme, thrice daily for five days. The first dose was given at the same time as the first dose of quinine, and both drugs were therefore given concurrently for the first three days. (Days, 1–5.)

(3) Plasmoquine, 0.01 gramme Quinine sulphate, grains 5 Thrice daily for next five days. (Days, 6–10.)

There was no rest period between the atebrin and the plasmo-quine. All drugs were given with a draught of water after meals. The whole treatment was completed in ten days.

MALARIA IN TROOPS AFTER LEAVING MALARIA AREA AND STOPPING ATEBRIN

Malaria in Troops after leaving Malaria Area and stopping Atebrin

Fairly accurate figures are available regarding the incidence of malaria after the cessation of atebrin administration. Troops began to return to New Caledonia from the Solomons at the end of April 1944, and the strength of troops in the malarious area dropped from 12,249 in April to 4121 at the end of May, and 637 at the end of June. Soon after their arrival in New Caledonia troops were sent back to New Zealand, some to essential occupations and others as reinforcements to 2 NZEF in Italy. As far as possible men were held in New Caledonia for four to six weeks after the cessation of atebrin. It was hoped that most of the cases of malaria would develop in that period. Actually the numbers of cases occurring in successive weeks were; 15, 32, 54, 62, 45, 17, 8, 7, 4— at the ninth week—after which there were only occasional cases. (Later Brigadier Fairley, AAMC, advised that atebrin in the ordinary suppressive dose of 0.1 gm. per day should be continued for one month after troops were withdrawn from a malarious area, and that such dosage would be effective in controlling falciparum infections.)

Actually hardly any falciparum infections developed in New Caledonia. Practically all the cases of malaria which developed following the cessation of atebrin were vivax infections. The atebrin had resulted in not only suppressing but in curing the falciparum infection, the vivax infection proving the more resistant.

In New Caledonia there were 250 primary cases, and 55 relapses were reported, while in New Zealand, up to December 1944, 218 cases were reported, of which 57 were primary cases, 79 were relapses, and 82 were not distinguished. Preparations were made in New Zealand for the hospitalisation of many more cases than actually occurred.

Early in 1944, by arrangement with the Department of Health in New Zealand, malaria was made a notifiable disease, and there is reason to believe that on the whole medical practitioners throughout the Dominion were conscientious about such notification. The importance of this was explained in a pamphlet sent to every practitioner. Practically all cases were treated in public hospitals where notification was automatic. The following are the figures for the total number of cases of malaria notified per annum from 1944 to 1948:

1944	397
1945	187
1946	50
1947	50
1948	12

These figures include all service personnel returned from all parts of the world and all civilians. When it is remembered that the troops in the Middle East also fought in the malarious areas, especially in Italy, it is clear that the number of malaria cases occurring in troops was extremely small.

MOSQUITO CONTROL AT NEW ZEALAND AIRFIELDS

Mosquito Control at New Zealand Airfields

New Zealand, along with Fiji and New Caledonia, lies outside the malarial zone, which however extends to Northern Australia. Therefore New Zealand has a duty to guard against introduction of anopheles mosquitoes into the country, possibly by aircraft travelling from malarial zones. It may be that the environment in New Zealand is unsuitable for the anopheles mosquito to get established, but until more is known of the habitat of the anopheles the threat must be treated as a real one. A species of anopheles introduced by fast destroyer or aircraft into Brazil from Dakar, West Africa, about 1930 established itself and caused a widespread epidemic of malaria in 1938 with 20,000 or more deaths. [1]

During the war in the Pacific tropical airfields used by the RNZAF planes were under strict mosquito control, and there was but slight chance of the insects boarding aircraft at these places and there were protective measures at Whenuapai airfield, Auckland. A hygiene and sanitation orderly boarded aircraft from places beyond New Zealand and sprayed the interior with a pyrethrum bomb before passengers and crew were disembarked and cargo unloaded. Mosquito-control measures were also enforced at Whenuapai, thus eliminating possible breeding places. Insects, including mosquitoes, were found in many aircraft coming from overseas airfields.

This control was continued at Whenuapai after the war, but on an experimental trip to Japan and back in an RNZAF aircraft in 1946 an entomologist, Sergeant M. Laird, made some interesting observations. Female mosquitoes, not anopheles, fed en route, survived the 13,000 mile return flight from New Zealand to Japan, while males lived for periods of up to seven days without food. Although no free mosquitoes were seen in the aircraft at any stage of the journey, larval and adult stages of anopheles were collected in the immediate vicinity of three airfields—in Australia, Netherlands East Indies, and the Philippines. It was found that caged mosquitoes were most active during take-off and landing, and were flying about each time the door of the aircraft was opened after landing. Thus there was every chance of mosquitoes and other insects making good their escape when the door was opened at Whenuapai to admit the spraying orderly.

A recommendation was made that aircraft from overseas should be sprayed with insecticide just before landing in New Zealand, thus reducing the chances of insects escaping after landing, yet spraying the insects when they were most likely to be in flight, at which time spraying is most effective. With increased air traffic in any future military activities in the Pacific there should be the utmost vigilance to guard against the introduction of anopheles mosquitoes, vectors of malaria, to New Zealand.

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[1] In 1952 Flt Lt M. Laird, RNZAF, began conducting research to discover why anopheles heavily infests some territories of the South-West Pacific and is unknown in some adjacent areas.

PENSIONS ASPECT

Pensions Aspect

Malaria cases of the Second World War have been no problem to the War Pensions Board. After the First World War there were many soldiers on pension for 'D.A.H. following malaria' or 'Debility following malaria', and who eventually became permanent pensioners for neurasthenia. This type of case was not seen after the Second World War, and there were soon no pensioners for malaria. Ex-servicemen ceased to have any recurrent attacks of malaria within three years of returning to New Zealand, the great majority within one year.

APPENDIX — 2 NZEF (IP) ADMINISTRATIVE ORDER — MALARIA

Appendix
2 NZEF (IP) Administrative Order

MALARIA

MEASURES FOR PREVENTION AND CONTROL

1. CONTROL OF MALARIA

Successful conduct of operations in the South Pacific Area depends to no small degree on prevention of casualties from malaria. Control of malaria is a military, rather than a medical problem. The responsibility for malaria control rests on the CO of every unit and every individual soldier. Malaria can be controlled by the application of proven control measures under strict military discipline. These measures are set out in the succeeding paragraphs of this order. They will be strictly enforced.

2. TRAINING

(a) Instruction on the nature of malaria, its effects on military operations, and the methods of control will be made an integral part of the training of all arms. Regular instruction in this respect will be arranged by COs.

(b) Attention is directed to the following publications:
   (i) The pamphlet “The Prevention of Malaria”.
   (ii) The pamphlet “Soldiering in the Tropics” (SW Pacific Area).

(c) COs of all units will ensure that an anti-mosquito squad on the scale of one NCO and 4 ORs per infantry Bn or equivalent, or a proportionate number for smaller units, is detailed and trained in anti-malarial work. Their primary function is destruction of mosquitoes within unit lines, and they should not be diverted to other duties which will in any way interfere with this work. As the work is technical, men of some education should be selected as far as possible, and it is particularly important that the NCO should be both energetic and intelligent. These squads are trained by the Malaria Control Unit, the OC of which arranges courses of lectures and field demonstrations for them. In addition, it is most desirable that the squads should be attached to the Malaria Control Unit for a further period when convenient, in order to gain practical experience in the field. Each squad should be supplied with a knapsack sprayer, oil for spraying, and a pick and shovel. The duties of the squads, under the direction of the Regimental Medical Officer are:

(i) To supervise the destruction of adult mosquitoes by spraying tents, etc., and to be directly responsible for spraying all shelters, e.g., offices, slit trenches, etc., which have no fixed occupants.

(ii) To oil, drain, or fill in all mosquito breeding grounds within the unit lines, except where these are so extensive or difficult as to require attention from the Malaria Control Unit.

(iii) To assist in policing the anti-malarial discipline of the Unit.

The results of the anti-mosquito work will be regularly examined by a checker from the Malaria Control Unit, who will advise on details and report any defects to the unit Regimental Medical Officer.

(d) In addition to the unit anti-mosquito squads who will be solely engaged in anti-mosquito work, the CO of each infantry company or equivalent formation will appoint for part time duties an NCO and two men. This Coy Squad will assist the Unit Squad in the execution of adequate anti-mosquito measures within its own Coy area.

3. PERSONAL PROTECTION AGAINST MALARIA IN MALARIOUS AREAS

The CO of each unit in a malarious area will ensure that—

(a) From ½ hour before sunset till ½ hour after sunrise every member, except when protected by a mosquito net, wears slacks, boots, anklets, web gaiters, SD, or puttees and long-sleeved shirt or jacket with sleeves rolled down.

(b) Every member has a container of insect repellent lotion and that the repellent is applied to exposed skin surfaces, as described in para 7 of this order.

(c) Every member has a mosquito net, and that it is kept in good repair.

(d) Every member sleeps under a mosquito net and that inspections are made nightly to insure that they are properly used.

(e) All occupied quarters, tents, or bivouacs are closed and sprayed with mosquito spray. SMO of area will issue appropriate instructions for methods of spraying to be used locally.

(f) Camps and bivouac areas are sited as far away as possible from obvious mosquito breeding areas and well away from native villages and habitations.

(g) The vicinity of all villages and habitations used by local people are placed out of bounds between sunset and sunrise and that local inhabitants are kept out of camp areas during that time.

(Every member takes atebrin tablets as directed.

h)

4. ATEBRIN: USES AND ADMINISTRATION

(a) Atebrin tablets are provided to maintain all ranks in good health by suppressing development of symptoms in those who are, or who have been, exposed to risk of malarial infection.

(b) Continued administration of atebrin in the dosages ordered has no harmful effects. Atebrin is a yellow dye, and a yellow tinge appears in the skin of a proportion of individuals who take it regularly. This yellow skin coloration is of no significance and will disappear when consumption of the drug ceases.

(c) Tablets will be taken after a meal, preferably the evening meal. Each tablet will be swallowed whole and followed by a drink of water.

(d) The CO of the unit is responsible for the administration of atebrin to every officer, NCO, and man in his unit. Atebrin will, whenever possible, be given on parade by roster under supervision of an officer. Strict supervision is necessary to guard against failure to swallow the tablets.

5. ANTI-MALARIAL MEASURES PREPARATORY TO PROCEEDING TO A MALARIOUS AREA

(a) The CO of a Unit will ensure that, prior to embarkation, the Unit has been issued with the following articles:

(i) Net, Mosquito, 1 per man.
(ii) Insect repellent lotion, 1 bottle per man.
(iii) Atebrin (0.1 gram) tablets, 24 per man.
(iv) Sprayers, hand, small (or equivalent apparatus), 10 per cent of unit strength.
(v) Mosquito spray.

Items (i), (ii), and (iii) will be a personal issue to the member prior to embarkation. Items (iv) and (v) or suitable equivalents will be taken with unit stores on the transport.

(b) On embarkation, every member will take one tablet of atebrin (0.1 gram) daily for six days in each week until disembarkation. On disembarkation, the dosage will become that in force in the area of disembarkation.

6. ATEBRIN: SUPPLY

(a) Medical Units will requisition, through the usual medical channels, for atebrin which is to be used in the standard course or maintenance course of treatment of cases of malaria.

(b) Atebrin tablets (0.1 gram) for suppressive treatment will be distributed by NZ ASC.

(c) Supplies will be drawn by NZ ASC from Advanced Depots of Medical Stores or from Medical Unit responsible for drawing medical supplies.

7. INSECT REPELLENT LOTION

(a) Supplies of insect repellent lotion, which is harmless, non-greasy, non-staining, and effective against mites which carry scrub typhus as well as against mosquitoes, will be distributed by NZ ASC.

(b) Its regular use, when combined with other essential measures of personal protection and with suppressive drug (atebrin) treatment, should greatly reduce the incidence of malaria. Each man should be supplied with one 2 oz. bottle and the allowance is one such bottle per man each month.

(c) COs will ensure that insect repellent lotion is made a personal issue to all members of the unit.

(d) Instructions for use:

(i) The lotion is to be applied by all ranks before sundown, and again on rising if reveille is before sunrise.

(ii) Men on night duty will apply the lotion on commencing duty and will renew applications at three-hourly intervals, or more often if necessary.

(iii) In the event of night air-raid alarms, all ranks will apply the lotion immediately if required to leave protection of mosquito nets.

(e) A few drops are shaken on to the palm and, after rubbing the hands together, smeared over all exposed portions of the face, neck, and arms to give a thin uniform covering. Do not apply to mouth or vicinity of eyes. Reapply when insects again begin alighting on the skin, using about one half of the amount originally applied.

(f) While liberal use of insect repellent lotion is to be encouraged, wastage should be carefully avoided; and, wherever possible, empty bottles are to be returned to NZ ASC.

8. ORDERS FOR ANTI-MALARIAL DRILL

For the purpose of preserving the health of all troops and for the prevention of malaria within the force, the following orders will be obeyed by all personnel immediately upon entering a malarious area or so soon before entering a malarious area as may be ordered:

(a) At all times from half an hour before sunset until half an hour after sunrise, except when protected by a mosquito net, all personnel will wear slacks, boots, anklets, web gaiters or puttees and long-sleeved shirt or jacket with the sleeves rolled down.

(Insect repellent lotion will be applied as described in para 7, sub-para (d) and (

(b) e) of this order.

(c) Mosquito nets will be kept in good repair at all times.

(d) All personnel will sleep only under mosquito nets.

(e) Atebrin tablets will be taken as directed. Each tablet will be swallowed whole and followed by a drink of water.

9. BREACHES OF ORDERS

The whole of the foregoing should be explained by officers to their men on frequent occasions. Para 7, sub-para (d) and (e) and para 8 will be read to all troops on parades at such intervals as will ensure that all troops are familiar with their provision. Breach of the instructions contained in these paras will be regarded as a serious breach of discipline. An appropriate penalty for a first offence might be forfeiture of gross pay for a period of say 10 days.

CHAPTER 5
Dengue

EPIDEMICS of dengue fever have occurred frequently in the Pacific area over many years, and it is not surprising that our troops in New Caledonia and Fiji suffered from this disease. There was no dengue recorded in the Middle East Forces.

Dengue fever is endemic in the Pacific area and is present in the Philippines, Hawaii, New Guinea, New Britain, the Solomons, Fiji, and Samoa. It is highly contagious and the virus is transmitted by mosquitoes—the Aedes aegypti in Australia and New Caledonia, and the Aedes scutellaris in New Guinea. Its prevention depends on the eradication of the vector by the removal of breeding places and the destruction of adult mosquitoes by spraying, as well as by the protection of the individual by protective clothing and repellent lotions during the day and by mosquito nets at night. All febrile dengue patients should be kept under mosquito nets day and night.

The major epidemics experienced by the New Zealand Expeditionary Force in the South-West Pacific were in New Caledonia, where there were 483 cases from April to July 1943 and 200 cases from March to May 1944. In the Royal New Zealand Air Force in the Pacific there was a high incidence of dengue at Espiritu Santo shortly after the establishment of the RNZAF station there. There were over 440 cases in the area in the twelve months April 1943 to March 1944. As the mosquito population was reduced the incidence of dengue fell away. From January to March 1945 there was an epidemic of dengue at Funafuti—43 cases were reported in a Catalina flight of about 130 men. Otherwise that area was almost completely free from dengue, there being only about 50 cases in the first eight months of 1945.

The Pacific Force was fortunate in the low incidence of dengue fever, and the disease had little or no influence on military operations. Nevertheless, the disease is important because of the danger of infection in endemic areas, and this demands adequate preventive measures.

The considerable epidemic that occurred among New Zealand troops in New Caledonia in the middle of 1943 was carefully studied by Colonel Sayers, Major Riley, and Captain Gatman. Of the 483 cases reported from April to July 1943, 176 cases were admitted to 4 NZ General Hospital, and of these 100 consecutive cases were selected for special study; detailed haematological studies of 50 cases were carried out.

Source of Infection and Transmission

The source of infection was in the local population where the disease appears to be endemic, becoming epidemic from time to time.

The virus was transmitted by Aedes aegypti which bred in towns and villages in man-made breeding places, e.g., cisterns, barrels, neglected spouting, empty tins, and other artificial collections of water. The mosquitoes were active both by night and day. This mosquito was not seen in rural areas where the camps were situated, and every soldier or nursing sister infected had paid a visit to one of the local villages. In some cases the visits had been of very short duration. In view of this troops were forbidden to enter urban areas unless permission was specially given, and this undoubtedly did a great deal to limit the size of the epidemic. Very few of the army personnel stationed in urban areas escaped infection.

Clinical Features

Dengue is a distressing, incapacitating illness which strikes with dramatic suddenness. The incubation period, where it could be determined, varied from five to twelve days, most cases occurring after seven or eight days.

There appeared to be no premonitory symptoms.

The disease can usually be divided into three phases:

(1) An initial fever of two to four days' duration.
(2) An interval of twelve to forty-eight hours with temporary relief of symptoms.
(3) A secondary fever of one to four days associated with a rash and a return of the general symptoms of the disease.

Most cases started with a feeling of chilliness which seldom developed into a true rigor. Malaise was marked in all cases but varied in intensity. Headache was severe and almost invariably frontal or fronto-occipital.

Eye symptoms were very prominent and included retro-orbital pain persisting right through the illness and pain on lateral movement of the eyes. The conjunctivae was congested in almost all cases. There was congestion of both bulbar and palpebral conjunctivae which began about the second day and persisted well on into convalescence. There was occasionally oedema of the lids, but no true conjunctivitis was seen. Photophobia occurred in about one third of the cases. One patient developed central choroiditis with exudate.

Backache was a distressing and constant symptom, usually worst in the lumbar region and more severe during the initial period of fever than later on. The backache was associated with limb pains, especially in the region of the knees. They were not as severe as described in textbooks and would not justify the old name of 'break-bone' fever. In the early half of the disease about half the patients complained of abdominal pain which appeared to be muscular in origin and associated with the backache and limb pains.

Anorexia was profound in nearly all patients and was very persistent; nausea occurred in half the patients and vomiting in 20 per cent. Insomnia was a troublesome feature, especially during the first three days, and some sufferers were depressed. On the whole the depression seemed to be much less with dengue than with sandfly fever. In this group of healthy young people depression was present in only a few patients, mostly nurses.

The pyrexia was usually of the 'saddle-back' type with an initial fever, a short period of remission, and a secondary fever. In 96 per cent of cases the fever lasted from five to seven days. The pulse was slow throughout.

Most patients had an initial flushing of the face, ears, neck, and upper part of the trunk, but the main or secondary rash which appeared between the third and sixth days was maculo-papular, the majority being rubelliform in appearance. It was first seen on the chest and back and ulnar sides of the forearms, spreading later to the feet and legs. The 'drawers' area was relatively free of the eruption. The rash became petechial in 11 per cent of patients, usually over the dorsum of the feet and on the forearms. The rash usually lasted from two to five days.

General glandular enlargement was the rule and persisted long after discharge.

Careful examination of the blood throughout the disease was carried out by Captain Gatman, and a very brief summary of his principal findings were:

Total Leucocyte Count: In all cases there was a leucopenia, the lowest figures being on the fourth, fifth, and sixth days. The average count on the fifth day was 2850 per cmm. and counts as low as 900 per cmm. were observed.

Neutrophils were greatly reduced and the average segmented cell count on the fifth day was 500 per cmm. There was a steep return to normal between the seventh and twelfth days.

Lymphocytes were also reduced, but not to the same extent as the neutrophils.

Plasma and Turck cells were frequently seen. Eosinophils were absent throughout the disease. Changes in the leucocytes did not bear any relation to the severity of the symptoms or to the type of temperature curve.

Convalescence was fairly rapid in most cases but some complained of malaise and tiredness for a considerable period.

Dengue fever, therefore, although it has no mortality and has few after-effects, can temporarily incapacitate a force with explosive suddenness. Its main danger is for troops in urban areas. It is unlikely to seriously concern a force engaged in jungle warfare or camped in rural areas.

2 NZEF (IP)

	Dengue Fever	
1943—		
April	120	1.25
May	243	1.5
June	78	0.47
July	37	0.21
August	8	0.04
September	3	0.017
October	3	0.016
November	1	0.005
December	1	0.005

1944—		
January	—	—
February	15	0.08
March	64	0.36
April	94	0.56
May	42	0.26
June	22	0.20
July	4	0.06

[SECTION]

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Dengue fever is endemic in the Pacific area and is present in the Philippines, Hawaii, New Guinea, New Britain, the Solomons, Fiji, and Samoa. It is highly contagious and the virus is transmitted by mosquitoes—the Aedes aegypti in Australia and New Caledonia, and the Aedes scutellaris in New Guinea. Its prevention depends on the eradication of the vector by the removal of breeding places and the destruction of adult mosquitoes by spraying, as well as by the protection of the individual by protective clothing and repellent lotions during the day and by mosquito nets at night. All febrile dengue patients should be kept under mosquito nets day and night.

The major epidemics experienced by the New Zealand Expeditionary Force in the South-West Pacific were in New Caledonia, where there were 483 cases from April to July 1943 and 200 cases from March to May 1944. In the Royal New Zealand Air Force in the Pacific there was a high incidence of dengue at Espiritu Santo shortly after the establishment of the RNZAF station there. There were over 440 cases in the area in the twelve months April 1943 to March 1944. As the mosquito population was reduced the incidence of dengue fell away. From January to March 1945 there was an epidemic of dengue at Funafuti—43 cases were reported in a Catalina flight of about 130 men. Otherwise that area was almost completely free from dengue, there being only about 50 cases in the first eight months of 1945.

The Pacific Force was fortunate in the low incidence of dengue fever, and the disease had little or no influence on military operations. Nevertheless, the disease is important because of the danger of infection in endemic areas, and this demands adequate preventive measures.

The considerable epidemic that occurred among New Zealand troops in New Caledonia in the middle of 1943 was carefully studied by Colonel Sayers, Major Riley, and Captain Gatman. Of the 483 cases reported from April to July 1943, 176 cases were admitted to 4 NZ General Hospital, and of these 100 consecutive cases were selected for special study; detailed haematological studies of 50 cases were carried out.

SOURCE OF INFECTION AND TRANSMISSION

Source of Infection and Transmission

The source of infection was in the local population where the disease appears to be endemic, becoming epidemic from time to time.

The virus was transmitted by Aedes aegypti which bred in towns and villages in man-made breeding places, e.g., cisterns, barrels, neglected spouting, empty tins, and other artificial collections of water. The mosquitoes were active both by night and day. This mosquito was not seen in rural areas where the camps were situated, and every soldier or nursing sister infected had paid a visit to one of the local villages. In some cases the visits had been of very short duration. In view of this troops were forbidden to enter urban areas unless permission was specially given, and this undoubtedly did a great deal to limit the size of the epidemic. Very few of the army personnel stationed in urban areas escaped infection.

CLINICAL FEATURES

Clinical Features

Dengue is a distressing, incapacitating illness which strikes with dramatic suddenness. The incubation period, where it could be determined, varied from five to twelve days, most cases occurring after seven or eight days.

There appeared to be no premonitory symptoms.

The disease can usually be divided into three phases:

(1) An initial fever of two to four days' duration.
(2) An interval of twelve to forty-eight hours with temporary relief of symptoms.
(3) A secondary fever of one to four days associated with a rash and a return of the general symptoms of the disease.

Most cases started with a feeling of chilliness which seldom developed into a true rigor. Malaise was marked in all cases but varied in intensity. Headache was severe and almost invariably frontal or fronto-occipital.

Eye symptoms were very prominent and included retro-orbital pain persisting right through the illness and pain on lateral movement of the eyes. The conjunctivae was congested in almost all cases. There was congestion of both bulbar and palpebral conjunctivae which began about the second day and persisted well on into convalescence. There was occasionally oedema of the lids, but no true conjunctivitis was seen. Photophobia occurred in about one third of the cases. One patient developed central choroiditis with exudate.

Backache was a distressing and constant symptom, usually worst in the lumbar region and more severe during the initial period of fever than later on. The backache was associated with limb pains, especially in the region of the knees. They were not as severe as described in textbooks and would not justify the old name of ‘break-bone’ fever. In the early half of the disease about half the patients complained of abdominal pain which appeared to be muscular in origin and associated with the backache and limb pains.

Anorexia was profound in nearly all patients and was very persistent; nausea occurred in half the patients and vomiting in 20 per cent. Insomnia was a troublesome feature, especially during the first three days, and some sufferers were depressed. On the whole the depression seemed to be much less with dengue than with sandfly fever. In this group of healthy young people depression was present in only a few patients, mostly nurses.

The pyrexia was usually of the 'saddle-back' type with an initial fever, a short period of remission, and a secondary fever. In 96 per cent of cases the fever lasted from five to seven days. The pulse was slow throughout.

Most patients had an initial flushing of the face, ears, neck, and upper part of the trunk, but the main or secondary rash which appeared between the third and sixth days was maculo-papular, the majority being rubelliform in appearance. It was first seen on the chest and back and ulnar sides of the forearms, spreading later to the feet and legs. The 'drawers' area was relatively free of the eruption. The rash became petechial in 11 per cent of patients, usually over the dorsum of the feet and on the forearms. The rash usually lasted from two to five days.

General glandular enlargement was the rule and persisted long after discharge.

Careful examination of the blood throughout the disease was carried out by Captain Gatman, and a very brief summary of his principal findings were:

Total Leucocyte Count: In all cases there was a leucopenia, the lowest figures being on the fourth, fifth, and sixth days. The average count on the fifth day was 2850 per cmm. and counts as low as 900 per cmm. were observed.

Neutrophils were greatly reduced and the average segmented cell count on the fifth day was 500 per cmm. There was a steep return to normal between the seventh and twelfth days.

Lymphocytes were also reduced, but not to the same extent as the neutrophils.

Plasma and Turck cells were frequently seen. Eosinophils were absent throughout the disease. Changes in the leucocytes did not bear any relation to the severity of the symptoms or to the type of temperature curve.

Convalescence was fairly rapid in most cases but some complained of malaise and tiredness for a considerable period.

Dengue fever, therefore, although it has no mortality and has few after-effects, can temporarily incapacitate a force with explosive suddenness. Its main danger is for troops in urban areas. It is unlikely to seriously concern a force engaged in jungle warfare or camped in rural areas.

2 NZEF (IP)

	Dengue Fever	
1943—		
April	120	1.25
May	243	1.5
June	78	0.47
July	37	0.21
August	8	0.04
September	3	0.017
October	3	0.016
November	1	0.005
December	1	0.005
1944—		
January	—	—
February	15	0.08
March	64	0.36
April	94	0.56
May	42	0.26
June	22	0.20
July	4	0.06

CHAPTER 6 — FILARIASIS

CHAPTER 6
Filariasis

FILARIASIS is due to a nematode worm Filaria Bancrofti, which exists in man in two forms—microfilaria in the blood and macrofilaria in the lymphatic system. The intermediate host is a mosquito, Culex fatigans and Aedes aegypticus in the Pacific, in which the worms develop and then enter the human body through the mosquito bite. The worms mechanically block the lymphatics and secondary infection arises. Reproduction is slow, taking generally two to three years, and it is therefore years before the microfilaria can be demonstrated in the blood.

Clinically the infection is shown by attacks of fever, with severe headache, aching in the limbs, and occasionally rigors, lasting a week and recurring once or twice a year—the Mu Mu of the Samoan. The next stage is lymphangitis of the arm or leg, with swelling and redness and enlarged glands, fever, headache and rigors. Testicular symptoms may also appear, with pain; followed much later by swelling and hydrocele. Finally, at a very late stage, elephantiasis with very marked swelling of the limbs or scrotum may arise. A mild eosinophilia may be present.

Filariasis has for a long time been recognised as an important endemic disease in the Pacific islands, especially in Samoa, Tonga, and Fiji, where the development of elephantiasis makes the condition so obvious. New Zealand troops were used to garrison both Fiji and Tonga during the war for considerable periods, but there was little incidence of the disease.

There were no cases of filariasis in 3 NZ Division. In New Caledonia thick blood film examinations for filaria were carried out on 700 men who had served for at least one year in Fiji, and who by that time had been away from that area for at least twelve months. All films were negative. In the RNZAF one case of filariasis was invalided from the Solomon Islands, and also three cases of suspected filariasis, the diagnosis of which could not be confirmed.

A few cases of filariasis were boarded and returned to New Zealand from Fiji and Tonga, but no case showed signs of elephantiasis or permanent swelling.

Up to 1949 some 43 cases had been dealt with by the War Pensions

Department, either because they had been down-graded at discharge or later applied for pension. Dr D. Macdonald Wilson found in a survey that there were 37 Army and six Air Force personnel in the total. The Army cases served in the following Pacific islands: Tonga, 21; Fiji, 11; Gilbert and Ellice Islands, 4; Solomon Islands, 1. They arose first in the following years: 1942, 3; 1943, 24; 1944, 5; and 1945, 4. The periods spent in the tropics before the onset of the first symptoms were; under six months, 1 case; six months to one year, 20 cases; one to two years, 9 cases; two to three years, 8 cases.

As these cases arose mainly where laboratory facilities were not available, diagnosis was usually made on clinical grounds. Where laboratory facilities were available, either overseas or in New Zealand, there is no record of any specific diagnosis by positive blood findings. The patients suffered from swellings of the testes, epididymus, spermatic cord, and inguinal glands. Lymphangitis in the arm with swelling and pitting was common, along with enlarged epitrochlear or axillary glands. Only one case suffered from swollen legs and one case from swellings of the face. Sometimes the first symptoms were testicular pain preceding swelling of the scrotum, and when this condition subsided perhaps the next recurrence would be in the arm. No case was severe, and symptoms and swellings usually subsided in a week to a fortnight, allowing the patient to return to duty. However, the policy was to evacuate such cases out of the tropics back to New Zealand.

It was found that 19 of the 37 cases had no further attack after leaving the tropics, while 13 had recurrences of symptoms in New Zealand, but such recurrences had all ceased after two years—mostly within one year. In five cases the first evidence of disease was revealed after the return of a man to New Zealand, the period after return from the tropics varying from two weeks to six months.

There have been no cases with any serious residual symptoms. All except three cases suffered no symptoms of chronic filariasis in 1949, and none of these three had suffered an acute flare for some years, and their state appeared stationary. One patient was receiving a small pension (20 per cent) for a small residual hydrocele and slight swelling of testicle, and two others a 10 per cent pension for subjective pains in testes with slight thickening of the spermatic cord. Thus incidence was low and disability slight. Since the war new drugs with a specific action against the filaria have been introduced.

CHAPTER 7
Sandfly (Phlebotomus) Fever

SANDFLY fever is a disease of considerable military importance because, although it is never fatal and has no serious sequelae, it may nevertheless suddenly incapacitate large numbers of men who may be urgently required for important operations.

It has long been endemic in the Mediterranean area and persists chiefly in the lowlands of those tropical and subtropical countries which have long periods of hot dry weather. The native population seems to be immune, probably because of infection in childhood. Newcomers, however, usually succumb to the disease during the first epidemic.

It is not surprising therefore that when British and Dominion troops entered the Middle East area large-scale epidemics occurred, and it is reported that about 25,000 cases were admitted to hospital.

Among the New Zealand troops about 2000 cases occurred, largely in the summer months. No reliable figures are available before July 1941, but it is known that many cases occurred before this. In addition many cases diagnosed as PUO were considered to be mild cases of sandfly fever.

Figures of incidence from July 1941 to October 1945 for 2 NZEF in the Middle East are as follows:

Sandfly Fever

	1941	1942	1943	1944	1945
Jan	—	—	—	—	—
Feb	—	—	—	—	—
Mar	—	1	2	2	—
Apr	—	4	15	—	—
May	—	88	24	2	3
Jun	?	213	55	3	8
Jul	134	79	78	4	4
Aug	205	133	62	39	6
Sep	205	95	42	72	5

Oct	73	45	63	18	1
Nov	30	14	17	4	—
Dec	3	6	—	—	—

Sandfly fever is due to a small virus which is present in the blood of a patient from twenty-four hours before till twenty-four hours after the onset of the disease. The virus can be readily transferred to volunteers by intravenous or intracutaneous injection. It has not so far been transmitted to lower animals.

In nature the disease is transmitted by the bite of the female of a small midge Phlebotomus papataci. There was no evidence in the Middle East that any other insect was concerned in transmission. These small insects bite during the night and early morning hours and are found near ground level. They avoid higher levels and strong breezes, and have a very short range of flight. It is thought that they seldom move more than fifty yards from their breeding places. They breed in rubble, cracks in walls, dugouts, and similar areas.

Sandfly fever first became a major problem among New Zealand troops in Egypt in June 1941. At this time a particularly severe epidemic occurred in 3 NZ General Hospital at Helmieh and Captain Sayers was sent to investigate the outbreak.

This hospital was a tented hospital situated on the edge of the desert. To guard against bombing the sites of the tents had been excavated several feet and then native workmen had built round each tent walls constructed of mud bricks. It was hoped that these walls would act as protection against bomb blast.

The epidemic started during the third week in June and appeared at first to affect mainly officers and NCOs. It soon spread not only to practically the whole staff, but also involved the patients. So bad did the situation become that it became necessary to close down the hospital completely for a short period.

Captain Sayers was able to establish that Phlebotomus papataci was breeding in large numbers in cracks in the brick walls which had been built a few months earlier round both the hospital tents and those used by personnel. Conditions in these walls were apparently ideal for breeding, and during the night and early morning hours the insects came out of their hiding places and infected the inmates of the tents.

Apart from this outbreak, there were no serious outbreaks among units of 2

NZEF, and at no time were divisional operations upset by sandfly fever, although each summer in the Middle East there were a number of cases from both field and base units, the incidence being fairly high in 1942. Sandfly fever was endemic in Syria, and admissions to the CCS rose in May 1942 and were rapidly increasing in June when the Division left Syria to return to the Western Desert.

Clinical Aspects

Few soldiers who suffered from sandfly fever will forget the three days of misery they suffered, and many will remember the days or weeks of debility and depression which followed the illness. The main clinical features were as follows:

Following an incubation period of three to six days the disease commenced with explosive suddenness. The temperature rose abruptly to between 102 and 104 degrees F. and remained there for between two and four days. Occasional cases were febrile for somewhat longer periods, and occasionally there was a slight recrudescence of fever after the temperature had become normal.

Headache was usually severe and distressing and was retro-orbital and frontal. This was associated with malaise and prostration and general aching of the limbs and back. Many patients complained of a feeling of stiffness in the neck and occipital pain.

The eyes were sore and movement of the eyes was very painful. On inspection there was usually marked conjunctival infection.

During the course of the disease, and indeed frequently for some days or even weeks afterwards, there was almost complete anorexia, and some patients complained of nausea. A minority vomited.

In some cases there was a slight congestion of the throat, but, generally speaking, this was not a marked feature. Although there was often a distinct flushing of the head and neck there was no rash such as one sees in dengue. Unlike dengue, too, lymphatic glands were not generally enlarged. After the temperature had returned to normal many patients still felt weak, mentally depressed, and had little appetite. Many lost a considerable amount of weight. There were no deaths from the disease and no known sequelae.

Blood examination usually showed a leucopenia with a shift to the left of the neutrophils.

After the epidemic at the Helmieh hospital in June 1941 real progress was made in the control of sandfly fever. Great care was taken in making camps not to create suitable breeding places for the mites, and whenever possible the area round sleeping quarters was freed of walls, banks, rubble, and other likely breeding sites.

It was proved that dimethyl-phthalate was an effective repellent against phlebotomi and that DDT spraying would apparently almost eliminate the infecting insect.

Sandfly nets were provided at times in 2 NZEF, and DDT-impregnated mosquito nets were used later. Nursing patients with sandfly fever under nets diminished the risk of spreading the infection. In Italy few cases were recorded and in the Pacific none.

[SECTION]

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CHAPTER 8 — TYPHUS FEVER

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Typhus Fever

EPIDEMIC louse-borne typhus has decimated armies and profoundly influenced campaigns over the centuries. Typhus claimed tens of thousands of Napoleon's Grand Army when he marched to Moscow. True to its traditions, typhus appeared in the first six months of the First World War, in the Balkan and Eastern areas, and subsequently in nearly all the countries and areas of Europe affected by the war, with the notable exceptions of France, Belgium, and Italy. Its scourges exceeded those of any other epidemic disease during the war, but British troops, although operating in areas where the disease was endemic, and in contact with infected allies and enemy, suffered little from typhus. Preventive measures were responsible for this freedom from the disease. Mortality was over 20 per cent in those small groups of British troops who did contract typhus. There was no typhus on Gallipoli, and there is no record of any cases of typhus among the troops of 1 NZEF, although there were outbreaks of the disease in Egypt and Palestine.

In the Second World War typhus again claimed thousands of victims on the Russian front, both Russian and German. With British troops their experience of the First World War was repeated—preventive measures again limited their cases to a small number. The full set of circumstances required for the outbreak or spread of an epidemic of typhus are lousiness, overcrowding, undernourishment, and filth. Where the care of troops and personal hygiene eliminates these conditions there is little danger of epidemic typhus, provided contacts with a poor local population are strictly limited.

Among New Zealand troops overseas in the Second World War there were only isolated cases of typhus. The greatest threat of an epidemic was to those prisoners of war in Lamsdorf camp, Germany, when some twenty cases developed among the 10,000 Allied prisoners there, but an epidemic was prevented by persuading the German authorities to allow the British medical officers to institute comprehensive control measures.

Incidence in 2 NZEF

In Egypt and other countries of the Middle East the troops of 2 NZEF were always subject to the danger of contracting typhus fever. In times of peace there were usually between two and three thousand cases of louse-borne typhus in Egypt. The poverty and miserable living conditions of the town dwellers favoured its propagation. The epidemic was seasonal, occurring annually between January and May, with its peak about April. During the war, as was also the case in the First World War, the incidence rose. In 1940 there were 4500 cases, and 9000 cases the next year. In 1942 the epidemic began as early as November, and by February 1943 the incidence had already passed the previous year's peak, and there was a sizeable epidemic in the civilian population.

For military reasons little publicity was given to the 1943 epidemic in Egypt, and most soldiers did not realise the risks involved in contacts with the native population, although general information on the control of typhus was published in 2 NZEF Orders in December 1942. In 2 NZEF there were six cases, with four deaths, at this period. The previous year there had been three cases, with two deaths, and then in October 1943 there were two cases, both of whom recovered. In 1944 and 1945 there were no New Zealand cases. The incidence was low but the mortality was high. Typhus also occurred among civilians in Syria and North Africa, and in the latter area one of our medical officers contracted it.

It is quite possible that there were cases of typhus not diagnosed and therefore not reported as such, and that the mortality was really lower. In June 1943, on the occasion of death from typhus in one of our hospitals, the Consultant Physician reported: 'There were in hospital at this time three cases of "PUO" in which the clinical features strongly suggested mild epidemic typhus. It is apt to be forgotten that the younger the patient, the milder an attack of typhus is, as a general rule, and cases with scanty rash, or no rash at all, can quite easily be missed. The completed temperature chart, when the disease is over, will often give a clue to what the correct diagnosis was, and it is not too late even then to get a positive Weil-Felix reaction.'

The care of troops in the provision of good living conditions, adequate ablution, shower and laundry facilities, and a high standard of personal cleanliness maintained by the troops, reduced louse infestation to a minimum. There was a possible chance of infection by inhalation of dust contaminated with dry louse excreta, and avoidance of close association with natives was important.

Native labourers employed in Maadi base camp were compulsorily showered and their clothing disinfected each week, an elaborate delousing station being built at the entrance to the camp and controlled by the Base Hygiene Section.

In June 1943 anti-typhus vaccine became available to 2 NZEF. There was insufficient vaccine available at first to immunise the whole of 2 NZEF, so priority in this form of protection was given to hospital staffs who might have been exposed to risks in nursing patients, and to hygiene personnel whose work brought them into contact with lousy natives. As more vaccine was supplied the whole force was inoculated. Most were inoculated prior to their move to Italy in October 1943 with three doses at weekly intervals, and 'booster' doses were given in Italy every six months.

Clinical Features

Early in 1943 the Consultant Physician 2 NZEF, Colonel Boyd, was asked by the DMS 2 NZEF to investigate the typhus epidemic as far as circumstances would permit, and he was fortunate in being able to make an extensive tour with the Director-General of Health in the Egyptian Government, covering many native villages around Cairo, Benha, Tanta and Alexandria. They visited the isolation hospitals and numerous emergency tented hospitals, and out of some thousand cases personally examined close on four hundred.

The clinical features of these cases were very similar to those encountered amongst the few cases admitted to New Zealand General Hospitals. In many cases there is a prodromal period of slight pyrexia and malaise lasting twenty-four to forty-eight hours. The temperature then drops to normal and the patient feels perfectly fit. Some twenty-four to thirty-six hours later the true fever develops.

The onset is sudden, the temperature rising rapidly to fairly high levels, 102 to 105 degrees F., and the patient at once feels very ill. He has generalised aches and pains, and often, but not always, some degree of headache, usually frontal. To begin with, the pulse is usually in keeping with the temperature, but later becomes relatively slow. By the second or third day the face is congested and the eyes suffused. The tongue soon becomes dry and coated; by the eighth or ninth day it is almost diagnostic of the disease—dry with a dirty brown or blackish fur, and tremulous. The patient at this stage is usually unable to protrude it, and his speech is thick and indistinct. Most patients are dull or stupid by the second day and delirium may occur at any stage.

The rash appears on the fourth or fifth day, first on the sides of the chest and abdomen, and quickly spreads over the trunk and limbs. It consists of dirty pink blotches of varying size and tiny punctate dark red petechiae. By the ninth or tenth day most patients are quite deaf, and the limbs are tremulous. The more toxic case lapses into a 'typhoid' state, like that of typhoid fever, but without the tumid abdomen. The spleen is palpably enlarged in only 25 per cent of cases.

The temperature drops about the twelfth to fourteenth day, usually by a rapid lysis. Numerous variations have been described in the type of temperature chart, but they are of little or no diagnostic or prognostic significance.

The disease may be suspected, but cannot be diagnosed with certainty till the rash appears. The white blood count gives no help, and the Weil-Felix reaction gives no help at the time it is really wanted.

There was during the war no specific treatment. Good nursing was the main essential. Sulphonamides and penicillin were useful for secondary infections but seemed to have no effect on the disease itself.

In Italy the New Zealand Division's anti-typhus measures were increased. The mobile shower unit of 4 Field Hygiene Company was busily engaged in showering an average of 450 men a day, and the company's disinfestor was used for the disinfestation of clothing and blankets, while the Mobile Laundry and Bath Unit functioned to capacity. The establishment of 4 Field Hygiene Company was revised in the summer of 1944 to include the anti-malaria control units, with the provision that they become anti-typhus sections in winter when there was a threat of typhus. In the winter of 1944 these sections carried out a limited spraying of divisional sleeping quarters with DDT, and 4 Field Hygiene Company constructed a power dusting unit for the dusting of all showered soldiers and their clothing. Supplies of

DDT-impregnated shirts became available and were issued to troops more likely to be exposed to risk of infection, while arrangements were made with the Laundry Unit for the dusting of blankets before re-issue. Anti-louse powders were readily available. Louse infestation in the Division increased in the winter of 1944, but no cases of typhus occurred among New Zealand troops during the time they were in Italy.

There was an epidemic of typhus among civilians in Naples from December 1943 to February 1944, but it was speedily terminated by rigorous methods of control. At the time the city was placed out of bounds to New Zealand troops who were in the area prior to attacking Cassino, but members of other forces on duty in the city escaped infection by carrying out adequate preventive measures. There were 1600 civilian cases but no British Army cases other than one deserter.

The lesson learned in Naples was that, even under conditions ideal for the spread of typhus such as existed in Naples, typhus can be quickly and effectively controlled by the energetic search for cases and contacts, the large-scale use of insecticide powders applied inside clothing by dust guns, the enforcement of routine preventive measures such as restriction of travel, closure of public places, and intensive propaganda which encouraged a lousy population to crowd into dusting stations. An army, even when employing large numbers of civilians, can live and work in an overcrowded, typhus-ridden city with freedom from infection, provided preventive measures are conscientiously carried out.

One of the powder insecticides used was AL 63, containing derris and naphthalene, and it was found effective for louse control but DDT (dichlor-diphenyl-trichlorethane) was found to be superior by reason of its more persistent action and also because it was non-irritating.

Pacific

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WAR SURGERY AND MEDICINE

[SECTION]

EPIDEMIC louse-borne typhus has decimated armies and profoundly influenced campaigns over the centuries. Typhus claimed tens of thousands of Napoleon's Grand Army when he marched to Moscow. True to its traditions, typhus appeared in the first six months of the First World War, in the Balkan and Eastern areas, and subsequently in nearly all the countries and areas of Europe affected by the war, with the notable exceptions of France, Belgium, and Italy. Its scourges exceeded those of any other epidemic disease during the war, but British troops, although operating in areas where the disease was endemic, and in contact with infected allies and enemy, suffered little from typhus. Preventive measures were responsible for this freedom from the disease. Mortality was over 20 per cent in those small groups of British troops who did contract typhus. There was no typhus on Gallipoli, and there is no record of any cases of typhus among the troops of 1 NZEF, although there were outbreaks of the disease in Egypt and Palestine.

In the Second World War typhus again claimed thousands of victims on the Russian front, both Russian and German. With British troops their experience of the First World War was repeated—preventive measures again limited their cases to a small number. The full set of circumstances required for the outbreak or spread of an epidemic of typhus are lousiness, overcrowding, undernourishment, and filth. Where the care of troops and personal hygiene eliminates these conditions there is little danger of epidemic typhus, provided contacts with a poor local population are strictly limited.

Among New Zealand troops overseas in the Second World War there were only isolated cases of typhus. The greatest threat of an epidemic was to those prisoners of war in Lamsdorf camp, Germany, when some twenty cases developed among the 10,000 Allied prisoners there, but an epidemic was prevented by persuading the German authorities to allow the British medical officers to institute comprehensive control measures.

INCIDENCE IN 2 NZEF

Incidence in 2 NZEF

In Egypt and other countries of the Middle East the troops of 2 NZEF were always subject to the danger of contracting typhus fever. In times of peace there were usually between two and three thousand cases of louse-borne typhus in Egypt. The poverty and miserable living conditions of the town dwellers favoured its propagation. The epidemic was seasonal, occurring annually between January and May, with its peak about April. During the war, as was also the case in the First World War, the incidence rose. In 1940 there were 4500 cases, and 9000 cases the next year. In 1942 the epidemic began as early as November, and by February 1943 the incidence had already passed the previous year's peak, and there was a sizeable epidemic in the civilian population.

For military reasons little publicity was given to the 1943 epidemic in Egypt, and most soldiers did not realise the risks involved in contacts with the native population, although general information on the control of typhus was published in 2 NZEF Orders in December 1942. In 2 NZEF there were six cases, with four deaths, at this period. The previous year there had been three cases, with two deaths, and then in October 1943 there were two cases, both of whom recovered. In 1944 and 1945 there were no New Zealand cases. The incidence was low but the mortality was high. Typhus also occurred among civilians in Syria and North Africa, and in the latter area one of our medical officers contracted it.

It is quite possible that there were cases of typhus not diagnosed and therefore not reported as such, and that the mortality was really lower. In June 1943, on the occasion of death from typhus in one of our hospitals, the Consultant Physician reported: 'There were in hospital at this time three cases of "PUO" in which the clinical features strongly suggested mild epidemic typhus. It is apt to be forgotten that the younger the patient, the milder an attack of typhus is, as a general rule, and cases with scanty rash, or no rash at all, can quite easily be missed. The completed temperature chart, when the disease is over, will often give a clue to what the correct diagnosis was, and it is not too late even then to get a positive Weil-Felix reaction.'

The care of troops in the provision of good living conditions, adequate ablution, shower and laundry facilities, and a high standard of personal cleanliness maintained by the troops, reduced louse infestation to a minimum. There was a possible chance of infection by inhalation of dust contaminated with dry louse excreta, and avoidance of close association with natives was important.

Native labourers employed in Maadi base camp were compulsorily showered and their clothing disinfected each week, an elaborate delousing station being built at the entrance to the camp and controlled by the Base Hygiene Section.

In June 1943 anti-typhus vaccine became available to 2 NZEF. There was insufficient vaccine available at first to immunise the whole of 2 NZEF, so priority in this form of protection was given to hospital staffs who might have been exposed to risks in nursing patients, and to hygiene personnel whose work brought them into contact with lousy natives. As more vaccine was supplied the whole force was inoculated. Most were inoculated prior to their move to Italy in October 1943 with three doses at weekly intervals, and 'booster' doses were given in Italy every six months.

CLINICAL FEATURES

Clinical Features

Early in 1943 the Consultant Physician 2 NZEF, Colonel Boyd, was asked by the DMS 2 NZEF to investigate the typhus epidemic as far as circumstances would permit, and he was fortunate in being able to make an extensive tour with the Director-General of Health in the Egyptian Government, covering many native villages around Cairo, Benha, Tanta and Alexandria. They visited the isolation hospitals and numerous emergency tented hospitals, and out of some thousand cases personally examined close on four hundred.

The clinical features of these cases were very similar to those encountered amongst the few cases admitted to New Zealand General Hospitals. In many cases there is a prodromal period of slight pyrexia and malaise lasting twenty-four to forty-eight hours. The temperature then drops to normal and the patient feels perfectly fit. Some twenty-four to thirty-six hours later the true fever develops.

The onset is sudden, the temperature rising rapidly to fairly high levels, 102 to 105 degrees F., and the patient at once feels very ill. He has generalised aches and pains, and often, but not always, some degree of headache, usually frontal. To begin with, the pulse is usually in keeping with the temperature, but later becomes relatively slow. By the second or third day the face is congested and the eyes suffused. The tongue soon becomes dry and coated; by the eighth or ninth day it is almost diagnostic of the disease—dry with a dirty brown or blackish fur, and tremulous. The patient at this stage is usually unable to protrude it, and his speech is thick and indistinct. Most patients are dull or stupid by the second day and delirium may occur at any stage.

The rash appears on the fourth or fifth day, first on the sides of the chest and abdomen, and quickly spreads over the trunk and limbs. It consists of dirty pink blotches of varying size and tiny punctate dark red petechiae. By the ninth or tenth day most patients are quite deaf, and the limbs are tremulous. The more toxic case lapses into a 'typhoid' state, like that of typhoid fever, but without the tumid abdomen. The spleen is palpably enlarged in only 25 per cent of cases.

The temperature drops about the twelfth to fourteenth day, usually by a rapid lysis. Numerous variations have been described in the type of temperature chart, but they are of little or no diagnostic or prognostic significance.

The disease may be suspected, but cannot be diagnosed with certainty till the rash appears. The white blood count gives no help, and the Weil-Felix reaction gives no help at the time it is really wanted.

There was during the war no specific treatment. Good nursing was the main essential. Sulphonamides and penicillin were useful for secondary infections but seemed to have no effect on the disease itself.

In Italy the New Zealand Division's anti-typhus measures were increased. The mobile shower unit of 4 Field Hygiene Company was busily engaged in showering an average of 450 men a day, and the company's disinfestor was used for the disinfestation of clothing and blankets, while the Mobile Laundry and Bath Unit functioned to capacity. The establishment of 4 Field Hygiene Company was revised in the summer of 1944 to include the anti-malaria control units, with the provision that they become anti-typhus sections in winter when there was a threat of typhus. In the winter of 1944 these sections carried out a limited spraying of divisional sleeping quarters with DDT, and 4 Field Hygiene Company constructed a power dusting unit for the dusting of all showered soldiers and their clothing. Supplies of DDT-impregnated shirts became available and were issued to troops more likely to be exposed to risk of infection, while arrangements were made with the Laundry Unit for the dusting of blankets before re-issue. Anti-louse powders were readily available. Louse infestation in the Division increased in the winter of 1944, but no cases of typhus occurred among New Zealand troops during the time they were in Italy.

There was an epidemic of typhus among civilians in Naples from December 1943 to February 1944, but it was speedily terminated by rigorous methods of control. At the time the city was placed out of bounds to New Zealand troops who were in the area prior to attacking Cassino, but members of other forces on duty in the city escaped infection by carrying out adequate preventive measures. There were 1600 civilian cases but no British Army cases other than one deserter.

The lesson learned in Naples was that, even under conditions ideal for the spread of typhus such as existed in Naples, typhus can be quickly and effectively controlled by the energetic search for cases and contacts, the large-scale use of insecticide powders applied inside clothing by dust guns, the enforcement of routine preventive measures such as restriction of travel, closure of public places, and intensive propaganda which encouraged a lousy population to crowd into dusting stations. An army, even when employing large numbers of civilians, can live and work in an overcrowded, typhus-ridden city with freedom from infection, provided preventive measures are conscientiously carried out.

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CHAPTER 9
Hookworm (Ankylostomiasis)

HUMAN ankylostomiasis is caused mainly by two species of blood-sucking nematodes —Ankylostoma duodenale and Necator americanus. Both are found on the mainland of Northern Australia, in New Guinea, and in most of the Pacific Islands. The nematodes attach themselves to the mucous membrane of the duodenum and jejunum and cause small haemorrhages. The eggs are passed in the faeces and develop as they are passed and in the soil, especially in hot, moist conditions, into filariform larvae. These infect man commonly by burrowing through the hair follicles of the skin of exposed parts, and sometimes by ingestion. When skin invasion occurs, the larvae travel by the blood to the lungs, then burst into the alveoli and so reach the oesophagus and alimentary canal. Eggs appear in the stools seven to ten weeks after skin infection.

The symptoms consist of (a) ground itch, generally seen in the feet, and less commonly in the arms, producing intense itchiness, redness, brawny swelling and a papular and vesicular eruption lasting two weeks; (b) upper abdominal symptoms; (c) anaemia. In mild cases no symptoms may arise before six months and then consist only of mild dyspepsia and fatigue. In severe cases symptoms may develop in ten to twenty weeks with marked fatigue and fainting attacks, and possibly some enlargement of the liver. The skin and nails may be dry, and oedema of the feet and ankles and puffiness of the face are common. Circulatory changes with rapid weak pulse and dilatation of the heart occur. The digestion is upset and constipation is the rule, with at times intermittent diarrhoea. The blood changes consist of an anaemia of hypochromic microcytic type, at times severe. Eosinophilia is the rule, ranging from 10 to 40 per cent, less marked in chronic cases.

Diagnosis is made either by routine stool examination, or by the detection of eosinophilia, or else by a history of ground itch, anaemia and dyspepsia.

Treatment consists in giving antihelminthic drugs. Three are commonly used: tetrachlorethylene, carbon tetrachloride, oil of chenapodium. The latter is commonly used in conjunction with either of the others. The drugs are given on an empty stomach, generally first thing in the morning, followed by a saline purge.

Tetrachlorethylene is the least toxic, and no ill effects have been noticed in the free use of the drug, even in the forward areas. Anaemia is treated by giving a well-balanced and liberal high-protein diet and also iron in large doses.

Prophylaxis consists of the prevention of skin infection by wearing boots at all times, especially on river banks and the seashore, by camping only on clean ground, and by the protection of water and food supplies from contamination.

2 NZEF (IP) Experience

The occupation of Nissan Island led to the development of hookworm in a considerable percentage of the New Zealand troops involved. Early in April 1944 a large proportion of the men of 30 Battalion were beginning to complain of vague gastro-intestinal symptoms, consisting chiefly of malaise, upper abdominal pain, anorexia, nausea and vomiting, general apathy, and loss of energy. This led to an investigation, including the taking of blood counts, the latter disclosing the presence of eosinophilia varying from 6 to 62 per cent, anything above 5 per cent being treated as abnormal. The battalion had spent five months in static occupation of Vella Lavella, and had landed on Nissan in the middle of February, living in a primitive condition in the jungle for the first fortnight's fighting. The natives of the island were known to be heavily infected with hookworm.

Of the 661 men examined, 32 per cent were shown to have eosinophilia above 5 per cent. A group of those with high eosinophil counts was evacuated to 2 NZ CCS for further investigation, which showed that ankylostomiasis was the most likely cause of the symptoms and the eosinophilia, but only 10 per cent of the cases revealed ova in the stools, probably due to the short interval following infection. A survey was then carried out of all cases of New Zealand troops on Nissan and blood films examined by the Field Ambulances. The evacuation of all cases of eosinophilia to Guadalcanal was thought to be unwarranted, and treatment was carried out on Nissan by the RMOs, 4 c.c. of tetrachlorethylene being administered, followed by magnesium sulphate aperient, with no untoward results. A number of men with high eosinophil counts were evacuated to New Zealand in returning drafts without treatment.

Approximately 2700 troops were evacuated before their differential count could be carried out. Of the 4169 men examined, 884 showed eosinophilia greater than 5 per cent, which was 21 per cent of the total examined. On this basis there would have been 567 untreated eosinophilias in the 2700 troops sent back to New Zealand. The degree of eosinophilia in the 884 cases was:

	Eosinophilia Percentage				
	6-10	11-20	21-30	31-40	40 and over
Percentage of positive cases	47	34	12	5	2

Three battalions (30, 35 and 37), the units most exposed, produced 574 cases, nearly two-thirds of the total of 884.

A report on the survey stated that during the first eight days of fighting all troops were sleeping on the ground, and 90 per cent complained of a papular, sometimes a pustular, rash about the ankles. The percentage in the companies affected by eosinophilia varied from 15 to 50 per cent, the higher percentage being in those engaged in combat. Clinically the severity of the symptoms varied considerably, the most characteristic being epigastric pains, loss of appetite, and ankle rash. Colonel Sayers, the Consultant in Tropical Diseases, considered that the rash that was noted on Nissan was probably not associated with the ankylostoma, and that the eosinophilia may not all have been due to the infection. He pointed out that hookworm did not necessarily cause eosinophilia, while other intestinal worms did. However, he considered that the symptoms of the Nissan cases strongly suggested hookworm infection. An American division after twelve months in the South-West Pacific had an average of 46 per cent of eosinophilia, and of those cases 56 per cent had hookworm ova in the stool on one examination, and 76 per cent after two examinations.

A survey was carried out at 4 General Hospital, New Caledonia, by Lieutenant-Colonel M. Williams and Captain M. W. A. Gatman of the patients who had been on Nissan Island. Two groups were investigated. One was a group of 54 found on Nissan to have more than 5 per cent eosinophil cells and treated at 2 NZ CCS, where hookworm ova were found in the stools in only three instances. In blood counts at 4 General Hospital on 46 of the cases, eosinophils showed a significant decrease in 9 cases, a significant increase in 8 cases, and no change in 25 cases, with 8 indeterminate. The range of eosinophils had changed from 6 to 62 per cent to 2 to

40 per cent, and the average from 15.5 per cent to 14.3 per cent. Up to three stool examinations in the 54 cases showed 14 men with abnormal intestinal parasitology —strongyloidiasis, 6; ankylostomiasis, 3; trichuriasis, 2; amoebiasis, 3. The other group comprised 80 cases who had all been on Nissan, of whom half had had blood examinations without eosinophilia being found and half had had no previous investigation. In 12 of these cases the eosinophil count exceeded 5 per cent, the range being 6 to 23 per cent and the average 10.9 per cent. Stool examinations in this group revealed trichuriasis in 5 cases and amoebiasis in 3. The general picture of this survey was confused by the variability of the subjects, but it was thought that probably a high proportion of cases of eosinophilia were not due to hookworm infestation.

Future of the Infection in New Zealand

Colonel Sayers considered there was little danger of hookworm infestation being spread in New Zealand by returning troops. The ova were not infective, and the infective filariform larvae did not develop for five days following excretion, so that re-infection of the individual or infection of other people by contamination of food handled by an infected person could not occur. The only method of infection was through the skin, or by eating food contaminated by the larvae. Hookworm normally die out gradually in the bowel, the maximum egg production occurring in six months, and the egg count dropped by 92 per cent in five years. Only when a sewerage system or septic tank was not used would any danger of spread arise. The only possibility of trouble might be in mines.

The experience of the Pacific Force showed the necessity to be on the alert for the development of hookworm infestation, although in its experience no serious trouble arose.

WAR SURGERY AND MEDICINE

[SECTION]

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CHAPTER 10
Cerebro-spinal Fever and Meningitis

MENINGOCOCCAL meningitis (cerebro-spinal fever) is essentially a primary infection which occurs often in epidemics and has therefore to be guarded against in a mobilised military population. On the other hand, acute meningitis caused by bacteria other than the meningococcus is almost always sporadic and is usually secondary to infection elsewhere, or to an injury to, or an operation on, the head.

Factors contributing to the susceptibility of young soldiers to meningococcal meningitis are the communal living and change of environment with the transfer from civil to military life, and the fatigue incidental to military training under varying conditions of weather. Circumstances tending to lower the resistance of the individual, such as previous attacks of disease, especially of influenza, may be considered predisposing causes. Therefore overcrowding, bad ventilation, chill and over-fatigue should be guarded against in troops.

Cerebro-spinal fever, which was made a notifiable disease in New Zealand in 1907, came into prominence in the First World War. There was a mild epidemic of the disease in the civil population in 1915 and 1916 and an outbreak of an aberrant type in Trentham Camp in July 1915, when there were 32 cases with 22 deaths. The camp was closed, but was reopened for a restricted number of troops in the summer months after the epidemic had subsided. In July 1916, after an outbreak of febrile catarrh, and later of measles, cerebro-spinal fever reappeared in the two principal camps. It became epidemic in August, but died out gradually in the summer months. In all, 51 cases with 36 deaths were recorded.

Between the wars the incidence of the disease in New Zealand declined. It rose again in 1941 and became epidemic in 1942, when 932 cases were recorded with 116 deaths. Of this total, 85 cases occurred in military camps. The incidence and fatality rates in the Army were not out of proportion to the civilian rates. (There had been epidemics in England in 1940 and 1941.) In later years the disease again abated.

In 2 NZEF in the Middle East no epidemic of cerebro-spinal fever occurred—a satisfactory achievement. Sporadic cases totalling fewer than fifty were recorded in a period of five years, with only one death. The remarkable reduction in the mortality rate compared with the First World War was due to the introduction of the sulphonamides. When penicillin was introduced it was equally effective as a treatment.

Pneumococcal Meningitis

This form of meningitis frequently occurs as a primary condition, but is sometimes secondary to a form of pneumococcal infection elsewhere—the middle ear, the accessory sinuses of the nose, the lungs—or as part of a pneumococcal septicaemia. In the primary form, a nasal catarrh frequently precedes the onset of meningitis, which is, as a rule, somewhat sudden.

In July 1943 the Consultant Physician 2 NZEF reported the recovery of a case of pneumococcal meningitis. Recovery in such cases was exceedingly rare and this was thought to be the first such case which had recovered in a New Zealand General Hospital. This soldier had been treated with intravenous sulphadiazine, and, in addition, sulphapyridine by mouth.

At this date there had been five deaths in 2 NZEF from pneumococcal meningitis, and there were two deaths after this date.

Results in other forces indicated that pneumococcal meningitis often failed to respond to sulphonamides, but treatment with penicillin produced better results.

Other Types of Meningitis

There were only a few cases of any other types in 2 NZEF and they were not severe. In August 1944 there were some twenty cases of a mild lymphocytic meningitis. Meningitic signs were obvious in each case at admission, and the cerebro-spinal fluid showed an increase in lymphocytes, but was always sterile on culture. The cases all made a rapid recovery.

There were a few deaths from streptococcal meningitis associated with mastoiditis, and from meningitis associated with peritonitis. Meningitis in all its forms, including tubercular, accounted for 18 deaths in 2 NZEF in the Middle East—the highest single cause of death from disease. In the Pacific Force it caused no deaths. This compares favourably with 1 NZEF overseas, which had 115 deaths from meningitis (109 from cerebro-spinal type), excluding tubercular meningitis.

Recommendations on Treatment by Consultant Physician 2 NZEF, July 1943

Meningitis

Cerebro-spinal (Meningococcal)

M & B 693 (Sulphapyridine)

For the first 3 days a total of 8–10 gms. daily.

For the next 6 days a total of 3 gms. daily.

Thus—1st day: 1st and 2nd doses 4 tabs each then 2 tabs every 4 hours.

2nd and 3rd day: 6 doses of 3 tabs every 4 hours.

4th to 9th day: 6 doses of 1 tab each every 4 hours.

In fulminating cases or with vomiting, use Sulphapyridine soluble—

First dose: 1 gm. in saline intravenously.

and the same dose intramuscularly.

Second dose: 1 gm. intramuscularly 4 hours later.

After six days' treatment, a daily leucocyte count to forestall agranulocytosis.

During treatment: 4 to 6 pints of fluid daily, and some alkali, e.g. sod-bicarb. No purges; enemas or liquid paraffin, if required. Symptomatic treatment as required.

Pneumococcal and Pyogenic

Sulphadiazine—10 c.c. of a 30 per cent sol. (3 gms.) in P. aeq. normal saline intravenously—

2 injections daily for 4 days.

1 injection daily 5th and 6th days.

The drug is obtainable in 10 c.c. ampoules. Instructions given by ME say the drug requires no further dilution. This, in our experience, obliterates the veins by thrombosis, and soon no suitable vein can be found. Fluids, etc., as in the meningococcal variety.

We have reason to believe that while Sulphadiazine may clear pneumococci out of the CNS [central nervous system], the blood may still act as a reservoir—e.g., a case, apparently cured of pneumococcal meningitis, and after ten days of apparent normal convalescence, suddenly developed rigors and died of acute pneumococcal endocarditis. We have since used in addition to Sulphadiazine from the 4th day onwards, M & B 693 in the same way as in pneumonia.

MENINGOCOCCAL meningitis (cerebro-spinal fever) is essentially a primary infection which occurs often in epidemics and has therefore to be guarded against in a mobilised military population. On the other hand, acute meningitis caused by bacteria other than the meningococcus is almost always sporadic and is usually secondary to infection elsewhere, or to an injury to, or an operation on, the head.

Factors contributing to the susceptibility of young soldiers to meningococcal meningitis are the communal living and change of environment with the transfer from civil to military life, and the fatigue incidental to military training under varying conditions of weather. Circumstances tending to lower the resistance of the individual, such as previous attacks of disease, especially of influenza, may be considered predisposing causes. Therefore overcrowding, bad ventilation, chill and over-fatigue should be guarded against in troops.

Cerebro-spinal fever, which was made a notifiable disease in New Zealand in 1907, came into prominence in the First World War. There was a mild epidemic of the disease in the civil population in 1915 and 1916 and an outbreak of an aberrant type in Trentham Camp in July 1915, when there were 32 cases with 22 deaths. The camp was closed, but was reopened for a restricted number of troops in the summer months after the epidemic had subsided. In July 1916, after an outbreak of febrile catarrh, and later of measles, cerebro-spinal fever reappeared in the two principal camps. It became epidemic in August, but died out gradually in the summer months. In all, 51 cases with 36 deaths were recorded.

Between the wars the incidence of the disease in New Zealand declined. It rose again in 1941 and became epidemic in 1942, when 932 cases were recorded with 116 deaths. Of this total, 85 cases occurred in military camps. The incidence and fatality rates in the Army were not out of proportion to the civilian rates. (There had been epidemics in England in 1940 and 1941.) In later years the disease again abated.

In 2 NZEF in the Middle East no epidemic of cerebro-spinal fever occurred—a satisfactory achievement. Sporadic cases totalling fewer than fifty were recorded in a period of five years, with only one death. The remarkable reduction in the mortality rate compared with the First World War was due to the introduction of the sulphonamides. When penicillin was introduced it was equally effective as a treatment.

PNEUMOCOCCAL MENINGITIS

Pneumococcal Meningitis

This form of meningitis frequently occurs as a primary condition, but is sometimes secondary to a form of pneumococcal infection elsewhere—the middle ear, the accessory sinuses of the nose, the lungs—or as part of a pneumococcal septicaemia. In the primary form, a nasal catarrh frequently precedes the onset of meningitis, which is, as a rule, somewhat sudden.

In July 1943 the Consultant Physician 2 NZEF reported the recovery of a case of pneumococcal meningitis. Recovery in such cases was exceedingly rare and this was thought to be the first such case which had recovered in a New Zealand General Hospital. This soldier had been treated with intravenous sulphadiazine, and, in addition, sulphapyridine by mouth.

At this date there had been five deaths in 2 NZEF from pneumococcal meningitis, and there were two deaths after this date.

Results in other forces indicated that pneumococcal meningitis often failed to respond to sulphonamides, but treatment with penicillin produced better results.

OTHER TYPES OF MENINGITIS

Other Types of Meningitis

There were only a few cases of any other types in 2 NZEF and they were not severe. In August 1944 there were some twenty cases of a mild lymphocytic meningitis. Meningitic signs were obvious in each case at admission, and the cerebro-spinal fluid showed an increase in lymphocytes, but was always sterile on culture. The cases all made a rapid recovery.

There were a few deaths from streptococcal meningitis associated with mastoiditis, and from meningitis associated with peritonitis. Meningitis in all its forms, including tubercular, accounted for 18 deaths in 2 NZEF in the Middle East—the highest single cause of death from disease. In the Pacific Force it caused no deaths. This compares favourably with 1 NZEF overseas, which had 115 deaths from meningitis (109 from cerebro-spinal type), excluding tubercular meningitis.

RECOMMENDATIONS ON TREATMENT BY CONSULTANT PHYSICIAN 2 NZEF, JULY 1943 — MENINGITIS

Recommendations on Treatment by Consultant Physician 2 NZEF, July 1943

Meningitis

Cerebro-spinal (Meningococcal)

M & B 693 (Sulphapyridine)

For the first 3 days a total of 8–10 gms. daily.

For the next 6 days a total of 3 gms. daily.

Thus—1st day: 1st and 2nd doses 4 tabs each then 2 tabs every 4 hours.

2nd and 3rd day: 6 doses of 3 tabs every 4 hours.

4th to 9th day: 6 doses of 1 tab each every 4 hours.

In fulminating cases or with vomiting, use Sulphapyridine soluble—

First dose: 1 gm. in saline intravenously.

and the same dose intramuscularly.

Second dose: 1 gm. intramuscularly 4 hours later.

After six days' treatment, a daily leucocyte count to forestall agranulocytosis.

During treatment: 4 to 6 pints of fluid daily, and some alkali, e.g. sod-bicarb. No purges; enemas or liquid paraffin, if required. Symptomatic treatment as required.

Pneumococcal and Pyogenic

Sulphadiazine—10 c.c. of a 30 per cent sol. (3 gms.) in P. aeq. normal saline intravenously—

2 injections daily for 4 days.

1 injection daily 5th and 6th days.

The drug is obtainable in 10 c.c. ampoules. Instructions given by ME say the drug requires no further dilution. This, in our experience, obliterates the veins by thrombosis, and soon no suitable vein can be found. Fluids, etc., as in the meningococcal variety.

We have reason to believe that while Sulphadiazine may clear pneumococci out of the CNS [central nervous system], the blood may still act as a reservoir—e.g., a case, apparently cured of pneumococcal meningitis, and after ten days of apparent normal convalescence, suddenly developed rigors and died of acute pneumococcal endocarditis. We have since used in addition to Sulphadiazine from the 4th day onwards, M & B 693 in the same way as in pneumonia.

CHAPTER 11
Poliomyelitis

ADESCRIPTION of an epidemic amongst 2 NZEF troops in Egypt from November 1940 to July 1941 was given by Majors Caughey and Porteous. There were 40 cases, with 4 deaths and 19 cases of paralysis.

The cases were spread widely throughout the base camps, but three battalions supplied the majority of them. There was no correlation with the incidence of dysentery and no indication of the method of spread.

The incidence was higher than in civilian epidemics in New Zealand, but the course milder. The commonest symptoms were headache, neck rigidity, backache, dry tongue, and vomiting. Cases with high fever were generally more severe in type.

Paralysis generally ensued in four to six days, and though more common in the leg was almost as common in the trunk and arm. It was not so common as in the New Zealand civilian epidemics, when nearly three-quarters of the cases developed paralysis. The cerebro-spinal fluid findings showed marked variation in the cell counts, which varied in type. As the disease progressed the cell count fell as polymorphonuclear cells were displaced by lymphocytes.

The conclusions arrived at were:

The seasonal incidence was similar to New Zealand experience.

The early symptoms gave no clue to the seriousness of the attack.

Apart from the fact that all the patients were adults, that the incidence was high, and the disease very mild, there was no cardinal difference from the epidemics of the disease in New Zealand experiences.

Nothing was learnt with regard to the mode of the spread of infection, though spread by intestinal infection was suspected in many cases.

Apart from this epidemic there was no serious outbreak, only occasional cases arising during the remainder of the war in 2 NZEF. Altogether there were 3 cases in

1940, 41 cases in 1941, 5 in 1942, 8 in 1943, 3 in 1944, and 6 in 1945—of which 4 occurred in August. In all, there were 66 cases with 8 deaths.

CHAPTER 12
Diphtheria

IN the Middle East diphtheria occurred as a seasonal disease during the months of November to March. Among New Zealand troops the incidence was low, except for two epidemics at 1 NZ General Hospital, at Helwan, Egypt, in December 1942, and at Senigallia, Italy, in the winter of 1944–45. In addition there were increased admissions at 2 NZ General Hospital in December 1941 and at 3 NZ General Hospital in February 1944. In the most serious epidemic, that at Senigallia in 1944, when over 150 cases were diagnosed, routine swabbing revealed four carriers on the hospital staff. In connection with the outbreak it was noted that many Italian children were suffering from diphtheria and were in close contact at times with New Zealand troops who were living in houses in the divisional sector. These epidemics involved both faucial and cutaneous diphtheria. In the Middle East true cutaneous diphtheria was rarely found, except in units where faucial infection was also present. Therefore, when diphtheria appeared in a medical unit, carriers (faucial and nasal) had to be sought and wound-dressing technique carefully scrutinised. Preparatory to invaliding to New Zealand by hospital ship in December 1942, a convoy of 161 cases was submitted to routine swabbing of wounds. Twenty-two swabs were returned positive for KLB (Klebs-Loeffler bacilli), but virulence tests were positive in only two cases. These latter cases were temporarily retained in Egypt.

On other occasions, and notably in the outbreak at Senigallia, a number of gunshot wounds were infected and the healing process protracted.

A possible complication in diphtheria cases was post-diphtheritic polyneuritis, of which there were in 2 NZEF 2 cases in 1942, 4 in 1943, 5 in 1944, and 13 in 1945. Though infection of gunshot wounds with the bacillus of diphtheria was rare, except at Senigallia, it was not uncommon to find various skin lesions with an infection of this nature. The organism responsible for the paralysis was found on various occasions in desert sores, the lesion of scabies, or even in an infected pile or ingrowing toenail. Apart from possible paralysis, it was found the cutaneous diphtheria caused a very great delay in the healing of a wound or lesion. Diphtheria bacilli in wounds caused more than local effects; when toxin was absorbed, paresis and death might follow unless full doses of anti-toxin were given at an early stage.

A full bacteriological examination, including a virulence test of any diphtheria-like organism that might be recovered, was essential in every case before a diagnosis of cutaneous diphtheria could be made. Diphtheroids or diphtheria-like bacilli were commonly found in a variety of superficial skin lesions, and it was most important, therefore, that the virulence of all such organisms should be checked.

On some occasions diphtheritic ulcers could be distinguished by oedema round the wound edges and blackened or yellowish-grey crusts or membrane in the wound, associated with blood-stained sero-purulent discharge and regional lymphadenitis. But clinical appearances were variable and the possibility of diphtheria had always to be remembered, when, after apparent initial healing, a wound developed a serous discharge and became necrotic. In some serious burn cases diphtheritic infection occurred without the characteristic wound appearances.

The incidence of diphtheria among New Zealand troops in the Pacific was low and complications were rare, but tropical ulcers had to be considered a potential diphtheria hazard until proved innocent by appropriate cultures, and, whenever possible, by virulence tests. Several cases of cutaneous diphtheria were diagnosed among patients admitted to 2 NZ CCS from Vella Lavella in January 1944.

Recommendations made by Consultant Physician 2 NZEF in July 1943

The great majority of the cases of diphtheria in this country (Egypt) are mixed infections—diphtheria bacilli and streptococci.

In diagnosis, do not rely upon the appearance of the throat alone. Take everything into consideration—the general condition of the patient, the degree of prostration and the toxaemia, glandular enlargement, albuminuria, the smell of the breath. Give anti-toxin at once, if there is the slightest suspicion of diphtheria. Don't wait for examination of the swab. If the swab should be negative in a suspicious case, ignore it.

Anti-toxin—a single large dose given early is better than repeated smaller doses. Give 40,000 units for an average case and three or four times this dose for a severe case. Anti-streptococcal serum may be required as well, and also sulphanilamide.

Cutaneous Diphtheria

Has probably been just as commonly the cause of post-diphtheritic paralysis or peripheral neuritis as the faucial type.

Infected sores, desert sores, etc., if there is the slightest suspicion of diphtheria, must be promptly treated with anti-toxin.

It was recognised that the type of diphtheria experienced in the Middle East tended often to be of a very virulent nature, and was readily picked up by those who were susceptible.

In 2 NZEF it was considered desirable that all nursing sisters and voluntary aids should be Schick-tested and, if necessary, immunised. As fresh reinforcements of sisters and nurses arrived overseas from time to time, and as supplies of Schick-testing and immunising material were not always immediately available there, the Consultant Physician 2 NZEF suggested that the immunisation of susceptibles be attended to in New Zealand prior to placing on the overseas roll.

This raises the question of the desirability of immunisation in the future for members of the services, firstly for sisters and voluntary aids, then for other medical personnel and for other service personnel generally.

In November 1943 a nurse died of severe faucial diphtheria, with an associated streptococcal infection complicated by myocarditis and cardiac failure.

There were two deaths, one from diphtheria and one from diphtheritic infection of a wound, in October 1941, and one from diphtheritic polyneuritis in June 1943.

In Italy diphtheria presented peculiar or unusual features, but there were no deaths. For example, multiple ulcers in the natal cleft were found to be due to Klebs-Loeffler infection and cleared up quickly with anti-toxin; a case of faucial diphtheria developed palatal paralysis on the fourth day of his illness; another case treated within twelve hours of onset with ample anti-toxin developed very extensive polyneuritis. The number of hospital admissions in 2 NZEF MEF and CMF, July 1941 to December 1945, recorded were faucial diphtheria, 339; nasal diphtheria, 23; while a group of 180 included unspecified diphtheria, cutaneous cases and carriers. There were four deaths.

Invalided to New Zealand

January 1942	Diphtheria, 1.
January 1945	Ischio-rectal abscess with diphtheritic infection, 1.
February 1945	Diphtheritic infection, 1.
March 1945	Polyneuritis diphtheritic, 1.
January 1946	Diphtheria, faucial, 1.

Epidemic, 1 NZ General Hospital (Italy)

—	Faucial	Cutaneous	Polyneuritis	Clinical D	Nasal	Wound Infections	Total
Sep 1944	1	1					
Oct 1944	2	3	1				
Nov 1944	6			10			
Dec 1944	14	3			3		
Jan 1945	15	4					
Routine Swabbing (Majority Carriers) 3–14 Feb	4	5			17	27	
	52	16	1	10	20	27	126

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CHAPTER 13
Pyrexia of Unknown Origin

AN inquiry was made in August 1943 by Colonel J. R. Boyd into the relative frequency of the non-committal 'diagnosis' PUO. The term was essentially a provisional diagnosis which lasted only until such time as the correct nature of the illness had been elucidated by clinical examination. It was a handy way of classifying many fevers which, in the early stages, might resemble any one of many different feverish conditions, and where an early definite diagnosis would be largely guesswork. There were two main groups.

The first group was a comparatively large one and was made up of all those short-term fevers whose onset and clinical course presented no special distinguishing features and where the whole illness was over and recovery complete in a matter of perhaps twenty-four to ninety-six hours. These cases were held and treated in forward medical units and returned direct to duty without further evacuation down the line. The provisional diagnosis thus became the final diagnosis and was registered accordingly in the Field Medical Card 3118.

The second group consisted of those cases which remained feverish for more than four or five days. Some more serious condition had to be thought of and they were evacuated to the base hospital for investigation. They represented a considerable number, but in most of them diagnosis was readily made with the facilities available in hospital. The minority were the unexplainable few who remained undiagnosed after the exhaustion of almost every accessory aid to diagnosis.

In our base hospitals we made it a rule not to give a definite name to any case of fever unless and until clinical evidence completely justified the diagnosis. Furthermore, it was our practice in all such cases never to make a final diagnosis of PUO without having first excluded, by repeated physical examinations and the help of all relevant laboratory tests, malaria, relapsing fever, the enteric group of fevers, tuberculosis, meningitis, and septicaemia. Influenza was usually fairly easily excluded.

It was said that sandfly fever had to some extent taken the place of PUO as a ready diagnosis, and that in this way the total cases of PUO registered were less than they should have been. This affected the position in two ways, and it was possible that the one cancelled out the other. It had to be admitted that not infrequently an early diagnosis of sandfly fever had to be corrected later on in the light of fresh evidence, and this lent support to the contention that the diagnosis might have been too readily made. As a matter of fact the clinical picture of sandfly fever was not just as clean-cut and easy to distinguish with certainty as textbooks depicted it. Nevertheless, the converse was also probably true. Except in the presence of an epidemic, many medical officers hesitated to diagnose sandfly fever, preferring to label the case PUO. Colonel Boyd was inclined to think that the boot was on the other foot, and that the majority of the short-term fevers which recovered before diagnosis was made were, in fact, cases of phlebotomus fever (sandfly fever).

In 2 NZEF, between June 1941 and December 1942, a large number of cases of PUO were dealt with in forward medical units. [1] Some 364 of these were able to return direct to their units without being evacuated farther than to a Field Ambulance or Casualty Clearing Station. The diagnosis of PUO was registered on the Form 3118 and was the only diagnosis. Of a considerable number whose illness was of sufficient duration or severity to make evacuation to hospital advisable, only in 25 was it found impossible to make a diagnosis, and the final diagnosis remained PUO.

Of the 364 cases returned to their units, 44 had blood films examined by a mobile laboratory unit with negative findings. In 47 per cent the fever lasted approximately three days; in 49 per cent approximately five days, and in only 4 per cent did it last longer than five days.

Eighty-five per cent of the cases occurred during the summer months, June to October. The incidence thus appeared to be seasonal, and suggested a relationship to atmospheric temperature and insect life. The incidence in different units appeared to be fairly evenly distributed.

Clinical Features

Three-day Fever: The onset was usually sudden with generalised aches and pains; frontal headache; soreness of the eyes or pain on lateral movement of the eyes. Severe backache was not infrequent, and sweating was common.

Five-day Fever: The symptoms were very similar, but the course was more prolonged, and loss of appetite was more complete.

Although a few blood films were examined to exclude malaria and relapsing fever, only a very few white blood counts were done. Although the impression was that leucopenia was the commoner finding, the estimations were too few in number to permit of any definite conclusions being drawn.

Over five days: In those cases where the fever lasted over five days, some were six, some eight, and some ten-day fevers. There was nothing distinctive in the clinical features, but the patients were more ill. Some looked almost like cases of typhoid, but suddenly the illness came to an end.

In none of the three groups was there any respiratory symptoms, and this was one of the main features which differentiated these short-term fevers from influenza.

In only 2.7 per cent of the cases was the spleen palpably enlarged. In none was neck rigidity a feature.

The cases which had to be evacuated to hospital, and in which a diagnosis was made later, consisted of a great variety of different conditions. The commonest were otitis media, sinusitis, prostatitis, pyelitis, rheumatic fever, catarrhal enteritis, bacillary dysentery and infective hepatitis.

Of the 25 cases which remained undiagnosed when recovery was complete, 5 were well by the time the base hospital was reached, and in another 5 the temperature became normal before time permitted full investigations to be made. In these cases only blood film examinations and white blood counts had been done.

In the remaining 15 the fever, calculated from the day of admission to hospital, lasted from seven to twenty-five days, and in one case there was intermittent fever for seven weeks. In each of these cases full investigations were made: repeated blood films; total and differential blood counts; agglutination reactions; cultures from blood, stools, urine; sedimentation rate; and, where indicated, the chest was X-rayed, the histamine test and icterus index done, and in some the Weil-Felix test.

Complete physical examinations were repeated regularly. One feature which the cases all had in common was a leucopenia with a slight relative diminution of polymorpho-nuclear cells. The total count was in no case higher than 7200. The usual was about 4000–5000 with 50–60 per cent of polymorphs.

In such cases it seemed clear that we should continue to adopt the honest course of making no definite diagnosis and that the term PUO was the most fully descriptive one.

In 2 NZEF in the period July 1941 to December 1945 there were 2848 admissions to medical units with a diagnosis of PUO, and these made up 3.55 per cent of all sick admissions.

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[1] It was not possible to obtain accurate figures of the total number.

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CLINICAL FEATURES

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Five-day Fever: The symptoms were very similar, but the course was more prolonged, and loss of appetite was more complete.

Although a few blood films were examined to exclude malaria and relapsing fever, only a very few white blood counts were done. Although the impression was that leucopenia was the commoner finding, the estimations were too few in number to permit of any definite conclusions being drawn.

Over five days: In those cases where the fever lasted over five days, some were six, some eight, and some ten-day fevers. There was nothing distinctive in the clinical features, but the patients were more ill. Some looked almost like cases of typhoid, but suddenly the illness came to an end.

In none of the three groups was there any respiratory symptoms, and this was one of the main features which differentiated these short-term fevers from influenza.

In only 2.7 per cent of the cases was the spleen palpably enlarged. In none was neck rigidity a feature.

The cases which had to be evacuated to hospital, and in which a diagnosis was made later, consisted of a great variety of different conditions. The commonest were otitis media, sinusitis, prostatitis, pyelitis, rheumatic fever, catarrhal enteritis, bacillary dysentery and infective hepatitis.

Of the 25 cases which remained undiagnosed when recovery was complete, 5 were well by the time the base hospital was reached, and in another 5 the temperature became normal before time permitted full investigations to be made. In these cases only blood film examinations and white blood counts had been done.

In the remaining 15 the fever, calculated from the day of admission to hospital, lasted from seven to twenty-five days, and in one case there was intermittent fever for seven weeks. In each of these cases full investigations were made: repeated blood films; total and differential blood counts; agglutination reactions; cultures from blood, stools, urine; sedimentation rate; and, where indicated, the chest was X-rayed, the histamine test and icterus index done, and in some the Weil-Felix test.

Complete physical examinations were repeated regularly. One feature which the cases all had in common was a leucopenia with a slight relative diminution of polymorpho-nuclear cells. The total count was in no case higher than 7200. The usual was about 4000–5000 with 50–60 per cent of polymorphs.

In such cases it seemed clear that we should continue to adopt the honest course of making no definite diagnosis and that the term PUO was the most fully descriptive one.

In 2 NZEF in the period July 1941 to December 1945 there were 2848 admissions to medical units with a diagnosis of PUO, and these made up 3.55 per cent of all sick admissions.

CHAPTER 14
Respiratory Diseases

IT is not possible from the available records to reach any conclusion about the total incidence of infections of the respiratory tract in 2 NZEF. Acute coryza was universally prevalent, as it is in civil life. All but the most severe cases endured their discomforts philosophically and inevitably spread the infection to others. Canadian estimates of the loss of training time from acute respiratory disorders suggest that familiarity alone does not excuse a complacent attitude. Under training conditions it is possible that more energetic treatment and isolation where practicable would be well rewarded not only in shortening the period of relative disability and preventing complications in individual sufferers, but also in reducing the incidence of such infections in large bodies of troops.

Influenza

The term 'influenza' was usually applied to short-term pyrexia, associated with symptoms of respiratory tract infection and occurring in epidemic form. Several outbreaks occurred in training camps in New Zealand, but only two of any significance among the troops of 2 NZEF. In March 1940 influenza occurred among the newly-arrived First Echelon in Egypt. A more serious epidemic involved the troops of the 5th Reinforcements travelling to the Middle East. In anticipation, all patients from 3 NZ General Hospital were transferred to 2 NZ General Hospital. When the convoy arrived on 13 May 1941 a special ambulance train took 290 cases of influenza, including 5 with pneumonia, direct to 3 NZ General Hospital. The incoming troops were segregated on arrival. A further 35 cases occurred in the next forty-eight hours, but the epidemic quickly abated and remained localised as a result of these precautions. There were no deaths from influenza in 2 NZEF.

There was a much higher incidence of influenza among troops in New Zealand than in those overseas, especially in the first half of the war. There was a widespread epidemic in the three main mobilisation camps in October 1939, and the numbers in each of the units of the First Echelon varied from 25 to 54 per cent of the strength of the units. The average period spent by the cases in camp hospitals was four days. It was found that the initial incidence was higher in tented units and that there was an improvement when extra tents were erected and the number per tent reduced from eight to six men. Factors lowering the resistance of the troops were, besides a certain overcrowding in tents and huts, dust arising from construction work in the camps, and the giving of TAB inoculations two or three weeks after the troops entered camp. Unit commanders were reminded of necessary preventive measures, including adequate air space and ventilation in sleeping quarters, provision for changes of wet clothing and ample drying facilities, and the avoidance of undue fatigue by graduated training.

It is recorded that there were 4685 cases of influenza from the main camps between January and September 1940, and in the winter of 1941 influenza was again very prevalent but mild in nature. In the winter of 1942, when many troops were mobilised for Home Defence, there were nearly 9000 cases recorded among troops, but the figures dropped in succeeding years to 736 in 1943, 369 in 1944, and 721 in 1945. Influenza was the most common cause of hospitalisation among troops in New Zealand. The number of deaths is not known, but for all respiratory disease from 1940 to 1944 the total deaths were only 17.

Brochitis

About 35 cases of bronchitis per month occurred in 2 NZEF during the period 1943–45. The earlier incidence was probably similar, with a tendency to increase slightly during the winter months.

Penumonia

There was, as expected, a definite relationship between the incidence of pneumonia and the wetness of the season. In March and April 1940 the incidence reached 2.8 per 1000 among troops of the First Echelon in Egypt. There were 49 cases during January and February 1941, of whom 2 died. Between 1 July 1941 and 31 March 1943 there were in all 218 cases of pneumonia, of which 164 were classified as lobar and 54 as bronchopneumonia. Six of the 164 cases of lobar pneumonia died (3.6 per cent). Many cases developed a serous effusion, but only in three did this proceed to empyema (1.8 per cent). The reduction of complications and the improved prognosis were directly attributable to the effective use of sulphonamides. In the earlier cases sulphapyridine was used: later sulphathiazole was preferred on account of its equal effectiveness with lesser toxicity. The dosage given was four tablets as soon as diagnosis was made and thereafter two tablets every four hours till the temperature dropped (usually thirty-six to forty-eight hours). Then two tablets t.i.d. till the temperature had been normal for two days. (Total was usually 18–24 gms. Each tablet equals .5 grammes.) The rapid symptomatic response to chemotherapy contrasted with the slowness of complete clinical and radiological resolution.

In July and August 1943, following the Nile flood, there were 258 cases of pneumonia. These cases were very toxic, with a tendency to more patchy distribution of consolidation.

Between January and June 1944, when 2 NZEF were exposed to the rigours of an Italian winter in the Cassino area and the mountain sectors, the incidence of pneumonia reached its highest figure (4.6 per 1000 in March 1944). Similarly in March and April 1945, as the Division prepared to launch the final spring offensive in Italy, an increased incidence was observed. In both these years the majority of the cases were classified as 'primary atypical pneumonia'. A consecutive series of these cases, mainly in British troops, was closely studied at 2 NZ General Hospital during 1945. The clinical features and later agglutination studies showed that these epidemics of 'atypical pneumonia' were in fact Q fever due to infection with Rickettsia burneti. (See

Chapter 15.) These cases ran a toxic course virtually uninfluenced by chemotherapy or by penicillin, which became available to a limited extent at this stage.

In many cases of short-term pyrexia, classified clinically as 'influenza', radiological examination revealed small and slowly resolving areas of pneumonitis.

The recorded incidence of pleurisy was closely related to that of pneumonia. The number of cases was usually between 10 and 20 per cent of the number of cases of pneumonia.

It is of particular interest to compare this record of pneumonia in 2 NZEF with that of 1 NZEF during the First World War. From 1941 to 1945 there were in 2 NZEF 2012 cases of pneumonia, of whom 10 died. These figures include atypical pneumonia and Q fever, but even so the mortality (.5 per cent approximately) is in striking contrast with that observed in 1 NZEF, when of 1579 deaths from disease in 92,860 New Zealand troops, 578 were from pneumonia, 20 from pleurisy, and 152 from influenza, often with complicating pneumonia during the epidemic of 1916–17. This gives a grand total of 750 deaths from acute respiratory disease—almost 50 per cent of all deaths from disease. The conditions of active service in France in 1914–18 undoubtedly favoured respiratory infections, and the 1916–17 epidemic of influenza which heralded the pandemic of 1918 was of extreme virulence. The highest incidence of pneumonia in 2 NZEF was 4.6 per 1000 in March 1944, whereas the overall incidence in 1 NZEF was 6.1 per 1000. Even allowing for an increased incidence and greater virulence, the transformation in the mortality rate from pneumonia in the two forces is noteworthy and may reasonably be attributed largely to chemotherapy.

Hospital Admissions, 2 NZEF, MEF and CMF

	1941	1942	1943	1944	1945
Empyema	1	1	8	4	
Pleurisy			22	39	60
Pleurisy fibrinous	11	32	70	54	21
Pneumonia	267	292	504	586	363

Asthma

There has always been a tendency among medical practitioners, when all other therapeutic measures have proved unavailing, to suggest for the asthmatic a change of climate. That this attitude had contributed to the appearance of large numbers of known asthmatics in the Middle East was suggested by the fact that many of the sufferers reported that they had been assured that their asthma would not trouble them in Egypt. Early experience soon proved, however, that asthma tended to flare up in the Middle East, and recommendations were made to the medical authorities in New Zealand to exclude men with a history of asthma, mild or otherwise, from overseas drafts. Many asthmatics had to be boarded for return to New Zealand soon after arrival in Egypt. By March 1943, 146 asthmatics (3½ per cent of the total invalided) had been evacuated to New Zealand. The total number invalided during the war was 239.

Originally the policy was that every asthmatic should be sent home, since there was evidence of an increased tendency to attacks in Egypt even in asthmatics whose attacks were previously mild or infrequent. Later, as shipping space became restricted, a few of the milder cases were retained for base duties.

Asthma seldom entailed admission to hospital (only 106 cases from 1941 to 1945), though in January 1943 there were 15 cases in hospital, all from the recently arrived 8th Reinforcements. Eight of these were immediately placed on the New Zealand Roll. Some of these were definite, known asthmatics before enlistment. Others had recrudescences of asthma which had been for many years quiescent in New Zealand. Some known asthmatics were free of attacks and were able to give good service in the field. Experience showed, in general, that asthmatics and persons of allergic heredity did not react favourably to conditions in Egypt.

During the seven months from August 1942 to February 1943, 37 cases of asthma in 2 NZEF were admitted to hospital for treatment. Of these, 19 had given no field service at all and only 3 were graded fit for full duties. The Consultant Physician expressed the view that, economically, it was questionable whether it was a wise policy to keep asthmatics in the Middle East, no matter how mild their attacks might at first appear to be. Recurring asthma bred the asthmatic 'habit' and men might become chronic asthmatics with a long-term pensionable disability.

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CHAPTER 15
Q Fever

A DISEASE regarded before the war as a medical curiosity with localised distribution, Q fever came to be recognised during the war as of world-wide incidence. In 1937 Derrick described the clinical features, diagnosis, and laboratory findings of a new fever entity which he named 'Q' fever. The original cases occurred among workers in a large meat works in Brisbane. Derrick was able to transmit the infective agent to guinea pigs by the injection of blood or urine from the cases in the acute stage of the disease. The study of the infective agent was taken up by Burnet and Freeman, who established the disease in mice and isolated the infective agent which proved to be a rickettsia, subsequently named by Derrick 'the rickettsia burneti'. The clinical picture in the human cases was quite characteristic. The incubation period was fifteen days or less, and the clinical features were constant. It is noteworthy that in the original cases described by Derrick no pulmonary lesions were noted. Between September 1935 and August 1942, 176 cases were recognised. All but two occurred in males, and the ages ranged from 10 to 64 years; 129 of the cases occurred among urban dwellers and 47 in country people. All but six occurred in men connected with the cattle industry in some way or other.

Serological surveys of men working in abattoirs in Brisbane showed that the infection was very prevalent among this group of workers, many of whom had evidence in the blood of Q fever but who had had no notable illness to suggest a Q fever attack. The first record of the so-called atypical pneumonia syndrome occurring in cases with Q fever was in an epidemic described by Hornibrook and Nelson which occurred in 1940 among employees of the National Institute of Health, Washington DC.

Atypical Pneumonia and Q Fever in Second World War

Q fever was one of the two new diseases of armies that came to be recognised during the Second World War. In Italy in the winter of 1943–44 there were several epidemics of what was called primary atypical pneumonia, which are now thought to have been Q fever. This was when New Zealanders first experienced it. In February 1944 there were between 70 and 80 cases admitted to 2 NZ General Hospital at

Caserta, 48 of them arising from 7 NZ Anti-Tank Regiment, and sporadic cases from other divisional units then bivouacked 10 miles south of Cassino. Some 30 cases were evacuated to hospital from the Anti-Tank Regiment within two or three days. Most of the cases began in one battery and nearly all came from two batteries. The disease was supposed to be spread by droplet infection, but in an investigation the Consultant Physician 2 NZEF and the RMO of the unit found little to support this contention. The Consultant Physician was inclined to the view that the disease was a virus infection.

The area occupied by the unit was a morass of mud as the result of constant rain, and the men were living in square tents holding four to six men, or else in small bivouac tents. Battery Headquarters was in some Italian farm buildings, but the men had not been living in Italian houses in any numbers and their general health was first class. Cooking was by individual battery arrangements. Sanitary facilities in the area were primitive and unpleasant.

Clinically the sudden onset with severe frontal headache and prostration were the salient features of the outbreak. Another striking feature was that the early stages were characterised by a complete absence of catarrhal symptoms. There was no coryza or sinusitis, and cough was unusual in the first day or two. The cough which developed about the third day never became troublesome or painful; there was little if any sputum, and what there was was clear and mucoid. The patients for the most part were very toxic, but physical signs were scanty throughout the illness. Treatment was only symptomatic, and there was no response to sulphonamide therapy. X-ray examinations, however, revealed typical shadows which were found to persist for some weeks after apparent clinical recovery. The consolidation might be generalised, or merely at the apex or in the region of the interlobar fissure. Often the fan-shaped appearance of the consolidation was characteristic. Increased bronchial markings were also a feature. There was cellular infiltration around the alveoli and a certain amount of intra-alveolar exudation and exfoliation of epithelium.

Turner reported a similar epidemic of 280 cases from the Naples area. During the same year the Germans, who were still in occupation of Greece, had their troubles with primary atypical pneumonia, which was referred to by them as the ‘Balkan Grippe’. Dr Caminopetros of the Pasteur Institute of Greece was able to establish the infective agent in guinea pigs by injection of blood from patients in the acute stage of the illness. Subsequently blood from these guinea pigs was flown to the United States and investigated at the laboratories of the Commission on Acute Respiratory Diseases at Fort Bragg, North Carolina, and the Rickettsia burneti was isolated.

Epidemics of primary atypical pneumonia recurred in Italy in the winter of 1945 among British and United States troops. Adams, Staveley, Rolleston, Henley and Caughey recorded a study of fifty cases which occurred among New Zealand and British troops in the Caserta and Naples area. Four epidemics of a similar nature, among United States troops in northern Italy, were investigated and the R. burneti was isolated as the infective agent, and by serological tests it was established that at least three-quarters of the cases of atypical pneumonia occurring in the same area were, in fact, cases of Q fever. Details of these epidemics have been published in the American Journal of Hygiene (1946).

In May 1945 an epidemic of primary atypical pneumonia occurred in mid-Atlantic among a group of airmen who had recently been stationed at Grottaglie air base in southern Italy in the Taranto area. These were fully investigated when the airmen arrived at Camp Patrick Henry, Virginia. Epidemiological and etiological studies were made by the Commission on Acute Respiratory Diseases and it was demonstrated that the infective agent was the 'Balkan Grippe' type of the R. burneti.

Clinical Features

Clinical details of the epidemic which was investigated at 2 NZ General Hospital have been published in the British Medical Journal, 16 February 1946, Vol. 1, page 227. The principal clinical features will be here summarised.

The epidemic occurred between February and April 1945, and during this period 511 cases were reported in the area, 161 of which were treated at 2 NZ General Hospital. Fifty consecutive cases were studied in detail clinically and by serial pathological and radiological investigation. In most there was a prodromal period of about six days. The actual onset was abrupt in 96 per cent of cases. Severe headache, malaise, lassitude, and anorexia were the most constant symptoms. Pyrexia from the onset averaged 8.6 days: was over 103 degrees in 70 per cent of cases and defervescence was by lysis in 86 per cent. The pulse followed the temperature though showing a tendency to a relative bradycardia. The respiratory rate was little affected. Cough occurred about the fifth day and was present in 94 per cent, although it was not an outstanding feature. Sputum was scanty and in 28 per cent contained blood. Chest pains occurred in 46 per cent of cases. (These symptoms were similar to those of the patients treated in 2 NZ General Hospital a year previously.)

Severe toxaemia was a feature of some and one-third showed generalised rhonchi on admission, but the most characteristic sign was a localised patch of sticky persistent crepitations heard on an average on the sixth day from the onset of the acute symptoms. Pleural friction occurred in 26 per cent of those with chest pains. There was usually enlargement of glands and the spleen was palpable in 36 per cent of cases. Scanty small pink macules fading on pressure were observed on the chest, back, and flanks in the early stages of the disease in 34 per cent of cases.

The results of serial pathological investigation can be summarised in brief. The white count revealed a slight polymorphonuclear response, followed by a slight depression which was maximal at the end of the first week. Thereafter there was a rise of polymorphs and lymphocytes, reaching a peak at the sixteenth to eighteenth day. Differential counts showed a slight relative lymphocytosis after the initial period. The blood sedimentation rate was elevated for two to three weeks. Cephalin-cholesterol flocculation was insignificant early in the disease, but increased rapidly after convalescence had been established in the second week, thereafter falling slowly. Using horse cells, a significant positive heterophil antibody reaction was found in 36 per cent of the cases at some stage of the disease. All but three, which were weakly positive, gave negative tests for cold agglutinins at all stages of the disease.

Posterior-anterior and lateral X-ray studies were made in all cases. The characteristic findings were the localisation of the lesion to one or more broncho-pulmonary segments. The infiltrations could be described as hazy, mottled densities. These investigations also revealed the importance of the lateral studies for the demonstrations of lesions situated behind the heart shadow or in that portion of the lung situated behind the summit of the dome of the diaphragm. In the majority complete radiological resolution occurred within six weeks of the onset. No specific treatment was found to be of any use and sulphonamides had no effect.

Serological investigation of some of these cases was carried out two years later by Caughey and Dudgeon. Sera from twenty of the cases were tested for complement fixation against antigen prepared from a strain of the Rickettsia burneti isolated in Italy. Nineteen gave a positive complement fixation test. The sera were also tested for antibody to the virus of psittacosis, and all were negative. In view of these findings, it seemed reasonable to assume that the infective agent in these cases was the Italian strain of the Rickettsia burneti.

Epidemiological Studies

1. In Australia epidemiologcal studies revealed a widespread incidence of the Rickettsia burneti. The native rodent, the bandicoot, was found to be susceptible, and evidence of latent infection was found in other bush animals, in water rats, other native rats, and also in cows. The Rickettsia burneti was isolated from ticks (haemaphysalis humerosa) collected from the bandicoots, and the faeces of these infected ticks were found to be highly infectious and capable of infecting guinea pigs when applied to the skin. In Derrick's opinion, this tick, the H. humerosa, is the vector among bandicoots. This tick was readily infected with the R. burneti by feeding on infected guinea pigs. The infection was transmitted from larvae to nymph, and from nymph to adult. The R. burneti were found to be confined to the lumen of the gut and faeces were heavily infected. Three other ticks could also be infected— rhipecephalus sanguinius, ixodes holocyclus, and haemaphysalis bispinosa—by feeding on infected guinea pigs, and could transmit infection to their host. Each, therefore, is a potential vector, and Derrick's conclusion is that the haemaphysalis bispinosa is the probable source of the human infection in Queensland and that the mode of infection is by inhalation of infected faecal dust from these ticks.
2. In Italy the possible route and sources of infection were examined in detail in some of the northern Italian epidemics, and although no vectors, such as ticks or fleas, were incriminated, it was found that the disease often made its appearance in units occupying farm billets and where men were living in close proximity to animals such as cattle, rats, and also pigeons. Various forms of mites were discovered in several of these billets, but it was thought that cases probably occurred by inhalation infection arising from the dust and droppings. The complete absence of any insect bites in any of the cases, and also the uniform picture of pulmonary involvement, suggested that the route of infection was via the upper respiratory tract, such as probably occurred in the laboratory infection with the same agent (Robbins and Rustigan, 1946), and which is also seen in at least laboratory infections with other rickettsial diseases such as epidemic murine

and scrub typhus. It was also found that many of the civilian population in the area where these cases occurred showed a high level of antibody to Q fever, suggesting that the infection was endemic in the local population.

3. In the New Zealand hospital cases most of the patients came from a British infantry training depot where men were living in hutments and where there was a rapid turnover of personnel. The staff of the hospital escaped lightly. A strict isolation technique was carried out in the wards until the temperature had been normal for a week, or until productive cough had ceased. The regimental aid post orderly, who treated men daily from the infantry training depot, and the hospital librarian who visited the wards, both contracted the disease, but no case occurred among nurses who were nursing the cases.

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WAR SURGERY AND MEDICINE

[SECTION]

A DISEASE regarded before the war as a medical curiosity with localised distribution, Q fever came to be recognised during the war as of world-wide incidence. In 1937 Derrick described the clinical features, diagnosis, and laboratory findings of a new fever entity which he named 'Q' fever. The original cases occurred among workers in a large meat works in Brisbane. Derrick was able to transmit the infective agent to guinea pigs by the injection of blood or urine from the cases in the acute stage of the disease. The study of the infective agent was taken up by Burnet and Freeman, who established the disease in mice and isolated the infective agent which proved to be a rickettsia, subsequently named by Derrick 'the rickettsia burneti'. The clinical picture in the human cases was quite characteristic. The incubation period was fifteen days or less, and the clinical features were constant. It is noteworthy that in the original cases described by Derrick no pulmonary lesions were noted. Between September 1935 and August 1942, 176 cases were recognised. All but two occurred in males, and the ages ranged from 10 to 64 years; 129 of the cases occurred among urban dwellers and 47 in country people. All but six occurred in men connected with the cattle industry in some way or other.

Serological surveys of men working in abattoirs in Brisbane showed that the infection was very prevalent among this group of workers, many of whom had evidence in the blood of Q fever but who had had no notable illness to suggest a Q fever attack. The first record of the so-called atypical pneumonia syndrome occurring in cases with Q fever was in an epidemic described by Hornibrook and Nelson which occurred in 1940 among employees of the National Institute of Health, Washington DC.

ATYPICAL PNEUMONIA AND Q FEVER IN SECOND WORLD WAR

Atypical Pneumonia and Q Fever in Second World War

Q fever was one of the two new diseases of armies that came to be recognised during the Second World War. In Italy in the winter of 1943–44 there were several epidemics of what was called primary atypical pneumonia, which are now thought to have been Q fever. This was when New Zealanders first experienced it. In February 1944 there were between 70 and 80 cases admitted to 2 NZ General Hospital at Caserta, 48 of them arising from 7 NZ Anti-Tank Regiment, and sporadic cases from other divisional units then bivouacked 10 miles south of Cassino. Some 30 cases were evacuated to hospital from the Anti-Tank Regiment within two or three days. Most of the cases began in one battery and nearly all came from two batteries. The disease was supposed to be spread by droplet infection, but in an investigation the Consultant Physician 2 NZEF and the RMO of the unit found little to support this contention. The Consultant Physician was inclined to the view that the disease was a virus infection.

The area occupied by the unit was a morass of mud as the result of constant rain, and the men were living in square tents holding four to six men, or else in small bivouac tents. Battery Headquarters was in some Italian farm buildings, but the men had not been living in Italian houses in any numbers and their general health was first class. Cooking was by individual battery arrangements. Sanitary facilities in the area were primitive and unpleasant.

Clinically the sudden onset with severe frontal headache and prostration were the salient features of the outbreak. Another striking feature was that the early stages were characterised by a complete absence of catarrhal symptoms. There was no coryza or sinusitis, and cough was unusual in the first day or two. The cough which developed about the third day never became troublesome or painful; there was little if any sputum, and what there was was clear and mucoid. The patients for the most part were very toxic, but physical signs were scanty throughout the illness. Treatment was only symptomatic, and there was no response to sulphonamide therapy. X-ray examinations, however, revealed typical shadows which were found to persist for some weeks after apparent clinical recovery. The consolidation might be generalised, or merely at the apex or in the region of the interlobar fissure. Often the fan-shaped appearance of the consolidation was characteristic. Increased bronchial markings were also a feature. There was cellular infiltration around the alveoli and a certain amount of intra-alveolar exudation and exfoliation of epithelium.

Turner reported a similar epidemic of 280 cases from the Naples area. During the same year the Germans, who were still in occupation of Greece, had their troubles with primary atypical pneumonia, which was referred to by them as the 'Balkan Grippe'. Dr Caminopetros of the Pasteur Institute of Greece was able to establish the infective agent in guinea pigs by injection of blood from patients in the acute stage of the illness. Subsequently blood from these guinea pigs was flown to the United States and investigated at the laboratories of the Commission on Acute Respiratory Diseases at Fort Bragg, North Carolina, and the Rickettsia burneti was isolated.

Epidemics of primary atypical pneumonia recurred in Italy in the winter of 1945 among British and United States troops. Adams, Staveley, Rolleston, Henley and Caughey recorded a study of fifty cases which occurred among New Zealand and British troops in the Caserta and Naples area. Four epidemics of a similar nature, among United States troops in northern Italy, were investigated and the R. burneti was isolated as the infective agent, and by serological tests it was established that at least three-quarters of the cases of atypical pneumonia occurring in the same area were, in fact, cases of Q fever. Details of these epidemics have been published in the American Journal of Hygiene (1946).

In May 1945 an epidemic of primary atypical pneumonia occurred in mid-Atlantic among a group of airmen who had recently been stationed at Grottaglie air base in southern Italy in the Taranto area. These were fully investigated when the airmen arrived at Camp Patrick Henry, Virginia. Epidemiological and etiological studies were made by the Commission on Acute Respiratory Diseases and it was demonstrated that the infective agent was the 'Balkan Grippe' type of the R. burneti.

CLINICAL FEATURES

Clinical Features

Clinical details of the epidemic which was investigated at 2 NZ General Hospital have been published in the British Medical Journal, 16 February 1946, Vol. 1, page 227. The principal clinical features will be here summarised.

The epidemic occurred between February and April 1945, and during this period 511 cases were reported in the area, 161 of which were treated at 2 NZ General Hospital. Fifty consecutive cases were studied in detail clinically and by serial pathological and radiological investigation. In most there was a prodromal period of about six days. The actual onset was abrupt in 96 per cent of cases. Severe headache, malaise, lassitude, and anorexia were the most constant symptoms. Pyrexia from the onset averaged 8.6 days: was over 103 degrees in 70 per cent of cases and defervescence was by lysis in 86 per cent. The pulse followed the temperature though showing a tendency to a relative bradycardia. The respiratory rate was little affected. Cough occurred about the fifth day and was present in 94 per cent, although it was not an outstanding feature. Sputum was scanty and in 28 per cent contained blood. Chest pains occurred in 46 per cent of cases. (These symptoms were similar to those of the patients treated in 2 NZ General Hospital a year previously.)

Severe toxaemia was a feature of some and one-third showed generalised rhonchi on admission, but the most characteristic sign was a localised patch of sticky persistent crepitations heard on an average on the sixth day from the onset of the acute symptoms. Pleural friction occurred in 26 per cent of those with chest pains. There was usually enlargement of glands and the spleen was palpable in 36 per cent of cases. Scanty small pink macules fading on pressure were observed on the chest, back, and flanks in the early stages of the disease in 34 per cent of cases.

The results of serial pathological investigation can be summarised in brief. The white count revealed a slight polymorphonuclear response, followed by a slight depression which was maximal at the end of the first week. Thereafter there was a rise of polymorphs and lymphocytes, reaching a peak at the sixteenth to eighteenth day. Differential counts showed a slight relative lymphocytosis after the initial period. The blood sedimentation rate was elevated for two to three weeks. Cephalin-cholesterol flocculation was insignificant early in the disease, but increased rapidly after convalescence had been established in the second week, thereafter falling slowly. Using horse cells, a significant positive heterophil antibody reaction was found in 36 per cent of the cases at some stage of the disease. All but three, which were weakly positive, gave negative tests for cold agglutinins at all stages of the disease.

Posterior-anterior and lateral X-ray studies were made in all cases. The characteristic findings were the localisation of the lesion to one or more broncho-pulmonary segments. The infiltrations could be described as hazy, mottled densities. These investigations also revealed the importance of the lateral studies for the demonstrations of lesions situated behind the heart shadow or in that portion of the lung situated behind the summit of the dome of the diaphragm. In the majority complete radiological resolution occurred within six weeks of the onset. No specific treatment was found to be of any use and sulphonamides had no effect.

Serological investigation of some of these cases was carried out two years later by Caughey and Dudgeon. Sera from twenty of the cases were tested for complement fixation against antigen prepared from a strain of the Rickettsia burneti isolated in Italy. Nineteen gave a positive complement fixation test. The sera were also tested for antibody to the virus of psittacosis, and all were negative. In view of these findings, it seemed reasonable to assume that the infective agent in these cases was the Italian strain of the Rickettsia burneti.

EPIDEMIOLOGICAL STUDIES

Epidemiological Studies

1. In Australia epidemiologcal studies revealed a widespread incidence of the Rickettsia burneti. The native rodent, the bandicoot, was found to be susceptible, and evidence of latent infection was found in other bush animals, in water rats, other native rats, and also in cows. The Rickettsia burneti was isolated from ticks (haemaphysalis humerosa) collected from the bandicoots, and the faeces of these infected ticks were found to be highly infectious and capable of infecting guinea pigs when applied to the skin. In Derrick's opinion, this tick, the H. humerosa, is the vector among bandicoots. This tick was readily infected with the R. burneti by feeding on infected guinea pigs. The infection was transmitted from larvae to nymph, and from nymph to adult. The R. burneti were found to be confined to the lumen of the gut and faeces were heavily infected. Three other ticks could also be infected— rhipecephalus sanguinius, ixodes holocyclus, and haemaphysalis bispinosa—by feeding on infected guinea pigs, and could transmit infection to their host. Each, therefore, is a potential vector, and Derrick's conclusion is that the haemaphysalis bispinosa is the probable source of the human infection in Queensland and that the mode of infection is by inhalation of infected faecal dust from these ticks.
2. In Italy the possible route and sources of infection were examined in detail in some of the northern Italian epidemics, and although no vectors, such as ticks or fleas, were incriminated, it was found that the disease often made its appearance in units occupying farm billets and where men were living in close proximity to animals such as cattle, rats, and also pigeons. Various forms of mites were discovered in several of these billets, but it was thought that cases probably occurred by inhalation infection arising from the dust and droppings. The complete absence of any insect bites in any of the cases, and also the uniform picture of pulmonary involvement, suggested that the route of infection was via the upper respiratory tract, such as probably occurred in the laboratory infection with the same agent (Robbins and Rustigan, 1946), and which is also seen in at least laboratory infections with other rickettsial diseases such as epidemic murine and scrub typhus. It was also found that many of the civilian population in the area where these cases occurred showed a high level of antibody to Q fever, suggesting that the infection was endemic in the local population.
3. In the New Zealand hospital cases most of the patients came from a British infantry training depot where men were living in hutments and where there was a rapid turnover of personnel. The staff of the hospital escaped lightly. A strict isolation technique was carried out in the wards until the temperature had been

normal for a week, or until productive cough had ceased. The regimental aid post orderly, who treated men daily from the infantry training depot, and the hospital librarian who visited the wards, both contracted the disease, but no case occurred among nurses who were nursing the cases.

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CHAPTER 16
Pulmonary Tuberculosis

BETWEEN the First and Second World Wars the development of mass radiography of the chest gave a new method of control of pulmonary tuberculosis in the forces. Chest X-ray of recruits during the Second World War ensured that a number were rejected who would otherwise have become centres of infection in the services, and themselves liable to hospitalisation and possible death. In 1 NZEF overseas there were 149 deaths from tuberculosis, whereas in 2 NZEF overseas there were only four deaths, two from miliary infection, and, as far as is known, only four deaths among the 8000 New Zealand prisoners of war.

Radiography of the chest has also removed the association of neurosis with tuberculosis. After the First World War, in addition to frank pulmonary tuberculosis cases, there were cases which physicians considered probably cases of tuberculosis, but as the physical signs were not definite and sputum was negative, they were classified as cases of 'chronic pulmonary disease indeterminate' (CPDI). These cases were often treated in sanatoria. They were warned against too much physical exercise until fit for it, and altogether it was impressed upon them that they were invalids. But they did not get progressively worse or change over the years, and when later radiography of the chest became possible it was seen there was little, if any, lung disease in these cases and these men might have returned to work long before. However, for too long they had been taught to be patients and had been in receipt of full pension. Many of them were still receiving pensions for neurasthenia after the Second World War. With servicemen of the Second World War there was nothing of this. Generally speaking, with modern X-ray and physical examination it is possible to determine whether a patient suffers from pulmonary tuberculosis or not.

Mass Radiography

Shortly after the start of the Second World War it was decided to X-ray the chests of all soldiers before they went overseas, but efficient equipment was lacking in certain areas, and there was a shortage of technicians, radiologists, and specialists in pulmonary tuberculosis. By the time arrangements had been made the First Echelon had sailed, and not many of the Second Echelon could be examined.

(This point is important, as will be seen in the discussion on incidence.) Thereafter most members of the forces were X-rayed as part of their initial medical examination or else while they were in training camp. Later, chest X-rays were taken on discharge from the forces.

Mass radiography was introduced in order to eliminate the recruit likely to be useless and a burden to the service. It was a rapid and efficient method of detecting latent tuberculosis, and reduced the number requiring specialist examination. In spite of the strain under which they worked, the radiologists missed very few cases, although medical histories could not be made available to them. When microfilm came into use later in the war extra checks on large films were made in 5 per cent of cases.

Between two and three recruits per thousand were rejected on account of an active tuberculous lesion, and these were in men otherwise reported as fit after medical examinations. Many hundreds of cases reported on at enlistment as showing abnormalities relating to tubercular infection, but accepted as having no active disease, served through the war and never had any symptoms of the disease. The methods adopted were justified. Although 71 cases taken into the Army overseas with some evidence of old or latent infection were later diagnosed as suffering from active pulmonary tuberculosis, on the average they gave several years service and 25 were detected only at discharge. If a policy of doubt and fear had been adopted in all suspicious cases the services would have lost many recruits. Great care is required that unnecessary invalidism is not created by mass radiography.

All cases showing radiological abnormality were referred for boarding to specialists in disorders of the chest. Cases of active tuberculosis, however slight, were totally rejected; others with inactive lesions were in some instances graded for limited military duties in New Zealand.

The benefits of routine radiography have been amply emphasized by a survey of records of over 100,000 apparently normal recruits. It was found that the incidence of active pulmonary tuberculosis was 2.4 per 1000—a figure which compares favourably with that obtained from similar surveys in other countries. Reliance on clinical examination alone permitted detection of active tuberculosis in only 3.6 per cent, and suspicion of active tuberculosis in a further 3.2 per cent of the cases subsequently proved to be tuberculous. In other words, in 93.2 per cent clinical examination was negative, and only routine radiography raised the suspicion for subsequent confirmation by specialist boards. These figures speak for themselves, yet probably do not give an accurate assessment of the true incidence of detectable clinical signs. The conditions under which initial medical boards are of necessity conducted are not ideal for careful auscultation. In any case, the knowledge that a routine X-ray was to follow probably prompted and in part justified a relatively cursory examination of the chest by medical examiners working in adverse conditions. In the small group of cases detected or suspected clinically most had a bad family history, gross symptoms, or obvious physical signs; 33 per cent were Maoris.

2 NZEF

Tuberculosis did not constitute any great problem in 2 NZEF. At no time was the incidence high enough to cause any difficulty in management. The cases were, of course, segregated when diagnosed, and returned to New Zealand by the next hospital ship when the condition of the patient was considered to be satisfactory enough to stand the journey. The infectious disease ward of the Maunganui, though small, was always able to accommodate all the tuberculosis cases. There were 115 cases of pulmonary tuberculosis invalided back to New Zealand from 2 NZEF in MEF and CMF during the war. More cases were discovered by routine X-ray at discharge, or became ill after return to civil life, than revealed active symptoms during their service with 2 NZEF.

The Navy

For some years before the war, and prior to the introduction of X-ray examinations at entry, it had been found that the incidence in the Royal Navy was considerably higher than that of the Army and Royal Air Force. From the inception of the New Zealand Division of the Royal Navy the local incidence had caused no particular concern until just before the war, when seven cases occurred in two years in the Achilles. Certain suggestions for the better ventilation of living and working spaces in the Achilles and Leander could not be put into effect owing to the outbreak of hostilities and the employment of the cruisers on active operations with increased complements.

From the end of 1940 X-ray examination of the chest was part of the standard naval recruiting procedure. Of the 117 cases of pulmonary tuberculosis which occurred in male RNZN personnel between 1 September 1939 and 21 December 1946, the chest X-rays had been clear on entry in 87 cases. This indicated that too much reliance should not be placed on the initial X-ray examination. The conditions of shipboard life make it necessary to keep the closest watch for any signs or symptoms that might point to tuberculosis. Early recognition and segregation of suspects is essential. Repeat X-rays and vaccination would seem desirable. A careful study of the cases occurring in continuous service personnel of the RNZN before and during the war showed that a significantly large number were members of the same initial training classes. The early training period involved closer common contacts than in any subsequent period of naval service, and it was suggested that some of these groups contained individuals from whom the infection was spread.

Pensions Survey

In 1949 Dr D. Macdonald Wilson made a survey of pulmonary tuberculosis among New Zealand service personnel, embracing all the cases that had occurred in the ten-year period 1939–49 in a military population of 200,000 medically examined and passed fit for service, of whom about 134,000 served outside New Zealand. In the main this was a specially selected population, but, on the other hand, chest X-rays at discharge from the services, plus pensions applications later, resulted in nearly all those developing tuberculosis being brought within the compass of the review. Up to 31 December 1949, 1412 cases had applied for pension, while there had been 8 deaths on service overseas and 30 among servicemen in New Zealand. Included were 193 cases of pleurisy with effusion. Approximately 37.5 per cent of the cases took ill on service, 42.5 per cent were diagnosed by routine X-ray (usually at discharge), and 20 per cent became ill after discharge from service.

It was found that whereas the Army and Air Force produced numbers roughly corresponding to their relative strengths, the Navy had almost double the number of cases on a comparative basis. This emphasized the fact that exposure to infection rather than the physical hardships of a campaign is the greater cause of tuberculosis in the services. The naval authorities early became aware of this, and routine surveys by X-ray were carried out as frequently as possible, thus enabling many unsuspected cases of active tuberculosis to be diagnosed.

The importance of X-ray at enlistment was emphasized by the higher incidence among those army personnel of the first two echelons who were not X-rayed in 1939–40. The members of the Maori Battalion fortunately were nearly all X-rayed, so removing most of the potential sources of infection (16 per cent were rejected for chest conditions), and the Maoris in the services had an incidence of less than double the incidence for the whole group (13.5 against 7.4 per 1000 over the ten years), whereas in the civil population the Maori rate is nearly five times that of Europeans. By comparison with the annual civilian Maori rate of 23.5 per 1000 the rate of 13.5 per 1000 for a decade in Maoris who served overseas shows a marked reduction. (It has to be noted that on a comparative basis living conditions were much the same for Maoris and Europeans in the forces, but this is not so in civil life.)

In prisoners of war the incidence was fairly high—over 17 per 1000 over the period, but 84 of the 155 army cases had not been X-rayed on enlistment. Most of the prisoners of war were taken in the early campaigns and had entered the Army in 1939 and 1940 before the X-ray examinations were properly organised. Irrespective of prisoner-of-war privations, this group would have produced a higher incidence than the average. Of the total of 729 cases in the Army overseas, 222 were not X-rayed before going overseas. The First and Second Echelons, with 193 cases, produced an incidence of 14.3 per 1000.

The annual incidence of new civilian cases in 1948 (the lowest on record at that date) was European 0.77 and Maori 3.6 per 1000. The average annual incidence in returned service personnel for the years 1945 to 1949 was European 0.95 and Maori 1.73 per 1000. It has to be noted that the service figures were swollen by the large number of cases brought to light by X-rays taken on discharge after return from overseas in 1945 and 1946.

Results of Treatment

All will agree that the best results of treatment should be obtained in the cases diagnosed early, for whom institutional treatment if required is available without delay, and who are relieved of financial worry should it be advisable for them to cease work. Except for prisoners of war, these two latter conditions existed for service personnel, and in over 40 per cent of cases the first condition was also present as they were diagnosed by routine X-ray before the patients were aware of any illness.

In the treatment of the 1404 cases under review, some 300 required no treatment but were merely kept under observation at the chest clinics. On the other hand, in addition to inpatient observation in sanatorium or hospital required for the remaining cases, the following operative procedures were carried out:

Thoracoscopy with pneumolysis or attempted pneumolysis, 33 cases.

Artificial pneumothorax was produced in 316 cases.

Pneumo-peritoneum was used in 22 cases.

Phrenic crush or avulsion was carried out in 54 cases.

Thoracoplasty was carried out in 27 cases, and 5 cases are at present in hospital for consideration of this operation.

While the production of an artificial pneumothorax was the commonest form of active treatment, more than one of the above procedures was carried out on the same patient in certain cases.

The classifications under which the results of treatment are tabulated have been used as an interpretation of the findings and reports of medical examiners. In examining patients for reports on any indications for treatment and assessments of degrees of disablement for pensions purposes, examiners do not always use the terminology used by the Health Department. Thus, in interpreting reports, it is felt they fall under the following headings:

(1) Apparently cured, where the examiner states there is no disability and recommends cessation of pension, or suggests a permanent minimal pension for a lesion healed and stationary for some years and requiring no further observation.

(2) Quiescent cases, which on examination appear much the same as the above but, owing to the short period the condition has appeared healed, a more conservative view is taken and observation for a further period at long intervals

is recommended as a safety measure.

(3) Stabilised cases, where any evidence of progressive disease has been removed but treatment and observation are still required. Included in this group are such cases as those where 'soft' shadows have hardened and where an artificial pneumothorax wholly controls the disease but the lung is still collapsed by introduction of air. The patient is allowed to follow his occupation provided it is of not too heavy a type, and if so, he is advised to seek another job in the meantime.

(4) The active class, where the disease is still active even if responding to treatment. The patient is attending for treatment at a clinic or under domiciliary treatment.

(5) Cases in hospital or sanatorium. Admission may be temporary for special active measures in treatment or may be in certain hospitals for an indefinite period owing to extensive and progressive disease not responding to treatment.

(6) Deaths in this series of patients which may be due to pulmonary tuberculosis or other causes. There have been four deaths in the series not due to pulmonary tuberculosis.

Using the above classifications, the following table sets out the results for various groups of the services, giving the percentage in each group for total cases from 1939 to 1949.

	Apparently Cured Per Cent	Quiescent Per Cent	Stabilised Per Cent	Active Per Cent	In Hospital Per Cent	Dead Per Cent
All services, overseas and New Zealand	29.3	21.8	17.7	15	10.4	5.8
Army overseas	30.2	19.4	15.4	16.5	11.2	7.3
Cases diagnosed by routine X-ray, all services	39.6	20.4	15.6	14.2	7.1	3.1
Cases diagnosed by routine X-ray, army overseas	40	22.72	12	14.6	7.1	3.6

The 193 cases of pleurisy with effusion were included in the survey because the clinicians considered them tuberculous in origin. The results of treatment showed that cases with a sudden onset did well, whereas the rarer cases with a slow insidious onset did badly.

Females: Among females there were 45 cases, 10 with overseas service and 35 with home service only, and there was one death in the Navy in New Zealand. The large majority (29 cases) were aged 20–25. Results of treatment in this group were excellent—23 cured, 8 quiescent, 4 stabilised, 8 active, and 1 in hospital. Some 15 cases diagnosed by routine discharge X-rays had not required institutional treatment.

Conclusion

From the survey it is difficult to compare the incidence of tuberculosis among service personnel with that of the civilian population, as the survey covered a closed group composed in the main of personnel of the age group in which the incidence of tuberculosis is the highest. Taking all factors into consideration, the incidence of tuberculosis in service personnel was much the same as for the civil population. In a group of Maori servicemen it was much lower. Mass radiography reduced the spread of infection, and should always be undertaken before the admission of recruits to camps. Thus radiography, plus improved hygiene and the elimination of overcrowding, seems the best means of reducing the incidence of pulmonary tuberculosis in a military community.

Associated Disabilities Present in the Pensions Cases of Pulmonary Tuberculosis

Tuberculosis elsewhere in the body:

(a) Genito-urinary tuberculosis: 25 cases; with nephrectomy (7) and orchidectomy (4).
(b) Tuberculosis of bones: Spine, 14 cases; sternum, 4 cases; ribs, 1 case; humerus, 1 case.
(c) Joints: Elbow (5), wrist (1), sacro-iliac (3), hip (1), knee (2), and ankle (3).
(d) Tuberculous synovitis: 4 cases.
(e) Tuberculous glands: Cervical (8) and abdominal (5).
(f) Tuberculosis of bowel (1) and Peritoneum (1).
(g) Fistula in ano: 10 cases.

(h) Tuberculous periphlebitis of eyes (2).

(i) Tuberculous meningitis (2).

(j) Erythema nodosum (3).

Other conditions associated with this series of pulmonary tuberculosis are: Diabetes mellitus (6), diabetes insipidus (1), gunshot wound involving the lung (3), dyspepsia (10), duodenal ulcer (22), gastric ulcer (3), anxiety neurosis (25).

Table I: Incidence of Pulmonary Tuberculosis in the Army, Overseas Only

Year of Onset of Pulmonary Tuberculosis	Year Entered Service 1939	1940	1941	1942	1943	1944	1945	Annual Totals
1939								
1940	8							8
1941	7	31	5					43
1942	5	25	7					37
1943	24	51	14	7				96
1944	22	67	21	15	2			127
1945	29	111	44	13	9	2		208
1946	7	47	27	25	4	3		113
1947	6	20	9	4	0	0		39
1948	4	17	6	6	1	0		34
1949	0	14	7	1	0	1	1	24
Total of cases according to enlistment years	112	383	140	71	16	6	1	729

Table II: Prisoners of War who Developed Pulmonary Tuberculosis
(Numbers of cases are shown according to year of enlistment and year of onset of disease.)

Year of Onset of Disease	Year of Enlistment 1939	1940	1941	1942	1943	Annual Totals
1939						
1940						
1941	1	3				4
1942	3	7				10
1943	0	7	1			8

1944	6	14	2		1	23
1945	22	42	6			70
1946	3	9	0			12
1947	3	11	0			14
1948	2	3	1			6
1949	1	6	1			8
Total according to year of enlistment	41	102	11	0	1	155 *

* Total does not include 4 deaths while PW.

[SECTION]

BETWEEN the First and Second World Wars the development of mass radiography of the chest gave a new method of control of pulmonary tuberculosis in the forces. Chest X-ray of recruits during the Second World War ensured that a number were rejected who would otherwise have become centres of infection in the services, and themselves liable to hospitalisation and possible death. In 1 NZEF overseas there were 149 deaths from tuberculosis, whereas in 2 NZEF overseas there were only four deaths, two from miliary infection, and, as far as is known, only four deaths among the 8000 New Zealand prisoners of war.

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MASS RADIOGRAPHY

Mass Radiography

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Mass radiography was introduced in order to eliminate the recruit likely to be useless and a burden to the service. It was a rapid and efficient method of detecting latent tuberculosis, and reduced the number requiring specialist examination. In spite of the strain under which they worked, the radiologists missed very few cases, although medical histories could not be made available to them. When microfilm came into use later in the war extra checks on large films were made in 5 per cent of cases.

Between two and three recruits per thousand were rejected on account of an active tuberculous lesion, and these were in men otherwise reported as fit after medical examinations. Many hundreds of cases reported on at enlistment as showing abnormalities relating to tubercular infection, but accepted as having no active disease, served through the war and never had any symptoms of the disease. The methods adopted were justified. Although 71 cases taken into the Army overseas with some evidence of old or latent infection were later diagnosed as suffering from active pulmonary tuberculosis, on the average they gave several years service and 25 were detected only at discharge. If a policy of doubt and fear had been adopted in all suspicious cases the services would have lost many recruits. Great care is required that unnecessary invalidism is not created by mass radiography.

All cases showing radiological abnormality were referred for boarding to specialists in disorders of the chest. Cases of active tuberculosis, however slight, were totally rejected; others with inactive lesions were in some instances graded for limited military duties in New Zealand.

The benefits of routine radiography have been amply emphasized by a survey of records of over 100,000 apparently normal recruits. It was found that the incidence of active pulmonary tuberculosis was 2.4 per 1000—a figure which compares favourably with that obtained from similar surveys in other countries. Reliance on clinical examination alone permitted detection of active tuberculosis in only 3.6 per cent, and suspicion of active tuberculosis in a further 3.2 per cent of the cases subsequently proved to be tuberculous. In other words, in 93.2 per cent clinical examination was negative, and only routine radiography raised the suspicion for subsequent confirmation by specialist boards. These figures speak for themselves, yet probably do not give an accurate assessment of the true incidence of detectable clinical signs. The conditions under which initial medical boards are of necessity conducted are not ideal for careful auscultation. In any case, the knowledge that a routine X-ray was to follow probably prompted and in part justified a relatively cursory examination of the chest by medical examiners working in adverse conditions. In the small group of cases detected or suspected clinically most had a bad family history, gross symptoms, or obvious physical signs; 33 per cent were Maoris.

2 NZEF

Tuberculosis did not constitute any great problem in 2 NZEF. At no time was the incidence high enough to cause any difficulty in management. The cases were, of course, segregated when diagnosed, and returned to New Zealand by the next hospital ship when the condition of the patient was considered to be satisfactory enough to stand the journey. The infectious disease ward of the Maunganui, though small, was always able to accommodate all the tuberculosis cases. There were 115 cases of pulmonary tuberculosis invalided back to New Zealand from 2 NZEF in MEF and CMF during the war. More cases were discovered by routine X-ray at discharge, or became ill after return to civil life, than revealed active symptoms during their service with 2 NZEF.

THE NAVY

The Navy

For some years before the war, and prior to the introduction of X-ray examinations at entry, it had been found that the incidence in the Royal Navy was considerably higher than that of the Army and Royal Air Force. From the inception of the New Zealand Division of the Royal Navy the local incidence had caused no particular concern until just before the war, when seven cases occurred in two years in the Achilles. Certain suggestions for the better ventilation of living and working spaces in the Achilles and Leander could not be put into effect owing to the outbreak of hostilities and the employment of the cruisers on active operations with increased complements.

From the end of 1940 X-ray examination of the chest was part of the standard naval recruiting procedure. Of the 117 cases of pulmonary tuberculosis which occurred in male RNZN personnel between 1 September 1939 and 21 December 1946, the chest X-rays had been clear on entry in 87 cases. This indicated that too much reliance should not be placed on the initial X-ray examination. The conditions of shipboard life make it necessary to keep the closest watch for any signs or symptoms that might point to tuberculosis. Early recognition and segregation of suspects is essential. Repeat X-rays and vaccination would seem desirable. A careful study of the cases occurring in continuous service personnel of the RNZN before and during the war showed that a significantly large number were members of the same initial training classes. The early training period involved closer common contacts than in any subsequent period of naval service, and it was suggested that some of these groups contained individuals from whom the infection was spread.

PENSIONS SURVEY

Pensions Survey

In 1949 Dr D. Macdonald Wilson made a survey of pulmonary tuberculosis among New Zealand service personnel, embracing all the cases that had occurred in the ten-year period 1939–49 in a military population of 200,000 medically examined and passed fit for service, of whom about 134,000 served outside New Zealand. In the main this was a specially selected population, but, on the other hand, chest X-rays at discharge from the services, plus pensions applications later, resulted in nearly all those developing tuberculosis being brought within the compass of the review. Up to 31 December 1949, 1412 cases had applied for pension, while there had been 8 deaths on service overseas and 30 among servicemen in New Zealand. Included were 193 cases of pleurisy with effusion. Approximately 37.5 per cent of the cases took ill on service, 42.5 per cent were diagnosed by routine X-ray (usually at discharge), and 20 per cent became ill after discharge from service.

It was found that whereas the Army and Air Force produced numbers roughly corresponding to their relative strengths, the Navy had almost double the number of cases on a comparative basis. This emphasized the fact that exposure to infection rather than the physical hardships of a campaign is the greater cause of tuberculosis in the services. The naval authorities early became aware of this, and routine surveys by X-ray were carried out as frequently as possible, thus enabling many unsuspected cases of active tuberculosis to be diagnosed.

The importance of X-ray at enlistment was emphasized by the higher incidence among those army personnel of the first two echelons who were not X-rayed in 1939–40. The members of the Maori Battalion fortunately were nearly all X-rayed, so removing most of the potential sources of infection (16 per cent were rejected for chest conditions), and the Maoris in the services had an incidence of less than double the incidence for the whole group (13.5 against 7.4 per 1000 over the ten years), whereas in the civil population the Maori rate is nearly five times that of Europeans. By comparison with the annual civilian Maori rate of 23.5 per 1000 the rate of 13.5 per 1000 for a decade in Maoris who served overseas shows a marked reduction. (It has to be noted that on a comparative basis living conditions were much the same for Maoris and Europeans in the forces, but this is not so in civil life.)

In prisoners of war the incidence was fairly high—over 17 per 1000 over the period, but 84 of the 155 army cases had not been X-rayed on enlistment. Most of the prisoners of war were taken in the early campaigns and had entered the Army in 1939 and 1940 before the X-ray examinations were properly organised. Irrespective of prisoner-of-war privations, this group would have produced a higher incidence than the average. Of the total of 729 cases in the Army overseas, 222 were not X-rayed before going overseas. The First and Second Echelons, with 193 cases, produced an incidence of 14.3 per 1000.

The annual incidence of new civilian cases in 1948 (the lowest on record at that date) was European 0.77 and Maori 3.6 per 1000. The average annual incidence in returned service personnel for the years 1945 to 1949 was European 0.95 and Maori 1.73 per 1000. It has to be noted that the service figures were swollen by the large number of cases brought to light by X-rays taken on discharge after return from overseas in 1945 and 1946.

Results of Treatment

All will agree that the best results of treatment should be obtained in the cases diagnosed early, for whom institutional treatment if required is available without delay, and who are relieved of financial worry should it be advisable for them to cease work. Except for prisoners of war, these two latter conditions existed for service personnel, and in over 40 per cent of cases the first condition was also present as they were diagnosed by routine X-ray before the patients were aware of any illness.

In the treatment of the 1404 cases under review, some 300 required no treatment but were merely kept under observation at the chest clinics. On the other hand, in addition to inpatient observation in sanatorium or hospital required for the remaining cases, the following operative procedures were carried out:

Thoracoscopy with pneumolysis or attempted pneumolysis, 33 cases.

Artificial pneumothorax was produced in 316 cases.

Pneumo-peritoneum was used in 22 cases.

Phrenic crush or avulsion was carried out in 54 cases.

Thoracoplasty was carried out in 27 cases, and 5 cases are at present in hospital for consideration of this operation.

While the production of an artificial pneumothorax was the commonest form of active treatment, more than one of the above procedures was carried out on the same patient in certain cases.

The classifications under which the results of treatment are tabulated have been used as an interpretation of the findings and reports of medical examiners. In examining patients for reports on any indications for treatment and assessments of degrees of disablement for pensions purposes, examiners do not always use the terminology used by the Health Department. Thus, in interpreting reports, it is felt they fall under the following headings:

(1) Apparently cured, where the examiner states there is no disability and recommends cessation of pension, or suggests a permanent minimal pension for a lesion healed and stationary for some years and requiring no further observation.

(2) Quiescent cases, which on examination appear much the same as the above but, owing to the short period the condition has appeared healed, a more conservative view is taken and observation for a further period at long intervals is recommended as a safety measure.

(3) Stabilised cases, where any evidence of progressive disease has been removed but treatment and observation are still required. Included in this group are such cases as those where 'soft' shadows have hardened and where an artificial pneumothorax wholly controls the disease but the lung is still collapsed by introduction of air. The patient is allowed to follow his occupation provided it is of not too heavy a type, and if so, he is advised to seek another job in the meantime.

(4) The active class, where the disease is still active even if responding to treatment. The patient is attending for treatment at a clinic or under domiciliary treatment.

(5) Cases in hospital or sanatorium. Admission may be temporary for special active measures in treatment or may be in certain hospitals for an indefinite period owing to extensive and progressive disease not responding to treatment.

(6) Deaths in this series of patients which may be due to pulmonary tuberculosis or other causes. There have been four deaths in the series not due to pulmonary tuberculosis.

Using the above classifications, the following table sets out the results for various groups of the services, giving the percentage in each group for total cases from 1939 to 1949.

	Apparently Cured Per Cent	Quiescent Per Cent	Stabilised Per Cent	Active Per Cent	In Hospital Per Cent	Dead Per Cent
All services, overseas and New Zealand	29.3	21.8	17.7	15	10.4	5.8
Army overseas	30.2	19.4	15.4	16.5	11.2	7.3
Cases diagnosed by routine X-ray, all	39.6	20.4	15.6	14.2	7.1	3.1

services						
Cases diagnosed by routine X-ray, army overseas	40	22.72	12	14.6	7.1	3.6

The 193 cases of pleurisy with effusion were included in the survey because the clinicians considered them tuberculous in origin. The results of treatment showed that cases with a sudden onset did well, whereas the rarer cases with a slow insidious onset did badly.

Females: Among females there were 45 cases, 10 with overseas service and 35 with home service only, and there was one death in the Navy in New Zealand. The large majority (29 cases) were aged 20–25. Results of treatment in this group were excellent—23 cured, 8 quiescent, 4 stabilised, 8 active, and 1 in hospital. Some 15 cases diagnosed by routine discharge X-rays had not required institutional treatment.

CONCLUSION

Conclusion

From the survey it is difficult to compare the incidence of tuberculosis among service personnel with that of the civilian population, as the survey covered a closed group composed in the main of personnel of the age group in which the incidence of tuberculosis is the highest. Taking all factors into consideration, the incidence of tuberculosis in service personnel was much the same as for the civil population. In a group of Maori servicemen it was much lower. Mass radiography reduced the spread of infection, and should always be undertaken before the admission of recruits to camps. Thus radiography, plus improved hygiene and the elimination of overcrowding, seems the best means of reducing the incidence of pulmonary tuberculosis in a military community.

ASSOCIATED DISABILITIES PRESENT IN THE PENSIONS CASES OF PULMONARY TUBERCULOSIS

Associated Disabilities Present in the Pensions Cases of Pulmonary Tuberculosis

Tuberculosis elsewhere in the body:

(a) Genito-urinary tuberculosis: 25 cases; with nephrectomy (7) and orchidectomy (4).
(b) Tuberculosis of bones: Spine, 14 cases; sternum, 4 cases; ribs, 1 case; humerus, 1 case.
(c) Joints: Elbow (5), wrist (1), sacro-iliac (3), hip (1), knee (2), and ankle (3).
(d) Tuberculous synovitis: 4 cases.
(e) Tuberculous glands: Cervical (8) and abdominal (5).
(f) Tuberculosis of bowel (1) and Peritoneum (1).
(g) Fistula in ano: 10 cases.
(h) Tuberculous periphlebitis of eyes (2).
(i) Tuberculous meningitis (2).
(j) Erythema nodosum (3).

Other conditions associated with this series of pulmonary tuberculosis are: Diabetes mellitus (6), diabetes insipidus (1), gunshot wound involving the lung (3), dyspepsia (10), duodenal ulcer (22), gastric ulcer (3), anxiety neurosis (25).

Table I: Incidence of Pulmonary Tuberculosis in the Army, Overseas Only

	Year of Onset of			Year Entered Service				Annual
Pulmonary Tuberculosis	1939	1940	1941	1942	1943	1944	1945	Totals
1939								
1940	8							8

1941	7	31	5					43
1942	5	25	7					37
1943	24	51	14	7				96
1944	22	67	21	15	2			127
1945	29	111	44	13	9	2		208
1946	7	47	27	25	4	3		113
1947	6	20	9	4	0	0		39
1948	4	17	6	6	1	0		34
1949	0	14	7	1	0	1	1	24
Total of cases according to enlistment years	112	383	140	71	16	6	1	729

Table II: Prisoners of War who Developed Pulmonary Tuberculosis
(Numbers of cases are shown according to year of enlistment and year of onset of disease.)

Year of Onset of Disease	Year of Enlistment 1939	1940	1941	1942	1943	Annual Totals
1939						
1940						
1941	1	3				4
1942	3	7				10
1943	0	7	1			8
1944	6	14	2		1	23
1945	22	42	6			70
1946	3	9	0			12
1947	3	11	0			14
1948	2	3	1			6
1949	1	6	1			8
Total according to year of enlistment	41	102	11	0	1	155 *

CHAPTER 17 — VENEREAL DISEASE

Contents

WAR SURGERY AND MEDICINE

[SECTION]

VENEREAL disease is inevitable in any military force, whether a home or overseas. But sulphonamides, and later penicillin, in the Second World War proved so effective in the treatment of all forms of venereal disease that the problem was much less serious than in previous wars, and manpower wastage was reduced. Gonorrhoea and syphilis seldom necessitated invaliding to New Zealand, a striking contrast to conditions in the First World War.

In addition the incidence among troops has tended to decrease. In his medical history of 1 NZEF Carbery states that 'approximately 3600 men per annum of the NZEF were infected and required treatment', and that 'at the end of 1917 there were 400 patients in the VD Section 3 NZ Gen Hosp Codford, with 200 convalescents attached'. The venereal disease rate in 1 NZEF was about 60 per 1000 per annum. More accurate figures recorded in the Australian medical history show the rate for the AIF overseas, 1915–18, to have been 71 per 1000 per annum, compared with 94 per 1000 per annum for the AIF in Australia during the same period.

In 2 NZEF overseas the rate was 47 per 1000 per annum for the years 1940 to 1945, while the rate for the Army in New Zealand was 22 in 1940, 31 in 1941, and 15 in 1942 (all per thousand per annum), compared with the Army rate in New Zealand of 34 in 1917.

Conclusions cannot be drawn with any certainty from comparisons of overseas forces as conditions vary so considerably. However, the troops in Egypt in the Second World War do not seem to have run the same risk of contracting syphilis from the local population. A record still available shows that from 7 February 1916 to 12 April 1916 there were 93 New Zealanders with fresh infections of syphilis admitted to 1 NZ Stationary Hospital, Moascar. Most were infected in Cairo, from which city the incidence was not nearly so high in the years 1940–45.

EGYPT, 1940

Egypt, 1940

Efforts were made from the start to educate the troops in the prevention of venereal disease. At the GOC's conference on 15 February 1940 the ADMS NZ Division addressed commanding officers and medical officers and gave a survey of the venereal disease problem.

The troops were lectured on the subject soon after their arrival in Egypt. They were informed that their use of the legalised brothels in Cairo did not render them safe from venereal disease. There was a regular medical examination of prostitutes by civilian authorities, but it was far from efficient. Troops who did indulge in sexual intercourse were encouraged to use the prophylactic outfits which they could draw prior to going on leave, and to attend the prophylactic ablution centre in the Birket immediately after exposure to infection. There were also centres in Maadi Camp, and troops were expected to undertake prophylaxis there on their return to camp if they had not already done so.

The early incidence of venereal disease in Egypt fortunately proved to be comparatively low, due, it was thought, to the supervision of the brothels and prostitutes, good control of the PA centres, and the educational efforts of the medical officers. Gonorrhoea was cleared up readily by sulphathiazole, and the men were soon returned to their units from the treatment centre set up at the Maadi Camp Hospital. On his arrival in September 1940 from England Lieutenant W. M. Platts, who had received training in venereal disease treatment at Connaught Hospital, Aldershot, was placed in charge of the venereal disease section of the hospital, which by the end of 1940 had accommodation for 70 patients, although its average occupied bed state was 35. Valuable assistance and advice was given at that time and subsequently by Lieutenant-Colonel R. Lees, Adviser in Venereology, GHQ MEF.

SYSTEM OF SURVEILLANCE

System of Surveillance

Patients were kept in Camp Hospital until non-infectious, but in many cases, notably the syphilis patients, further treatment as outpatients was necessary. In July 1941 it was arranged that the men receiving courses of anti-syphilis injections could be posted to field units and receive their follow-up treatment, as did other outpatients, at New Zealand field ambulances. A special record system was introduced to enable a check to be kept on outpatients to ensure that they did not fail to report for treatment.

To give a fuller control in all these follow-up measures it was decided in April 1942 that a special register be maintained by a senior clerk in the office of DMS 2 NZEF to correlate all records and details of treatment. This system proved to be very successful.

It is interesting to note that the Adviser in Venereology, GHQ MEF, adopted a similar scheme in September 1942 in regard to surveillance and after-treatment of venereal cases returned to British units. Among the British troops, with their more complex layout, the system could not, however, function as simply or as completely as in the self-contained New Zealand force.

VD TREATMENT CENTRES ESTABLISHED AS UNITS

VD Treatment Centres Established as Units

In March 1942, after the New Zealand troops had moved to Syria, new units were formed for the treatment of venereal disease. In place of the VD Section of Maadi Camp Hospital there were established two 50–bed VD Treatment Centres, which could be attached to General Hospitals and which were independent as regards equipment and staff. (They were called 101 and 102 VDTCs to avoid confusion with 1 and 2 British VDTCs.) The change took place on 27 April 1942, and 101 NZ VDTC was on that date attached to 1 NZ General Hospital at Helwan to provide for base troops, and 102 NZ VDTC was later attached to 2 NZ General Hospital at Nazareth to provide treatment for New Zealand troops in Syria and Palestine.

INCIDENCE

Incidence

The growth of 2 NZEF in Egypt from a brigade to a division boosted the VD admissions to Camp Hospital—the average bed state in December 1940 was 36.2; in January 1941, 43.1; and in February 1941, 58.5. The incidence of VD in New Zealand and British forces at that time was stated in a report by the Adviser in Venereology to be almost the same. The incidence continued to rise and by July 1941 gave rise to some concern, and an examination of the problem was carried out by the 2 NZEF authorities. In that month there were 111 cases from New Zealand divisional units and 36 from other New Zealand troops. Figures were produced to show that 6.3 per cent of the force acquired VD in the period of one year. (Note: In all these figures no clear distinction was made between 'venereal' and 'non-venereal' admissions. About 30 per cent of the patients had their condition diagnosed as 'non-venereal', although many of these had exposed themselves to infection.)

In a report to DDMS 2 NZEF in July 1941 the officer in charge VD Section, Maadi Camp Hospital, set out some disturbing facts about the habits of New Zealand troops at the time. An accurate tally of the number of New Zealanders using the PA Centre at the Sharia Wagh el Birket for the week ended 4 July 1941 gave the following figures: Friday, 503; Saturday, 683; Sunday, 303; Monday, 258; Tuesday, 172; Wednesday, 127; Thursday, 116. Total for week, 2164. Some soldiers doubtless used the Centre more than once in the week, but there were also those who used other places and means of prophylaxis, and those who took no precautions at all. There was an obvious need to stress further the dangers of incontinent life in Egypt, and to correct the unwitting but dangerous sentiments conveyed by non-medical lecturers who tended to recommend the use of legalised brothels. Emphasis on prophylactic measures was repeated.

Position in Syria

In Syria venereal disease was rife among the civilian population, and in March 1942 the ADMS 2 NZ Division decided to establish controlled brothels. Two were opened in Aleppo and two in Baalbek, with PA Treatment Centres being established by 6 and 4 NZ Field Ambulances respectively. Prostitutes were examined weekly by New Zealand medical officers. Field ambulances cooperated with DAPM NZ Division in the questioning of patients regarding the source of infection and the tracking down of infected prostitutes. In two brigades in Syria in four weeks there were only 5 cases of venereal disease. In April there were 9 cases (mostly from 'secret prostitutes' in Damascus and Beirut), in May 8 cases and in June 4 cases.

In Syria the rigid supervision of brothels, examination of prostitutes, and encouraged use of PA Centres had most satisfactory results. In Baalbek in May 4 Field Ambulance gave approximately 850 prophylactic treatments weekly, while 5 Field Ambulance (replacing 6 Field Ambulance) gave approximately 1400 such treatments weekly. Although the latter serviced only one brigade group, its numbers also included RAF and British troops.

It is evident that the troops had not limited their sexual intercourse to any great degree, but the period in Syria was an example of what could be achieved by adequate control of sources of infection and the taking of reasonable precautions by way of prophylaxis by those concerned.

INCIDENCE AND THE USE OF PROPHYLACTIC FACILITIES DURING 1942

Incidence and the Use of Prophylactic Facilities During 1942

In his review of medical work in VD Section Maadi Camp Hospital and 101 NZ VDTC for the year ended 31 December 1942, Captain Fox set out the classification of the 583 inpatients as follows: Gonorrhoea, 144; soft sore, 177; syphilis, 51; other diseases, 106; urethritis (non-venereal), 105. The average daily bed state was 44.

There were 155 cases which received outpatient treatment only. The monthly average for New Zealand outpatient treatments at 101 NZ VDTC was 488, or a daily average of 18.44 (Sundays excluded). Of the total of 738 cases reviewed it was found that 28.99 per cent admitted having had previous venereal disease, that 47.78 per cent had used PA Centre facilities, and that 24.71 per cent stated that they had alcohol before exposure to infection.

The figures showed that the precautions taken to avoid venereal disease were far from satisfactory. In an analysis taken over a nine-months period in 1940–41 at Maadi Camp Hospital the percentage using the PA Centre facilities was 87 per cent. (In November 1941 DGMS Army HQ NZ observed that there was 'a deplorable failure to use PA facilities in New Zealand.')

CLOSING OF LEGALISED BROTHELS

Closing of Legalised Brothels

The opinions of a conference at GHQ MEF in March 1942 were expressed in the following terms:

It was unanimously agreed that the use of brothels should be discouraged:

(a) The existence of brothels is an incentive to immorality, for it is popularly supposed by soldiers that medical examination of prostitutes renders them free from the risk of infecting those who consort with them. It should be pointed out to all troops that this is not true ….

(b) The use of brothels is, from many points of view, morally undesirable and it is likely that young soldiers may be led by more hardened comrades into consorting with prostitutes, merely because such conduct is rendered easier by the existence of a brothel area.

DMS 2 NZEF attended a conference at GHQ MEF on 1 August 1942 when VD policy in Egypt was considered. Following a discussion in which many divergent views were expressed, it was decided that the Birket area should be closed and placed out of bounds. This action was taken on 12 August 1942, and its wisdom was reflected in the much lower average incidence of VD among New Zealand troops in Egypt.

Throughout 1943 the incidence of VD was low–the lowest it was in any one year in 2 NZEF, notwithstanding the fact that from May to September all New Zealand troops were congregated in Maadi Camp after the conclusion of the North African campaign and prior to their departure for Italy. As other factors in 2 NZEF remained the same, it can only be concluded that the closing of the 'Birket' was mainly responsible for the gratifying reduction.

NEW ZEALAND VD TREATMENT CENTRES

New Zealand VD Treatment Centres

The growth of the New Zealand VD Treatment Centre was an interesting one. Not being bound by a rigid military establishment it was completely flexible, and the type and size of the unit were changed as circumstances demanded.

When the numbers of troops in the desert were small and Base Camp was at Maadi, Camp Hospital filled all needs, the only disadvantage being the inability to prevent the more incorrigible patients from breaking bounds and reinfecting themselves in Cairo. This was partially remedied by the issuing of 'Blues' and withdrawing uniforms.

As the numbers increased, laboratory facilities, and the smooth machinery of admission and discharge, together with the attendant discipline of a General Hospital, were indicated.

Nos. 101 and 102 NZ VD Treatment Centres fulfilled these needs admirably, being attached, as they were, to the General Hospitals, which were close enough to the battlefield at Alamein to avoid loss of time in transit of cases, and also near leave centres and the detached troops in Palestine.

The mobile type of warfare after Alamein meant ever-lengthening distances, and attempts were made to hold cases in the Field Ambulances under officers who had previously taken a short refresher course in VD at Camp Hospital. This avoided the enormous wastage by evacuation of cases beyond the Division, and, since opportunities for contracting VD were almost absent in the Western Desert, the small number of cases was adequately treated.

However, more and more difficulty was experienced in coordinating and ensuring weekly treatment of cases of syphilis, because of the evacuation of wounded personnel and the arrival of reinforcements, and the need of a more highly trained and coordinated unit was soon felt.

In modern warfare movement is so rapid and formations are so scattered at times that a mobile unit limpet to a divisional formation, viz., a field ambulance, is the only way of keeping infected personnel from being shunted back down the long line of evacuation.

It was found that the only alternative scheme—treatment at the nearest non-New Zealand VD Treatment Centre—was hazardous, as records were lost, continuation of treatment was missed, and much time was wasted.

FORMATION OF A MOBILE VD TREATMENT CENTRE

Formation of a Mobile VD Treatment Centre

During 1943 these difficulties of treatment of VD cases on the long line of evacuation during the victorious North African campaign led to a consideration of the advisability of making 102 VD Treatment Centre a mobile unit. British forces did not have an establishment for a mobile VDTC, [1] but Colonel Lees, Adviser in Venereology, was favourably disposed to the idea. Such a unit could effect a big saving of manpower by enabling the earlier return of men to their units.

In a memorandum of 6 August 1943, Major Platts, 6 Field Ambulance, set out the advantages of a mobile unit, including (a) the provision of efficient and standardised treatment throughout 2 NZ Division, whereas individual medical units lacked specialist personnel and equipment, and used different drugs; (b) the ensurance of the necessary regular treatment for syphilis outpatients; (c) a smoothing-out of some of the difficulties of distant control from Base. He proposed that the projected unit travel as a 'limpet' establishment and be normally attached to an open MDS. It could undertake all VD treatments and surveillance and final tests of cure in divisional troops, keep a current roll of all those on treatment, and if the occasion arose could act as a VD Treatment Hospital by borrowing beds from its parent unit.

The matter was immediately followed up by DMS 2 NZEF, and CO 2 General Hospital and Officer i/c 102 VDTC were in agreement with the proposal. The latter, Captain N. C. Begg, pointed out that on the long line of evacuation from Tunisia cases of gonorrhoea had been made 'sulpha-resistant' by only occasional doses of sulphapyridine, mild cases of urethritis had recovered before reaching the treatment centre, and sores had healed, making it difficult to clinch a diagnosis in the case of syphilis. The CO 2 General Hospital suggested that there was an analogy with the mobile surgical team attached to the MDS, where it had been proved necessary to have independent equipment, transport, and staff.

On this basis, and with the approval of GOC 2 NZEF, application was made for a war establishment to be issued and authority given for 102 NZ VDTC to adopt it in order that it might act as a mobile unit to accompany 2 NZ Division in any future move to a theatre of active operations. The mobile treatment centre was established at the end of August with Captain Begg as OC.

The unit was therefore established and equipped in time to proceed to Italy with the Division in October 1943. Here it had a wide sphere of usefulness, as VD incidence in Italy generally was high and measures for control could not easily be enforced. The unit found itself steadily busy in Italy, where it was usually attached to the Field Ambulance MDS taking sickness cases. Here it was possible to hold up to twelve or fifteen inpatients, and yet the unit was forward enough for outpatients to report from their units. This meant a considerable saving of manpower to the Division.

Patients provided a problem when the unit had to move. This was overcome by an advanced section, consisting of the OC, sergeant, and driver, proceeding in the 15–cwt. truck to the new site and setting up, while the balance of the unit acted as a nursing section for three or four days until patients were fit to return to their units, or else were evacuated, and then this group moved forward to join up with the advance section.

The 3–ton truck was efficiently and ingeniously fitted up as a laboratory and the 15–cwt. as an office where the medical officer could interview patients. The 15–cwt. truck was also used for carrying stores and for other QM duties. Blankets and socks were carried for men admitted straight from the line, but all other clothing and stores were obtained through the parent Field Ambulance. It was often necessary to carry up to a week's reserve of rations as well as stocks of petrol and kerosene, so that when the unit was on the move its limited transport was taxed to the utmost.

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[1] British forces had a VD treatment team incorporated in the CCS in Italy, i.e., as a Corps' unit.

RISE OF VD IN ITALY

Rise of VD in Italy

In Italy the ever-present opportunity of acquiring infection resulted in a large increase in the numbers of cases. These were dealt with effectively by the newly formed NZ Mobile Treatment Centre, which had the benefit of resilience and mobility and close co-ordination with Base.

In December 1943 the fresh VD cases in 2 NZ Division had increased in spite of the precautions. With troops scattered through a thickly-populated area, complete control of a new area was usually delayed a few days. Infected prostitutes were removed from the Division's area. ADMS 2 NZ Division made the following comment: '102 NZ Mob. VDTC has proved its worth in that 82 per cent of cases have been returned to their units.'

This was achieved in spite of an unduly large number of sulphonamide-resistant cases, a number of whom had to be evacuated, and it was found necessary to open a 30–bed VD ward at 3 NZ General Hospital at Bari to accommodate them.

The rise in VD figures for 2 NZEF was in common with other services in Italy, as shown in an Allied Force HQ circular issued early in the campaign: 'Since the occupation of Sicily and Italy the venereal rate has rocketted to more than 20 times the rate in UK…. In Italy the rate of sickness from VD is greater than the battle casualty rate. Italian women are causing as much damage to the army as the German men…. In Italy, owing to the economic condition (now being improved), women offer themselves for a few cigarettes, and prostitutes abound. Nearly all these women are suffering from a virulent form of infection.'

In April 1944, 102 Mobile VDTC found itself unable to cure with sulphathiazole the gonorrhoea contracted at Naples and Pompeii. British, American, and Canadian units had recourse to penicillin for the treatment of such cases. A number of these patients had banked up at 3 General Hospital, and their treatment fell to the lot of 101 VDTC, when it went across to Italy in April 1944 with 1 General Hospital (after leaving a detachment at 5 General Hospital, Helwan) and was attached to 3 General Hospital at Bari on arrival.

INCREASE IN INCIDENCE

Increase in Incidence

By May the VD figures for 2 NZEF (217 fresh cases for the month) had surpassed the previous peak of June and July 1941 following the return of troops from Greece and Crete. Figures tended to be somewhat higher than those in Egypt because 'nonspecific urethritis' had usually been classed as 'non-venereal' in Egypt, whereas in Italy it was more usual to class it as a venereal disease.

But, apart from that, the figures gave rise for concern. In April there was an increase in leave granted following the relief of 2 NZ Division in the line at Cassino. The OC 102 Mobile VDTC made the following comment in May: 'Two reasons for the high incidence suggest themselves. 1. The attitude to this disease is not healthy. Officers' attitude to the trouble and their control of their men is an important factor. 2. Healthy recreation and suitable rest spots have not been afforded the men. Those units who sent their men to Naples for the day have suffered most heavily. A unit such as 19 Arm. Regt. which arranged a healthy leave camp has had very little trouble.'

The GOC 2 NZEF, acting on medical advice, placed Naples out of bounds to New Zealand troops other than those on duty.

In June the incidence of VD continued to be high. The Division had advanced to the area of Sora and then rested at Arce following the fall of Rome. AMGOT reported sixty prostitutes in the Sora area; only seven of these were apprehended by the carabinieri and six had venereal disease. Leave to Rome was the next feature in divisional life. In Rome the position was far from satisfactory as many civilians were infected, but the city was not such a 'plague spot' as Naples. Numerous cases, however, developed while 2 NZ Division was reorganising prior to going into action south of Florence. The wastage from the Division was relatively low as 102 Mobile VDTC held up to thirty inpatients and had others reporting daily for treatment. In August the number of fresh cases fell to 92, less than half the average of the previous three months, although the number of cases of syphilis was on the increase. The 102nd Mobile VDTC was kept very busy with final tests of cure for cases of infection contracted three to four months previously in the peak period. Outpatient treatments for the month numbered 531, exclusive of British troops.

At the end of August 2 NZ Division moved to the Adriatic coast and was committed to the line in subsequent weeks. For several months the incidence of VD remained reasonably satisfactory, the majority of fresh cases coming from troops who had recently returned from leave, mostly in Rome. Including outpatients, there were over 800 troops in 2 NZEF under treatment for VD in October 1944, and considerable work was involved in arranging and completing final tests of cure. Most of the cases of gonorrhoea proved satisfactory when they reported for tests of cure, and in only a few instances had the final tests to be postponed.

In the months up to April 1945 the number of fresh cases of VD continued to rise slowly and reached 119 that month. At this stage the remaining outpatients in the Division on arsenical courses for syphilis completed their injections, so that all cases had then had their full treatment, with any new cases undergoing the seven and a half day penicillin treatment.

HIGH POST-ARMISTICE INCIDENCE

High Post-Armistice Incidence

April had seen the lightning advance by the Division to Trieste, and early in May the war ended in Italy and Europe. In northern Italy in the post-armistice period 2 NZEF had the worst VD rate in its history. A huge increase in incidence first became manifest in the Trieste area in May, when there were 244 fresh cases in 2 NZ Division alone. ADMS 2 NZ Division ascribed the increase to:

(a) Some temporary slackening of discipline following the defeat of Germany.

(b) Trieste is a large seaport with an enormous number of prostitutes who have a high infection rate.

(c) Owing to political difficulties with the Yugoslavs, control of the civil population was not possible and it was impossible to picquet known infected brothels.

(d) The men have, through 'popular' articles in certain periodicals and papers, got the idea that VD is now so readily cured that it is not worth while taking precautions.

As soon as the increase became evident, an intensive anti-VD campaign was launched by ADMS 2 NZ Division. PA Centres were established in Trieste, lectures by RMOs arranged, and the GOC addressed a strong memorandum on the subject to all commanding officers. In June it was possible to keep a closer check on brothels, but the 'enthusiastic amateur' continued to provide a problem and be a prolific source of infection.

The VD rate began to show a decrease at the end of June. This was attributed primarily to the more efficient identification and segregation of infected women. The June figures of 401 fresh cases in 2 NZ Division were higher than ever, but the bulk of these were developments from sexual contacts in the previous month.

The concentration of the Division in the Lake Trasimene area at the end of July had a steadying effect on venereal disease, and in August and September the incidence was nearer an average rate. It began to compare less unfavourably with the VD incidence among English troops in Italy. At this stage British commands were taking disciplinary action against any individual without exception who, on contracting VD, could not prove he had taken preventive prophylactic measures after intercourse. The move north into winter quarters in the Florence- Siena area at the end of September had its repercussions on the VD rate, which rose sharply in October and reached the highest total for 2 NZEF in November—and this in spite of reduced numbers due to the steady departure of reinforcement groups for New Zealand. The location of the troops in the city, many being billeted in houses, was pointed out at the time as a big contributing factor in the high incidence of venereal disease.

The GOC 2 NZEF (then Major-General Stevens) on 8 December 1945 held a conference on the high incidence of venereal disease. The findings were recorded by the DDMS 2 NZEF in the words: 'The consensus of opinion is that the principal causes are overindulgence in alcohol and inability to take same, coupled with a general spirit of bravado, all combined with boredom.'

The 102nd Mobile VD Treatment Centre found itself busier than ever in its history and had by this time two medical officers and additional men on its staff. Without the help of penicillin it is difficult to see how venereal disease could have been successfully treated, at least without a very large staff. In November the total of fresh cases treated by 102 Mobile VDTC numbered 425 venereal and 122 non-venereal, follow-up treatments for outpatients totalled 941, while 282 blood tests were made.

All troops under treatment or surveillance for syphilis, gonorrhoea, or soft sore were prohibited from participating in the leave scheme to the United Kingdom. The New Zealand Medical Corps continued to be most thorough in its treatment of all cases. All men concerned were kept under strict surveillance until satisfactory final tests of cure were obtained in each individual case. For outpatients in transit surveillance was continued until final test of cure was completed—either at NZ Advanced Base, NZ Maadi Camp, or under arrangements provided by the SMO of each returning ship—or until ultimate arrival in New Zealand. All records were forwarded by the medical officer to DGMS Army HQ, Wellington, on disembarkation of respective drafts, and the system of follow-up then became the responsibility of authorities in New Zealand.

In Italy the Mobile VD Treatment Centre treated the following totals of patients up to July 1945 (i.e., while the Division had an operational role): Syphilis, 53; gonorrhoea, 963; gonorrhoea relapses, 222; chancroid, 383; chancroid relapses, 57; balanitis, 153; urethritis, 797; prostatitis, 39; others, 211; a total of 2878. In addition outpatient treatments totalled 9136, request examinations 488, and fresh cases from British units 301, which gives a grand total of 12,618 treatments.

The unit more than justified its existence. The 2878 fresh cases were probably nearly all back with their units a fortnight sooner than if they had been sent to base hospitals.

Throughout the war 2 NZEF medical officers and staff applied themselves to carrying out efficiently the modern developments in treatment of venereal disease and were very successful in reducing the loss of manpower to the Force.

2 NZEF (JAPAN), 1946-48

2 NZEF (Japan), 1946-48

In the brigade that went to Japan as an occupation force venereal disease caused more cases of sickness than any other disease. The medical services were able to protect the troops from most of the other diseases prevalent in Japan, but, with venereal disease, determining factors in its incidence lay rather in the standard of discipline in the Force and the outlook of individual soldiers.

The venereal disease rate was very high while the brigade waited in Italy for its embarkation. It left Italy from Naples on 21 February 1946 and disembarked in Japan on 31 March. In Japan the rate dropped to about a quarter of that which had obtained in Italy, and was for some time consistently the lowest in the components of BCOF. The incidence of venereal disease among the local population was probably higher in Japan than in the Italian cities, but fraternisation was probably more restrained. The reason for the lowered incidence in J Force was stated to be 'the intensive anti-VD campaign conducted within units, and the approaching relief of the Force'.

The first relief was completed by August 1946, after which the venereal disease rate began to rise. It continued to climb after the arrival of the second relief in 1947, and by 1948 had exceeded the high incidence in the final months in Italy. When asked for a report on the subject in April 1947, the SMO 2 NZEF (Japan), who had served in Italy, was able to complete it in two sentences: 'It is my opinion that the chief cause of the increase in VD rates is the letting up in discipline generally among the troops. The rate will be reduced only when Unit Commanders and officers make a determined effort to raise the standard of discipline and take a personal interest in their troops' welfare'.

In July 1947 Commander 2 NZEF (Japan) set out relevant factors as increased troop movements; deterioration in the outlook of some junior officers, and therefore in the outlook of the troops under their command, prior to repatriation to New Zealand; the marked increase in street women due to the closing of black-market cafeterias throughout Japan and shortages in rationed commodities available to the Japanese public; unit farewell functions; and reduced seriousness of infection in the eyes of the troops because modern treatment was painless and believed to offer a certain cure.

The problem was not confined to the New Zealand Force. In an instruction of 10 February 1948 the Commander-in-Chief BCOF directed all commanders 'to take the most energetic, practical, and positive measures to reduce, initially, the present tragic rate of venereal disease, which is the highest in the world wherever British Forces are serving. …' The incidence among United States troops was also high, and reports emphasized the influence of alcohol.

The opinion of the Occupation Force authorities was divided on the relative importance of prostitutes, part-time street walkers, and 'amateurs' on the VD rate. All Japanese brothels were out of bounds, but were used to some extent by the troops. (Over the last five months of 1947, 30 patients came to 6 NZ General Hospital from one small New Zealand unit and admitted exposure at brothels which were reputedly examined weekly and therefore popularly considered safe.) Provost patrols were active in apprehending street walkers; DAPM 2 NZEF reported 195 street women apprehended from 1 January to 31 March 1948, of whom 70 were treated for venereal disease, 70 detained in civil hospitals for treatment, and 16 ordered out of the area. In his report for March 1948 SMO 2 NZEF stated, 'It appears that many men have been cohabiting each with his own girl for months, and that they are now reporting for a check up as the end of their term in Japan draws nearer…. We reached the peak figure of 54 cases in 6 NZGH by the end of the month—as many as Surgical and Medical combined'. A survey showed that most of the cases were contracted within the New Zealand occupation area, and not while men were absent from their units on leave. Attendances at PA Centres were very low.

In the twelve months August 1947 to July 1948 the number of venereal cases treated at 6 NZ General Hospital from the brigade, which was reduced from about 4000 men to some 2300 by 1948, was 768. These were diagnosed as syphilis 37, gonorrhoea 384, urethritis 264, other 83. In seven months from 2 August 1947 to 29 February 1948, first infections varied from 3.5 per cent to 18.3 per cent of the strengths of the units, the unit with the lowest figure being 6 NZ General Hospital. The Maori and pakeha rates in 2 Battalion were very similar (19 per cent and 17.9

per cent). In March the Force numbered only some 2300 and a total of 302 individuals had contracted venereal disease, and of these, 57 men had contracted the disease twice, 14 three times, 3 four times, and 2 five times.

It became apparent that some troops had become infected with an attenuated strain of gonorrhoea which was causing them no concern, and in April 1948 an appeal was made to all those who had indulged in sexual intercourse to present themselves for examination. The discovery thus in 748 men examined of 148 cases of gonorrhoea and 4 of syphilis boosted the VD figures for April and May. From the figures available it seems that the incidence of VD was reduced a little in succeeding months until the return of the Force to New Zealand in September 1948. Medical officers travelled on each of the returning transports to conduct further tests, with the objective of having all men free of infection by the time they reached New Zealand.

Cases Of Venereal Disease (J Force)

	1946	1947	1948
January	120 Italy	31	69
February	69	48	92
March	46	62	80
April	26	54	101
May	37	56	137
June	33	44	91
July	15	53	42
August	19	22	Retd NZ
September	24	20	
October	33	66	
November	49	77	
December	29	59	

These figures include some cases diagnosed as non-venereal, about 10 per cent.

GENERAL OUTLINE OF TREATMENT

GENERAL OUTLINE OF TREATMENT

The discovery of the action of the sulphonamide group of drugs greatly simplified the treatment of gonorrhoea during the early part of the war.

It meant that, in the majority of cases, the infection was overcome before it could involve the posterior urethra with its attendant glands, and therefore the laborious and relatively ineffective local treatments that a chronic posterior case demands were avoided.

A small proportion became chronic, despite sulphonamides—a proportion which steadily increased as time progressed, owing to the increased use of the drug and consequent resistance.

In these cases treatment relapsed to the well-tried methods of the First World War—namely, daily irrigations, prostatic massage, urethral instillations, etc. The average hospital stay for these cases was at least three times that of those which responded promptly to sulphonamides.

Later on when sulphonamide resistance increased to frightening proportions penicillin became available in large enough quantities to be used as routine treatment, greatly simplifying the task of combating the enormous rises in incidence in Italy in 1943 and 1944.

Non-specific urethritis was a problem. The frankly purulent discharge, devoid of all organisms at first, soon became full of secondary invaders, and the posterior urethra and glands were quickly involved despite full doses of sulphonamides. Some gradually cleared up with local therapy; others defied all treatment for months, even years.

Soft sore, fairly common in Egypt, healed promptly on sulphonamide and was no problem.

An interesting sidelight on the use of the sulphonamides in hot Cairo weather in a tented hospital was the lack of toxic effects. No cases of sulphonamide oliguria occurred and only a very small number of photosensitive skin rashes.

Syphilis

This disease was not diagnosed nor treatment commenced until a positive dark ground examination and/or a positive complement fixation test (Wasserman or Kahn), repeated if necessary, had been obtained.

The current standard treatment was adopted in 2 NZEF from 1940. It comprised courses of ten weekly injections of neoarsphenamine, commencing with 0.45 gm. and continuing with 0.60 given concurrently with bismuth intramuscularly, 0.2 gm. each injection. At the termination of each course a serum complement fixation test was done, and the number of courses given depended on when the blood became sero-negative, three further courses being given after this. An interval of four weeks was made between courses.

Sulpharsphenamine was used at first to save the trouble of intravenous injection, but was soon discarded as being too painful.

Final tests of cure consisted of a complement fixation test on the cerebro-spinal fluid at the completion of the last course and six-monthly blood serum tests for two years.

The patient was retained in camp hospital until non-infective (usually two to four weeks), then discharged to reception depot for the rest of his first course.

In these early days the Division was in the Western Desert and gross sources of infection were out of reach. As a result, of the small number of men being treated for syphilis the majority were base personnel, and, from the centralised VD hospital, their treatment could be efficiently and regularly given; but after the return of the Division at the end of 1940 the incidence rose and it soon became obvious that, to ensure continuity of treatment, some arrangements had to be made for treatment to be given by field medical units, a central authority at Base being responsible for seeing that it was carried out.

Thus men were returned to their unit after their first course, and specially trained officers in their nearest field ambulance gave them their injections and arranged for their final tests of cure at a suitable hospital.

In 1943 there was a modification in the treatment, oxoarsphenamine (mapharside) being used in an attempt to obviate what we now know as homologous serum jaundice. At the time the picture was very confused, there having been at the end of 1942 a severe epidemic of infectious hepatitis amongst all Middle East troops, and the drug was suspect as the cause of syringe-transmitted jaundice. Finally extremely strict sterilisation of syringes and needles eliminated the serum jaundice.

In August 1944 a tremendous advance was made when sufficient penicillin became available for it to be used in the treatment of syphilis. In a course lasting only seven and a half days 2.4 mega units of penicillin was injected in doses of 40,000 units every three hours. Later it was found that 2,400,000 units was insufficient to effect a complete cure in all cases, and, if checks by monthly quantitative Kahn tests were not satisfactory, a further course of penicillin was given. In July 1945 the course was amended to 30,000 units two-hourly for seven days.

Gonorrhoea

A positive diagnosis was made only in those cases of urethral discharge in which gonococci were seen in the stained smear, all other cases being diagnosed as non-specific urethritis.

Sulphapyridine was the only antibiotic available early in the war, and the standard treatment was 5 gm. a day for seven days, the pills being administered by an orderly every four hours. In these early days of sulphonamide administration very few strains of gonococci had developed sulphonamide resistance, and nearly all cases cleared up clinically under this regime.

They were transferred to Base Reception Depot as soon as the discharge had ceased and were seen at regular intervals until three months had elapsed, when final tests of cure were applied and had to be satisfactory before the patient was crossed off the VD roll. These tests comprised a serum complement fixation test, prostatic examination and smear, and anterior urethroscopy.

The small minority who did not clear up on exhibition of sulphapyridine were retained in camp hospital as chronic gonorrhoea, and were treated by irrigations, instillations, prostatic massage, and sometimes TAB vaccine fever therapy. These cases provided the biggest problem, and their treatment often dragged on for months or years.

The proportion of sulphonamide-resistant cases gradually increased as the war progressed. In August 1943, following a direction from GHQ MEF, the treatment of simple clinical gonorrhoea by an RMO within unit lines was authorised, using sulphathiazole or sulphapyridine, but it was found more satisfactory, partly due to complications developing, for such cases from Base to be admitted to VD Treatment Centres as hitherto.

At the beginning of the Italian campaign, notably in the Naples area at the beginning of 1944, treatment of gonorrhoea began to produce serious difficulties owing to the appearance of sulphonamide-resistant strains of gonococcus. In 2 NZEF the number of uncured cases of gonorrhoea, involving hospital treatment, grew rapidly.

Until penicillin was made available to it in Italy the Mobile Unit treated 326 cases of gonorrhoea with sulphathiazole and sodium citrate between October 1943 and August 1944, with 181 relapsing cases. The patients dosed themselves with the drugs in their own unit lines, and failure to observe the instructions may have accounted for some of the relapses, apart from the sulphonamide resistance built up by the gonococcus in Italy. For relapsed cases the only recourse was to evacuate them to 3 NZ General Hospital, Bari, where 101 Treatment Centre was attached, for intravenous TAB vaccine therapy. In May 1944 penicillin was made available for resistant cases only, a dose of 60,000 units being given in injections of 5000 units three-hourly. The course was very successful, especially when washes of acriflavine were introduced to prevent symbiotic organisms from the prepuce invading the inflamed urethra and causing a residual urethritis. In September 1944 permission was given to use penicillin for all fresh cases of gonorrhoea, 100,000 units being given in five injections. The relapse rate dropped markedly, and of 644 cases treated from September 1944 to July 1945 only 41 relapsed.

Non-gonococcal Urethritis

In contrast to the First World War, there was a relatively high proportion of the cases of urethritis which were classed as nonspecific, or more correctly as non-gonococcal. (A War Office instruction of 5 October 1940 stated that cases of urethritis other than those in which the gonococcus was found, and other than those in which history of special treatment and common sense pointed to the gonococcus as the infecting agent, were to be diagnosed as 'urethritis non-venereal', and that the patient was to be given the benefit of any doubt.)

These cases, in which the diagnostic smears usually showed profuse pus with no organisms, were a difficult problem. Secondary invaders appeared in quantity when the disease became chronic, and the gleety urethral discharge resisted all the usual local treatments. Complications such as epididymitis, prostatitis, etc., were frequently seen. Eventually, however, over a period of months the discharge cleared up. The final tests of cure were the same as for gonorrhoea.

Venereal Sore

All genital sores were regarded as syphilitic until disproved as such by three dark ground examinations. If negative they were called soft sore and, in fact, did clinically fall into one group, although B. Ducrey was never recovered because of inaccessibility of laboratory facilities. Later the terminology was changed to penile sore, venereal.

All cleared dramatically on a total of 40 gm. of sulphapyridine, given four-hourly over ten days.

In Italy it was found that healing of the lesion was hastened when the usual eusol washes and dressings were supplemented by iodoform and eusol powders, and eusol and acriflavine were alternated every two days as washes. A serum complement fixation test was done three months later to make certain that syphilitic infection was not present.

Anxiety Neurosis

Men who reported to a treatment centre suspecting they had venereal disease, but which could not be confirmed by clinical examination, proved a problem in the later stages of the Italian campaign. These neurotic outpatients often expected to be given treatment, but this was refused where a thorough examination, supplemented by anterior urethroscopy, proved negative. Explanation and reassurance generally gave heartening results and allayed the neurotic's fears, whereas the giving of unnecessary treatment might have cemented in the neurotic's mind the belief that he had contracted venereal disease.

VD Treatment, J Force

VD treatment at 6 NZ General Hospital followed in the main the directive issued by DDMS BCOF. In the revised instructions of early 1948 the treatment for syphilis was by a combination of penicillin and arsenic and bismuth as follows:

Penicillin: 4 mega units by three-hourly intramuscular injections of 50,000 units each over ten days.

Arsenic and bismuth:

(i) In hospital— 2nd day—NAB 0.3 gm., Bismol 0.2 gm. 5th day—NAB 0.45 gm., Bismol 0.2 gm. 9th day—NAB 0.6 gm., Bismol 0.2 gm.
(ii) After discharge from hospital, by unit MO— Weekly for eight weeks—NAB 0.6 gm., Bismol 0.2 gm.

Thus the total dosage by eleven injections was NAB 6.15 gm. and Bismol 2.2 gm.

In the instructions treatment of uncomplicated gonorrhoea and urethritis was by 250,000 units of penicillin given by five three-hourly doses of 50,000 units each. Sulphonamide drugs could also be used.

Frequently strains of gonococci resistant to penicillin and sulphonamides were found. These cases often became chronic, and prostatitis developed. Large doses of penicillin were sometimes necessary, and the old-time practice of irrigation was often used.

In March 1948 the OC VD Wing, 6 NZ General Hospital, reported that a number of gonorrhoea cases treated with penicillin alone, and whose symptoms had rapidly disappeared, were being found to have chronic prostatitis, and he said: 'It would seem that the standard treatment as set out in the BCOF instructions, though adequate for halting the symptoms, in many cases is not sufficient to prevent prostatitis developing. I would advocate the addition of sulphonamide drugs as a routine to the treatment of all cases of gonorrhoea. It is interesting to note that cases of chronic prostatitis persisting for many months are responding to treatment with TAB. The vaccine is given in doses of 50 million organisms intravenously and at the same time penicillin and/or sulphonamide drugs are administered.'

The period of hospitalisation was slightly increased and this was found to lower the relapse rate, which earlier was 10 per cent. The average case of acute gonorrhoea remained three to four weeks in hospital, and the average case of acute urethritis remained four to five weeks. In a check it was found that relapses occurred in 19 per cent of all cases treated at 6 NZ General Hospital, whereas 59 per cent of New Zealand soldiers treated at other hospitals were subsequently found to have a relapse or chronic disease. There seems to have been only one relapse detected in the treatment for syphilis.

functioning of 102 nz mobile vdtc in 1944–45

Administration

(a) Personnel: Medical Officer in charge; a WO II; a sergeant; a lance-corporal (clerk, i/c records); 2 treatment orderlies; 1 general duty orderly; ASC attached, consisting of 4 drivers.

(b) Vehicles: 1 15–cwt. truck, MO's vehicle; 1 water cart; 1 3–ton truck fitted out as a laboratory with cupboards, etc.; 1 3–ton truck for equipment.

(c) Tentage: 1 hospital cover; 1 180–pounder for MO's use; 1 180–pounder for examination room and laboratory; 1 180–pounder for office and QM store.

(d) Organisation for handling cases:

   (i) A new case reported to the lance-corporal clerk, who filled out all the various papers required, including the A and D book, etc.

   (ii) The man then reported to the examination part, and here the medical officer saw him and filled in the history and physical examination results.

   (iii) He then reported to an orderly, who performed a complete urine test, a urethral smear, and also a prostatic smear if there was no discharge on that day.

(iv) The orderly, equipped with a second microscope, performed a dark ground examination if there were any lesion from which a specimen could be obtained.

(v) He then reported to the equipped truck, where blood was drawn for a Kahn test.

(vi) With these results entered on his card (excluding the Kahn, which required some time) he reported back to the medical officer and had treatment ordered.

(vii) Each day the patients, who were housed in the hospital cover, reported, and the results of therapy were evaluated.

There was a strong necessity for such a routine set-up, whereby cases pass smoothly from one department to another, and in which (where there are large numbers to be treated) the full personnel of the unit is actively engaged. With one man performing a routine test, very soon the man becomes highly expert, e.g., at staining a smear and reading it.

(e) Siting: The unit was invariably sited next to the Sick MDS, and for rations was served from the MDS cookhouse.

APPENDIX

Appendix

Venereal Disease in 2 NZEF

	1940		1941		1942	
	No. of Cases	Per 1000 tps per Month	No. of Cases	Per 1000 tps per Month	No. of Cases	Per 1000 tps per Month
Jan			62	4.20	126	2.39
	Egypt					
Feb	31	4.58	65	3.81	96	1.87
Mar	52	7.88	82	3.64	62	1.28
Apr	33	4.96	60	2.31	32	0.72
May	24	3.55	86	2.89	49	0.89
Jun	28	4.13	190	6.96	36	1.28
Jul	39	5.75	192	7.07	60	2.15
Aug	47	6.94	144	4.68	42	1.40
					Birket closed	
Sep	33	4.7	119	3.90	26	1.54
Oct	68	5.3	95	2.98	62	2.85
Nov	47	3.77	59	1.63	26	1.15
Dec	46	3.29	60	1.66	37	1.50
	448 *		1214 †		654	

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* Includes non-venereal; excludes 2 Echelon (UK) figures.

† Of these, 369 non-venereal.

	1943		1944		1945	
	No. of Cases	Per 1000 tps per Month	No. of Cases	Per 1000 tps per Month	No. of Cases	Per 1000 tps per Month
Jan	16	0.59	43	1.31	114	3.59
Feb	25	0.97	84	2.73	125	3.58

Mar	16	0.72	56	1.73	130	4.03
Apr	19	0.88	104	3.23	119	4.08
			Naples		Trieste	
May	24	1.00	217	6.33	299	9.61
Jun	37	1.54	178	5.22	401	12.33
			Rome			
Jul	56	1.84	217	6.43	279	8.76
					Lake Trasimene	
Aug	39	1.13	92	2.68	204	7.23
Sep	16	0.76	89	2.34	230	9.98
					Florence	
Oct	26	0.79	78	2.46	281	13.91
	2 Div in Italy					
Nov	44	1.33	96	2.92	491	29.24
Dec	55	1.70	107	3.36	402	23.46
	373		1361		3075	

Grand total: 7025 (includes over 369 non-venereal).

Venereal Cases, 2 NZEF

	Feb 1949–Feb 1945	Mar–Dec 1945	Total (Approx)
Syphilis	260	127	387
Gonorrhoea	1826	1687	3513
Venereal sore	1203	424	1627
Urethritis	476	341	817
Other VD	320	178	498
	4085	2757	6842

Year	Av. Strength of 2 NZEF	Rate per 1000 per Annum
1940	8875	50.5 *
1941	28,308	42.9 *
1942	30,151	21.7 *
1943	31,554	11.8
1944	32,538	41.8
1945	26,557	115.8

* Includes some non-venereal

II: SYSTEMIC AND CONSTITUTIONAL DISEASES

II: SYSTEMIC AND CONSTITUTIONAL DISEASES

CHAPTER 18
Dyspepsia

IN the Second World War dyspepsia among New Zealand troops overseas was an important cause of disability, as well as being a frequent reason for initial rejection. This experience was shared by other forces. In the First World War neither peptic ulcer nor dyspepsia of other types formed a problem of any magnitude, and the frequency of gastro-duodenal disorders in the later war was rather surprising. Investigations showed that in a majority of cases symptoms had dated from civilian life, and that there had been a very considerable increase in dyspepsia among civilians between the wars. The stresses and strains of modern life had no doubt played their part.

In the code of instructions for Medical Boards provision was made for rejecting cases of definite ulcer of the stomach or duodenum, but the mere complaint of indigestion with abdominal pain, even if extending over some years, was not a bar to placing the man in the grade for which he was otherwise suitable.

If a man had never consulted a doctor, had a healthy appetite, but stated that he occasionally had a little indigestion which did not worry him much, he was accepted. This resulted in a few men reporting sick in camp who, after X-ray, were found to have a duodenal ulcer. Gastric ulcer, however, was found to be very uncommon. On the introduction of conscription large numbers of men produced radiological evidence of duodenal ulcer and were placed in Grade III, 'not fit for camp'. This experience led to a revision of the code of instructions, and the revised code issued in the middle of 1942 laid down that 'if a Board is satisfied from the man's history, supported by medical evidence, that he has at any time suffered from a peptic ulcer, then he should not be placed higher than Grade III—unfit to live in camp.' Any doubt as to diagnosis or an unfavourable history had to be verified by X-ray and gastric analysis tests.

The ulcer cases were not admitted to camp because applications for pensions had been received, supported by medical certificates, that the ulcer had been caused or aggravated by service, and pensions had been granted to many of them.

In a total of 714 soldiers reboarded after entering camp in New Zealand up to

30 April 1940 there were 16 cases of peptic ulcer, 2 of gastro-enteritis, and 4 of dyspepsia.

In a survey of 1000 soldiers rejected from the Army in New Zealand and 2 NZEF up to January 1942 (630 from overseas and 370 in New Zealand) Hill and Goodson found that 8 per cent were rejected for disorders of the digestive system. This cause ranked fourth in the list of major causes, whereas in the Canadian and Australian Forces it was first and third respectively, as revealed by similar surveys. It was stated: 'Of 270 men rejected from the Canadian E.F. for digestive disorders, 251 were due to peptic ulcer—31 per cent of all rejections. This high figure was said to be due to a policy of returning home (from United Kingdom) all cases of peptic ulcer. The British E.F. policy is to return to civil life not only all proved cases but also the so-called functional dyspeptics with a long-standing history of gastric disturbance.'

A survey in 1943 in the United Kingdom showed that peptic ulcer was one of the major causes of wastage attributable to disease, whether the yardstick applied was its proportionate contribution to invalidings (13 per cent), deaths due to sickness (5 per cent), or to man-day wastage (1.3 per cent).

In a survey made by the National Service Department of the causes of rejection for military service in 1942 and 1943 in New Zealand it was found that stomach and duodenal disorders accounted for the rejection of 1.18 per cent of the recruits, a figure which placed this cause sixth in the common causes of rejection. The percentage of rejection advanced rapidly with the increasing age of the men examined.

As far as 2 NZEF was concerned, the problem of dyspepsia was early brought into prominence. In this connection the Consultant Physician of 2 NZEF, reporting on the Army Medical Conference, Cairo, in April 1942, said: 'The views put forward by various speakers on digestive disorders confirmed the conclusions arrived at in the special investigations which we have been making at 1 NZ General Hospital. Nervous dyspepsias are four times more numerous than organic. The organic cases first develop symptoms at a much earlier age than we have been accustomed to think, and a large majority originate in civil life.'

In a detailed analysis of 100 cases of dyspepsia admitted to 1 General Hospital from 2 NZEF as a whole from October 1941 to June 1942, Major C. G. Riley found that there were 18 cases of chronic ulcer, 37 cases of 'ulcer-like' dyspepsia without radiological evidence of a chronic ulcer, 40 cases of obvious nervous dyspepsia, and 5 miscellaneous cases. Of the chronic ulcer cases, two-thirds were returned to New Zealand and one-third downgraded for base duties; of the radiologically negative dyspepsias, one-quarter were returned to New Zealand and one-quarter graded for base duties; while of the nervous dyspepsias, just under one-fifth were returned to New Zealand and the same proportion graded for base duties. From the total of 100 patients 55 were down-graded, and of these, 32 were returned to New Zealand and 23 graded for base duties overseas. Some of the latter were subsequently returned to New Zealand. The average length of service in the Middle East for each group was twelve months or more.

Accurate hospitalisation figures are not available to show whether there was an increase in dyspepsia after the campaigns of Greece and Crete. It is probably significant to note that cases increased suddenly in July 1942 when 2 NZ Division, which had been in Syria, joined the Eighth Army, which had its back to the wall at El Alamein after the fall of Tobruk. This increase persisted until July 1943, by which time victory had been won in North Africa and long-service personnel were proceeding to New Zealand on furlough. Available records show the regimental units from January 1943 onwards, and it is to be noted from these that there was an undue proportion of cases of dyspepsia from base units. Probably a number of these were graded men who were re-hospitalised.

A very common cause of persistence of symptoms in graded men at Base was uncongenial work. Recommendations made by medical boards in regard to suitable work were not always implemented.

In Italy the number of cases of dyspepsia admitted to hospital remained steady and was not unduly large, the only noticeable increase being in December 1944, the final winter of the war, when the static warfare and frustration probably played their part.

Very large numbers were admitted to medical units with some type of digestive disorder, often minor in nature, and a large proportion of these were treated in field medical units and discharged direct to their units. Records show that the total such were 2768 in 1943, 3155 in 1944, and 2707 in 1945.

Figures for Admissions to Hospital and Invalidings

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In 2 NZEF (IP) there were 210 patients admitted to medical units for 'peptic conditions' from June 1943 to July 1944, and of these, 42 were returned to New Zealand and 71 graded for base duties.

Clinical Features

The discussion of the clinical aspects of dyspepsia as experienced in 2 NZEF is largely based on the investigation of Major Riley in 1942, and observations made from time to time by Colonel Boyd, the Consultant Physician.

Causes of Dyspepsia

Depression, anxiety, fatigue, and suggestion played an important part in the production of dyspepsia. Separation from home, true or imagined infidelity, family sickness, financial worry, or just boredom and discontent readily interfered with digestion. Army food, though not well tolerated by the soldier with a dyspeptic tendency, was not generally an important factor. As the Consultant Physician commented in 1942, 'Many cases of nervous dyspepsia are not due to army diet or "ulcer diathesis" but to army life and certain psychological factors.' The nervous strain of battle affected a few, and some men developed acute symptoms, such as retching or vomiting, during a battle.

Riley compared the ulcer (and ulcer-like) group with the nervous group. Just over a third of each group smoked more than twenty cigarettes daily, but only 10 per cent in each group admitted that they took more than an occasional alcoholic drink. A family history of dyspepsia was frequent in each group, and this affected a man in two ways. It provided him with a constitutional tendency to dyspepsia, with or without ulceration, and it also meant that he was surrounded in his early impressionable years by a stomach-conscious family. As one passed from the ulcer to the nervous group the influence of constitution gave place to that of environment. In the neurotic group depression, sleeplessness, and loss of appetite led to a loss of weight and energy. Food did not seem to be 'digested properly'; the soldier told his friends that he had 'no energy'. Sympathetically they suggested that he must have 'a gastric stomach'. The unhappy fellow eagerly clutched at this hint of escape from his troubles, and after frequent calls at the Regimental Aid Post he eventually set out on the path that led to X-rays, test meals, and repeated admissions to hospital.

Individual Symptoms

Pain was the chief symptom, although in the nervous group complaint of vomiting was just as frequent. Assessment of pain was difficult as it depends on the subjective sensibility, and the neurotic always tended to exaggerate his symptoms. In the ulcer and the 'ulcer-like' groups, pain was described as burning, aching, or gnawing. In the nervous group it was variously described as burning, aching, dragging, stabbing, pressing, sinking, cramping, and knot-like. Some actually likened it to a 'lump of ice', others to 'turning rollers' or 'rattling nails'. In the ulcer cases, both duodenal and pyloric, pain tended to come on two hours after a meal and to disappear immediately afterwards. In the 'ulcer-like' group the time interval after meals was often less than two hours, while in 51 per cent of the neurotics pain and meals had no constant relationship. In the nervous group the situation of pain was variable, e.g., near the umbilicus, over the whole abdomen, in the iliac fossae, or if it happened to be epigastric, right across the epigastrium. In most of the 'ulcer-like' cases and in all the ulcers pain was felt in one small area of the epigastrium. Periodicity was less common in the nervous group, many of whom complained of 'constant pain' or 'pain every day'. Alkalies relieved only 37 per cent of the nervous cases, while some even complained that it aggravated their pain. Appetite tended to diminish as one passed from the ulcer to the neurotic group.

Although many patients, especially the neurotics, complained of loss of weight, undernourishment was evident in only a few.

Diagnosis

Dyspeptics were not treated as outpatients during the period of Riley's investigations, but were all admitted to hospital for thorough investigation for an average period of seven to ten days. Rest was enforced and a milk diet given.

A test meal was given with specimens withdrawn every half hour. The stools were examined for occult blood after four days, and then a full radiological examination was carried out for the whole intestinal tract, the chest being screened at the same time. A further barium meal was given in ten days in cases of doubt.

Cholecystography, sigmoidoscopy, warm stool examinations, and ENT and dental examinations were made when thought fit. Phenobarbitone thrice daily was given to those with evidence of neurosis.

(a) Peptic Ulcers: A typical history was the first necessity before diagnosis of ulcer was considered. Burning pain in the epigastrium, heart-burn, and water-brash were the usual complaints. Localised tenderness was uncommon and hyperaesthesia noted only twice. Radiological examination was the most important procedure, but patience and caution were both needed. Pyloric ulcer was shown by persistent deformity. Duodenal ulcer was diagnosed if a deformity in the bulb was seen to be constant in appearance and was present on re-examination after seven to ten days' rest and milk diet. Twice only was a niche seen. No cases had a five-hour residue. Hyperchlorhydria was present in 4 per cent of ulcer cases. A therapeutic test of some value was the satisfactory response to rest and diet made by ulcer patients.

(b) Organic Dyspepsia:Under this heading were included cases of 'ulcer-like' dyspepsia, including gastritis, duodenitis, achlor-hydric, or hyperchlorhydric, dyspepsia, with negative radiological findings. Symptoms were similar to the ulcer group. A few showed some radiological abnormality such as duodenal spasm or rapid emptying of the stomach; 16 per cent hyperchlorhydria, 13 per cent hypochlorhydria, and 8 per cent had achlorhydria. They responded well to treatment in most cases, and loss of appetite was less frequent than in the nervous group.

(c) Nervous Dyspepsia: This group comprised patients suffering from obvious anxiety or hysteria, whose symptoms were not like those of a case of peptic ulcer. The history was generally confused and contradictory. Retching and vomiting was a common feature. A personal or family history of nervous disorder was usually obtained, and the patient's facial expression revealed his state of anxiety. Barium meals revealed no abnormality apart from rapid emptying of the stomach in a few cases. Fourteen per cent had hyperchlorhydria, 2 per cent had hypochlorhydria, and none achlorhydria. Appetite was capricious or absent, and response to rest and diet rare. Sedatives and occupational therapy were more effective than diet.

A diagnosis of 'reflex dyspepsia' was not made in any case.

The average duration of symptoms in the three groups was 7 years, 4 years, and 4¾ years respectively, the individual range being from 6 months to 18 years.

Diagnostic Criteria

The relative values of diagnostic criteria as they proved themselves in 2 NZEF in Egypt were discussed by Riley. These were stated to be (in order of importance):

(a) Haemorrhage or perforation.
(b) History.
(c) Radiological appearances.
(d) Response to treatment.
(e) Gastric analysis.
(f) Occult blood test.

(a) Haemorrhage and perforation need not be discussed.

(b) A history given by a patient was not necessarily reliable, since the common dyspeptic symptoms were well known and not infrequently discussed by soldiers. However, a patient's story and his reliability as a witness had to be assessed together.

(c) X-ray examination was subject to the limitations of the apparatus available. The radiologist, however, was satisfied that he could say with some degree of certainty that a given stomach or duodenum was not the site of a chronic ulcer.

(d) Ulcer cases and 'ulcer like' dyspeptics made some response to treatment while the neurotics were unaffected by rest, diet, and alkaline therapy.

(e) The value of this test depended to some extent on the mechanical skill of the operator. The nervous group had the least number of abnormal acid curves. Achlorhydria was found only in the 'ulcer like' dyspeptic group.

(f) This test proved insufficiently sensitive due to poor reagents.

Response to Treatment

The ulcer cases lost their symptoms a few days after the commencement of treatment, and were then given four to six weeks' rest and diet with alkalies, belladonna, and olive oil. Sixty-eight per cent were subsequently returned to New Zealand. The remainder, since they already held a position at the Base as clerk, doctor, quartermaster, or hospital orderly, were regraded II and retained in the overseas force provided they could look after themselves. All of these Grade II men managed satisfactorily at least during the succeeding nine months.

'Ulcer like' dyspeptics in most cases responded to four to six weeks' gastric regime, though a number relapsed when returned to ordinary diet. One probable case of gastritis recovered after his antrum had been drained, and denture fitted, and his stomach lavaged daily for three weeks.

The type of case in which fatigue and general debility played an important part responded well to ten days' rest and light diet, followed by a change of surroundings at a convalescent depot.

The nervous cases were retained in hospital for a short time only, since prolonged hospitalisation led to further introspection and neurosis. After ten to fourteen days' rest, with sedatives, explanation, and encouragement, and if necessary two to three weeks at a convalescent depot, an attempt was made to return the nervous dyspeptic to his unit—if he had not previously been in hospital for the same complaint. The dietetic aspect was not stressed in these cases, for it had little influence on their well-being.

Disposal

Nearly 50 per cent of the 'ulcer like' and nervous dyspeptics were eventually regraded. Regraded men included the patient who was classified as a hopeless neurotic from the beginning, the patient whose symptoms recurred during convalescence, and the patient who after returning to his unit was again evacuated to hospital. Some regraded men of all types improved while performing lighter duties under more favourable conditions at the Base, but it is probable that over half of them continued to have symptoms. A quarter of these men had eventually to be returned to New Zealand—though the follow-up was not complete—and this applied especially to the nervous dyspeptic whose longing for home, once he had been regraded as unfit for the field, became intensified. This state of mind was greatly aggravated by boredom and lack of congenial occupation. His complaints increased in variety and intensity until he was sent home. It was fortunate that we were able to evacuate men of this type, for not only did their suitable employment create a difficult problem, but they were a bad influence amongst the troops at the Base.

Boarding Criteria

Grade I: 'Ulcer like' or nervous dyspeptics who showed marked improvement after hospital treatment, with or without a period at a convalescent depot.

Grade IA (temporary grading only): Radiologically negative dyspeptics who required prolonged treatment but who were likely to be fit within three months.

Grade II: The usual grading for base duties overseas. It included 'ulcer like' or nervous dyspeptics who made only slight improvement after hospital treatment, with or without a period at a convalescent depot; and men who, after one admission to hospital, were again evacuated from their units. It also included ulcer cases amongst men whose rank or occupation enabled them to look after themselves.

Grade III (returned to New Zealand): 'Ulcer like' or nervous dyspeptics with persistent symptoms, who had had repeated hospitalisation, and who were incapable of base duties. Some of these men would improve in New Zealand and be able to remain in the home forces.

Grade IV (returned to New Zealand): Haematemesis. Malaena. Perforation. Previously operated-upon stomach or duodenum. Radiologically proven ulceration in men who had no special position or suitable occupation. Such men were regraded as being unfit for military service.

As a result of his investigations Riley strongly recommended that the indefinite and nervous dyspepsias should be retained in their units and treated by the RMO. In his opinion (and this was strongly supported by Colonel Boyd, Consultant Physician 2 NZEF) hospitalisation aggravated the position.

Pensions Experience

Medical examiners for war pensions in New Zealand saw several cases of active tuberculosis in men returned to New Zealand for nervous dyspepsia and in one diagnosed overseas as probably a gastric ulcer. Some of the nervous dyspepsia cases had developed duodenal ulcer, thus showing a neurotic predisposition to peptic ulcer. Many again were later proved to have chronic amoebiasis even when there had been no previous suspicion of this infection.

With the high incidence of peptic ulcer in the community the development of the disease in any overseas force was inevitable, however careful the initial medical examinations might be.

The importance of dyspepsia in returned service personnel is shown by the totals of disabilities recorded by the War Pensions Branch up to 31 March 1949: dyspepsia, 1655, duodenal ulcer, 1063; and gastric ulcer, 49.

Summary

Important aspects of the problem of dyspepsia in army administration may be summarised as follows:

1. Dyspeptics with a definite and confirmed history of dyspepsia should not be accepted in the Army for overseas service.
2. If accepted on a lower grade for Home service they should be posted so that they can have their meals at home.
3. In the Army every effort should be made to retain and treat a man in his unit, and consultation should be arranged at that level. If a man is evacuated to Base he seldom returns to his unit.
4. If the history and assessment of the patient warrants it a man should be returned at once to New Zealand without prolonged investigation and treatment at Base.

[SECTION]

IN the Second World War dyspepsia among New Zealand troops overseas was an important cause of disability, as well as being a frequent reason for initial rejection. This experience was shared by other forces. In the First World War neither peptic ulcer nor dyspepsia of other types formed a problem of any magnitude, and the frequency of gastro-duodenal disorders in the later war was rather surprising. Investigations showed that in a majority of cases symptoms had dated from civilian life, and that there had been a very considerable increase in dyspepsia among civilians between the wars. The stresses and strains of modern life had no doubt played their part.

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If a man had never consulted a doctor, had a healthy appetite, but stated that he occasionally had a little indigestion which did not worry him much, he was accepted. This resulted in a few men reporting sick in camp who, after X-ray, were found to have a duodenal ulcer. Gastric ulcer, however, was found to be very uncommon. On the introduction of conscription large numbers of men produced radiological evidence of duodenal ulcer and were placed in Grade III, 'not fit for camp'. This experience led to a revision of the code of instructions, and the revised code issued in the middle of 1942 laid down that 'if a Board is satisfied from the man's history, supported by medical evidence, that he has at any time suffered from a peptic ulcer, then he should not be placed higher than Grade III—unfit to live in camp.' Any doubt as to diagnosis or an unfavourable history had to be verified by X-ray and gastric analysis tests.

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In a survey of 1000 soldiers rejected from the Army in New Zealand and 2 NZEF up to January 1942 (630 from overseas and 370 in New Zealand) Hill and Goodson found that 8 per cent were rejected for disorders of the digestive system. This cause ranked fourth in the list of major causes, whereas in the Canadian and Australian Forces it was first and third respectively, as revealed by similar surveys. It was stated: 'Of 270 men rejected from the Canadian E.F. for digestive disorders, 251 were due to peptic ulcer—31 per cent of all rejections. This high figure was said to be due to a policy of returning home (from United Kingdom) all cases of peptic ulcer. The British E.F. policy is to return to civil life not only all proved cases but also the so-called functional dyspeptics with a long-standing history of gastric disturbance.'

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(a) Haemorrhage and perforation need not be discussed.

(b) A history given by a patient was not necessarily reliable, since the common dyspeptic symptoms were well known and not infrequently discussed by soldiers. However, a patient's story and his reliability as a witness had to be assessed together.

(c) X-ray examination was subject to the limitations of the apparatus available. The radiologist, however, was satisfied that he could say with some degree of certainty that a given stomach or duodenum was not the site of a chronic ulcer.

(d) Ulcer cases and 'ulcer like' dyspeptics made some response to treatment while the neurotics were unaffected by rest, diet, and alkaline therapy.

(e) The value of this test depended to some extent on the mechanical skill of the operator. The nervous group had the least number of abnormal acid curves. Achlorhydria was found only in the 'ulcer like' dyspeptic group.

(f) This test proved insufficiently sensitive due to poor reagents.

RESPONSE TO TREATMENT

Response to Treatment

The ulcer cases lost their symptoms a few days after the commencement of treatment, and were then given four to six weeks' rest and diet with alkalies, belladonna, and olive oil. Sixty-eight per cent were subsequently returned to New Zealand. The remainder, since they already held a position at the Base as clerk, doctor, quartermaster, or hospital orderly, were regraded II and retained in the overseas force provided they could look after themselves. All of these Grade II men managed satisfactorily at least during the succeeding nine months.

'Ulcer like' dyspeptics in most cases responded to four to six weeks' gastric regime, though a number relapsed when returned to ordinary diet. One probable case of gastritis recovered after his antrum had been drained, and denture fitted, and his stomach lavaged daily for three weeks.

The type of case in which fatigue and general debility played an important part responded well to ten days' rest and light diet, followed by a change of surroundings at a convalescent depot.

The nervous cases were retained in hospital for a short time only, since prolonged hospitalisation led to further introspection and neurosis. After ten to fourteen days' rest, with sedatives, explanation, and encouragement, and if necessary two to three weeks at a convalescent depot, an attempt was made to return the nervous dyspeptic to his unit—if he had not previously been in hospital for the same complaint. The dietetic aspect was not stressed in these cases, for it had little influence on their well-being.

Disposal

Nearly 50 per cent of the 'ulcer like' and nervous dyspeptics were eventually regraded. Regraded men included the patient who was classified as a hopeless neurotic from the beginning, the patient whose symptoms recurred during convalescence, and the patient who after returning to his unit was again evacuated to hospital. Some regraded men of all types improved while performing lighter duties under more favourable conditions at the Base, but it is probable that over half of them continued to have symptoms. A quarter of these men had eventually to be returned to New Zealand—though the follow-up was not complete—and this applied especially to the nervous dyspeptic whose longing for home, once he had been regraded as unfit for the field, became intensified. This state of mind was greatly aggravated by boredom and lack of congenial occupation. His complaints increased in variety and intensity until he was sent home. It was fortunate that we were able to evacuate men of this type, for not only did their suitable employment create a difficult problem, but they were a bad influence amongst the troops at the Base.

BOARDING CRITERIA

Boarding Criteria

Grade I: 'Ulcer like' or nervous dyspeptics who showed marked improvement after hospital treatment, with or without a period at a convalescent depot.

Grade IA (temporary grading only): Radiologically negative dyspeptics who required prolonged treatment but who were likely to be fit within three months.

Grade II: The usual grading for base duties overseas. It included 'ulcer like' or nervous dyspeptics who made only slight improvement after hospital treatment, with or without a period at a convalescent depot; and men who, after one admission to hospital, were again evacuated from their units. It also included ulcer cases amongst men whose rank or occupation enabled them to look after themselves.

Grade III (returned to New Zealand): 'Ulcer like' or nervous dyspeptics with persistent symptoms, who had had repeated hospitalisation, and who were incapable of base duties. Some of these men would improve in New Zealand and be able to remain in the home forces.

Grade IV (returned to New Zealand): Haematemesis. Malaena. Perforation. Previously operated-upon stomach or duodenum. Radiologically proven ulceration in men who had no special position or suitable occupation. Such men were regraded as being unfit for military service.

As a result of his investigations Riley strongly recommended that the indefinite and nervous dyspepsias should be retained in their units and treated by the RMO. In his opinion (and this was strongly supported by Colonel Boyd, Consultant Physician 2 NZEF) hospitalisation aggravated the position.

PENSIONS EXPERIENCE

Pensions Experience

Medical examiners for war pensions in New Zealand saw several cases of active tuberculosis in men returned to New Zealand for nervous dyspepsia and in one diagnosed overseas as probably a gastric ulcer. Some of the nervous dyspepsia cases had developed duodenal ulcer, thus showing a neurotic predisposition to peptic ulcer. Many again were later proved to have chronic amoebiasis even when there had been no previous suspicion of this infection.

With the high incidence of peptic ulcer in the community the development of the disease in any overseas force was inevitable, however careful the initial medical examinations might be.

The importance of dyspepsia in returned service personnel is shown by the totals of disabilities recorded by the War Pensions Branch up to 31 March 1949: dyspepsia, 1655, duodenal ulcer, 1063; and gastric ulcer, 49.

SUMMARY

Summary

Important aspects of the problem of dyspepsia in army administration may be summarised as follows:

1. Dyspeptics with a definite and confirmed history of dyspepsia should not be accepted in the Army for overseas service.
2. If accepted on a lower grade for Home service they should be posted so that they can have their meals at home.
3. In the Army every effort should be made to retain and treat a man in his unit, and consultation should be arranged at that level. If a man is evacuated to Base he seldom returns to his unit.
4. If the history and assessment of the patient warrants it a man should be returned at once to New Zealand without prolonged investigation and treatment at Base.

CHAPTER 19 — NEUROSIS

Contents

WAR SURGERY AND MEDICINE

[SECTION]

‘ In war the spiritual is to the material as three to one.’—

Napoleon

LITTLE appreciation of the problems of neurosis was shown during the early part of the First World War, and there were even courts martial imputing cowardice to men suffering from the effects of battle strain. Later the pendulum swung the other way and cases of war neurosis were labelled ‘shell shock’, though the large majority had never been affected by any concussion.

Special centres were formed in England, notably by Sir Arthur P. Hurst at Seely Hay, for the study and treatment of these cases. Psychoanalysis and persuasion were the basis of the treatment adopted, but hysterics were treated by suggestion, aided sometimes by anaesthesia. Loss of voice was comparatively common in hysteria escape syndrome.

In the 1914–18 War the percentage of those invalided in British hospitals through neurosis rose on occasion to 40 per cent and, in 1918, of 100,000 pensioners, 32,000 were functional nervous and mental cases. Three years later the number rose to 65,000, and even in 1938, 29,000 were still drawing pensions. There were also 44,000 pensions granted for effort syndrome, which was looked upon as an organic disability.

In New Zealand pensions were also granted for shell shock and effort syndrome. From 1 NZEF, from May 1916 to December 1918, 1370 men were invalided to New Zealand with nervous disease or shell shock. This was about 10 per cent of the sickness invalidings over the period.

BETWEEN THE WARS

Between the Wars

A committee appointed in the United Kingdom in 1922 advised the elimination of the term ‘shell shock’, pointing out that neurosis in the soldier differed in no way from that in the civilian. In New Zealand provision was made for the rehabilitation and treatment of these cases by the institution of Queen Mary's Hospital at Hanmer for nervous disorders, and excellent work was carried out. The hospital has continued in the same capacity and was available for the treatment of cases arising during the Second World War.

SECOND WORLD WAR

Second World War

During the Second World War perhaps the major problem in war medicine was that of the breakdown of personnel from psychotic and psychoneurotic disabilities. Up to September 1942 there had been 38,000 discharges from the British Army on account of neuroses, but at that time only 5.7 per cent were granted pensions. The total was about one-third of the total invaliding, a figure which was stated to be comparable to the incidence of psychiatric illness in civil life in the United Kingdom and other countries.

Arrangements in New Zealand

In the selection of recruits for overseas service no special stress was laid on the problem of mental instability until reports came back from 2 NZEF that men who had previously been in mental hospitals had been taken overseas. Arrangements were then made to have the names of all men accepted for the forces submitted to the Mental Hospitals Department for checking up, so as to eliminate any man known by the Department to be unsuitable.

No provision was made for the psychiatric examination of recruits, and the Mental Hospitals Department considered this undesirable, as well as impracticable, owing to shortness of qualified staff. Psychiatrists were available if necessary for consultation. A psychiatrist was appointed to act in a consultant capacity for cases referred from military camps, and by this means many unsuitable recruits were eliminated from the forces.

War Cabinet, at a meeting on 18 October 1940, decided that early provision be made for the reception and treatment of neurasthenics and cases of a like nature on their return to New Zealand. A special conference of the Organisation for National Security was held on 24 October 1940 and submitted a report to Cabinet covering the question. This report, which was approved, stressed the necessity of full and accurate case histories, and recommended the setting up of a specialist medical board to include psychiatrists to examine all such cases on arrival in New Zealand from overseas and arrange for their disposal and treatment.

All cases requiring institutional treatment were to be admitted to the psychiatric wards of the public hospitals in the four main centres, and other cases were to be referred to psychiatric clinics near their home town. Admission to a mental hospital was to be arranged for when necessary. Cases not likely to be fit for return to duty were to be discharged from the forces and arrangements made for rehabilitation. The report was strongly opposed to the segregation of service personnel in special institutions and advised their admission to the ordinary civil mental hospitals. This report was forwarded to Medical Headquarters 2 NZEF, and the DDMS, commenting on it, stated that up to the end of 1940, 36 cases of anxiety neurosis had been admitted to hospital, of whom 20 had been returned to New Zealand.

Early Experience in 2 NZEF

Early in 1941 the DDMS 2 NZEF considered the number of cases of neurosis to be unduly high for the conditions of service met with up to that stage. He set up a board consisting of senior medical officers from the base hospital and the Division, under the chairmanship of a psychiatrist, to report on measures that should be taken for the prevention, treatment, and disposal of such cases, with special reference to officer personnel.

The board, after hearing evidence from medical officers representative of the divisional units and base hospitals, presented its report. It pointed out that the Force had up till then experienced no active fighting and only slight bombing, and that there had been no prolonged stress of any kind. It recalled that in the 1914–18 War early incidence of the neuroses was experienced, a large percentage of the total cases occurring in men who had no front-line service at all. This meant that a number of men were, in varying degrees, improperly adjusted to army environment and broke down readily.

In the numerous cases of anxiety state the breakdown was primarily due to an inherent and, in some cases, hereditary psychological inferiority. No amount of training would make such men efficient soldiers. Any normally adjusted man might crack under prolonged emotional stress, but in these ill-adjusted men the common associations of army life, such as separation from wife and family, restrictions on liberty, discipline, and monotony, precipitated a breakdown.

The board found that the number of cases of mental breakdown was not unduly high, and that regimental medical officers agreed that practically all the cases arose in misfits quite unsuited for service. A neuropathic condition, hereditary or acquired, was present in the majority of cases, and physical and mental fatigue was a precipitating factor. Histories of onset given by the patients had been accepted without corroboration by medical officers in charge of the cases, and in the cases of persistent cerebral contusion there was rarely any corroborative evidence of injury.

There was no evidence that alcohol had been a factor in causation. In few cases was there any evidence of prolonged mental stress, and the mental diseases resembled those met with in civil life.

The board recommended that at enlistment there should be an elimination of persons with previous histories of nervous or mental disorder and of head injury with persisting complaints, and that a psychiatrist should be appointed to each of the training camps in New Zealand. Strong emphasis was placed on the importance of training and discipline as a means of reducing the number of cases of breakdown. Allied to these controls were welfare measures such as food, sports, entertainment and leave.

In the matter of disposal it was recommended that generally cases of hysteria and anxiety neurosis should be evacuated to base hospital; that acute emotional shock should be treated by rest in rear areas; and that unsatisfactory cases of anxiety neurosis should be selected for return to New Zealand, undergoing vocational therapy at the convalescent depot prior to embarkation.

This report was commented on by the GOC 2 NZEF and by the DDMS. The former stressed his opinion that good feeding and entertainment were beneficial to the men, and that platoon commanders could by careful planning prevent men becoming nervy; and that medical officers should lecture the men on the need for care, warmth, and entertainment. The DDMS considered the practical point was the necessity to get confirmation of the soldier's story from the commanding officer of his unit, and forms were printed to enable facts to be elicited for the guidance of medical officers.

Observations in a Base Hospital

In October 1941 Colonel Spencer, CO 2 NZ General Hospital furnished a long and thorough report on anxiety neurosis based on a year's experience at the base hospital. Recognising that a large number of men had become psychiatric casualties before ever they came under enemy action, he had endeavoured to assess the nervous and physical make-up of a large number of soldiers regraded for return to New Zealand. One problem he dealt with, amongst others, was the association of nervous symptoms with organic abnormalities. In the Army the chronic neurotic revealed himself by his constant attendance at the medical inspection room on account of his recurrent headache, backache, painful feet, gastric complaints, and other psychosomatic symptoms. He was tense and over-anxious and did not concentrate on his work on account of his preoccupation with his disabilities.

Men complained of minor organic malformations such as foot deformities and varicose veins, which were normally ignored in civilian life. The man's mental attitude was the deciding factor in the disability. The condition was fastened on as a way of escape from the danger and boredom of army life and it was difficult to deny some disability. It was wrong policy for an MO to draw attention to any presumed abnormality of the feet.

Men played on past illnesses. A common illustration was the persistent headache complained of by men with a previous head injury (often many years before), sometimes associated with concussion. In most cases the man had carried on with his civil occupation. The cases proved an encumbrance and were best sent to New Zealand for Home Service.

In relation to old operative scars, symptoms complained of could not be assessed and the scars acted as an excuse to the soldier. In dyspepsia an underlying nervous factor was very frequently present. When ulcer was suggested to the patient it was difficult to effect any improvement.

It was recommended that constant reminders should be given to medical officers that all suggestion to soldiers parading sick must be positive, i.e., towards feeling well; and that they should rarely be given a diagnosis, or peg, on which symptoms could be hung and added to until a full-grown complex was evolved, which meant down-grading or invaliding.

CASES AS SEEN ON HOSPITAL SHIP RETURNING TO NEW ZEALAND

Cases as Seen on Hospital Ship Returning to New Zealand

From experience of psychoneurotic cases on the Hospital Ship Maunganui during the first two voyages in 1941, Captain Aiken noted that the number of cases developing in men who had never been engaged in fighting was highly significant, and in not a few symptoms were apparent before arrival in Egypt. The number of psychotic cases was small, no more than would be present in a similar civilian group, and the earliest symptom was often a tendency to delinquency.

In a survey of the cases of anxiety neurosis he found that half were over thirty-five years of age, the largest group being forty years and over. Of the fifty-five cases, a history of previous breakdown occurred in 20 and a family history in 22. Less than half the cases had been engaged in Greece and Crete and the rest had had no battle experience, but 60 per cent had had eighteen months in the Army.

Later Experiences in 2 NZEF

The problem as seen by the Board of Inquiry was one solely associated with the reactions to change of environment and mode of life. When the Division was involved in actual combat other factors came into play, associated with the stresses and strains of bombing, shellfire, and exhaustion.

At a conference of New Zealand medical officers in August 1943 Major Caughey summed up the position: predisposing factors were a lowering of individual morale (noise, near-escapes, and anything lowering resistance, such as infective hepatitis, dysentery, and desert sores), or a lowering of group morale. In this latter regard the progress of the campaign was all-important. In the static period at Alamein cases were numerous, but after the breakthrough there was a progressive decrease in incidence.

In July 1942, during the hard fighting at and after Minqar Qaim and Ruweisat, the psychiatric casualties were 334. In August and September, when the Alamein Line was being held in the heat of summer with the added trial of flies, the numbers were 155 and 66. In October, with the added stress of the Battle of Alamein, the number rose to 106, but fell rapidly during the victorious advance from 57 to 25 a month till with the Mareth battle it rose again to 134. In May and June there were sharp drops to 27 and 8 respectively. The 4th Field Ambulance, in 3000 battle casualties passing through the unit from June to October 1942, had 300 nervous cases, 10 per cent of the total.

Confidence in the higher command and in equipment lowered the incidence of neuroses. Unit morale depended on the CO and the MO to a surprising extent. Age and rank were found not to have any significance. Length of service was of some importance, and prolonged service in the forward area tended to lower the resistance to psychoneurotic illness. In this regard it was of importance for the RMO to ensure that men showing any early signs of neurosis, such as slight changes in personality and behaviour, minor psychosomatic illness or loss of weight, should be rested and given leave from the forward areas.

Major J. Russell stated that 5 per cent was the average figure for psychiatric casualties, and this was the figure for the Division during the North African campaign in 1942–43, over half the cases arising during the withdrawal to Alamein in the first two months. There were great unit differences, sometimes depending on the MO or the CO being taken prisoner, killed or lost. (Of seven battalions equally engaged from 26 October to 30 November 1942, the incidence of nervous breakdown varied as follows: 24, 23, 0, 8, 22, 16, 12.) If a unit got a bad name there was a great collapse of morale, evidenced by frequent desertions and rise of nervous disorders.

Every individual has his eventual breaking point, and continued battle stress produced both physical and mental exhaustion. In the Tunisian campaign in April 1943, of 400 battle casualties 40 per cent were nervous disorder cases (NYDNs). The types seen included those with panic state occurring usually during battles, those with somatic symptoms as well, e.g., gastric symptoms; but a number were cases of pure physical exhaustion, just 'done in', with no nervous system involvement.

A survey at 3 NZ General Hospital at Tripoli, covering the period of six weeks ended 31 May 1943, showed that neurotic casualties totalled 72, while wounded admitted to the hospital numbered 478. Most of the nervous cases were of anxiety neurosis; half the admissions had long service of two to three and a half years. In these long-service men a gradual deterioration had been noted, with several diverse factors as causes. The precipitating factor in one group of twelve was a period of forty-eight hours' constant shelling.

As regards disposal, 10 of the 11 physical exhaustion cases were returned to their units; of the remaining 61, 22 were returned to their units, 3 were boarded for New Zealand, 36 were graded for base duties. The men suffering from physical or nervous exhaustion in the forward areas usually reacted more favourably to treatment because of their more stable personalities.

The Maori Battalion had the excellent custom for a man in his first battles to be closely attached to experienced campaigners to give him confidence, and it had a proud record, but by the end of the North African campaign some of the men of the unit, and of other units, had become exhausted.

In August 1943 a special board was set up to examine 22 Maori soldiers of 28 Battalion, the board having as its chairman Major Russell, consultant psychiatrist to 2 NZEF. Of the cases:

(a) One man was so mentally dull and backward that his return to New Zealand was recommended.
(b) Two men with least service had been nervous in action, the first after severe bombing on his first day, and the other after wounding.
(c) Nineteen cases had experienced strenuous service, 11 having been through Greece and Crete. Quite a number had been wounded on at least two occasions, one man three times, and some had nervous incapacities remaining. They had all been good soldiers, but had eventually broken down. All were worried and were mentally and physically tired and certain of their inability to go into action again. Emotional incidents played a part in some cases, but extended strenuous service was the main cause in all. They all required boarding and an extended period of rest.

In the Italian campaign no fresh problems arose, but the majority of cases were due to nervous and physical exhaustion. The incidence varied considerably according to the stress and, particularly, according to the morale and success of the campaign. As at the time of the breakthrough by the enemy to El Alamein in 1942, the period in Italy in early 1944 after the remnants of the first three echelons had returned from furlough was the second occasion when the morale of the Division was below its usual high level, and a noticeable temporary increase in the incidence of neurosis occurred. It has also, of course, to be appreciated that the fighting at these periods was also the most severe. The ADMS 2 NZ Division, Colonel R. King, took a keen interest in the problem and encouraged his RMOs in the weeding-out of personnel and in the resting of soldiers showing signs of exhaustion.

Prevention was of the utmost importance, and the RMO was in the key position in this regard. While his battalion was at the Base it was his duty to comb through his men and eradicate all those who were obviously constitutionally unfitted to be fighting soldiers. This culling was necessary at all times and could be readily carried out in the quieter intervals. Opportunities for holding neurosis cases in battle were very small, either in advance or in retreat, but it was advised that in static periods such casualties be held at least for a day or two, treated by the RMO with sedatives and rest, then assessed. Questions to be considered were: Is the soldier going to be of use in forward areas again? Will his presence affect unit morale? Is he in a constitutional group predisposed to neurosis? It was advised that reasons for sending a soldier back from his unit should be recorded, giving the opinion of the MO and CO as to whether the man would be of further service in a forward area.

INCIDENCE IN 2 NZEF

Incidence in 2 NZEF

As far as the New Zealand Force as a whole was concerned, neurosis and exhaustion made up just over 3 per cent of all sickness admissions to hospital (neurosis 2.11 per cent, physical and nervous exhaustion 1.26 per cent).

There were 1927 nervous cases invalided to New Zealand during the war, and they fell into the following categories: anxiety neurosis 692, nervous exhaustion 163, schizophrenia 84, psychopathic personality 72, depression 94, while other miscellaneous cases totalled 822.

To this chronological account must be added some reference to several special problems in the handling of neurosis in 2 NZEF.

NOMENCLATURE

Nomenclature

Medical officers, partly through a relative ignorance of psychiatry, were often unable to agree as to the appropriate diagnosis in nervous disorders not necessarily associated with battle stress. At first diagnoses were made by the RMOs and by forward units, but it was later decided that the diagnosis be left to medical officers at the base hospitals when the patients were sent there. Fewer people were responsible, and the diagnoses they commonly used were: dullness and backwardness (to describe those with low intellectual capacity); psychopathic personality (to designate those who were potentially unstable); hysteria (for those showing physical manifestations); anxiety neurosis (to describe the commonest type); and psychoses.

Nervous disorders associated with battle stress created other difficulties in nomenclature. These were at first differentiated into 'battle casualties' and 'sick', depending on the patient's personal experience, but after June 1943 all cases breaking down through battle stress were called 'sick'. At that time too it was realised that the diagnoses 'physical exhaustion' and 'nervous exhaustion' were the most suitable ones for many of these cases, and they became established in the nomenclature, though they were not listed in the official Nomenclature of Diseases.

SYMPTOMS

Symptoms

In a study of psychoneurosis cases treated in 2 NZEF in 1942 and 1943, Major Caughey stated that the symptoms shown by men differed, some showing acute symptoms with or without terror, with reactions of panic or stupor. Others showed various forms of psychosomatic disorders with or without depression. The signs might be referable to the cardio-vascular, the gastro-intestinal, the visual, the cerebral, nervous or motor systems, or to two or more of these systems. Generalised signs might be slight proptosis, fine tremors of the outstretched hands, sweating of the hands and feet, loss of weight, anorexia, restlessness, tachycardia, diarrhoea, frequency of micturition and insomnia. It was very common to find a state of reactive depression, superimposed on a state of anxiety, often the result of insomnia. When sleeping these patients were often disturbed by anxiety dreams such as battle dreams. Gastric symptoms were very common, with loss of appetite and sometimes vomiting. The cardiac type previously called effort syndrome showed shortness of breath, fatigue, palpitation, left mammary pain, giddiness, and headache. The symptoms following head injury, such as persistent headache, dizziness, lack of concentration, visual fatigue and depression, formerly thought to be the sequelae of concussion, were now believed to be entirely due to neurosis.

Lieutenant-Colonel Caughey, at 2 NZ General Hospital at Caserta in 1944, carried out investigations, using Raven's Matrices test, as to the relation between intelligence and neurosis. Grades of intelligence in a neurotic group were found to correspond substantially with the grades in a non-neurotic group, but in the neurotic group there were more below-average persons, a number of above-average persons, and fewer persons of average intelligence.

TREATMENT IN THE FORWARD AREAS

Treatment in the Forward Areas

In the forward areas management was concerned more with physical and nervous exhaustion. At first all these cases were evacuated to the Base. It was then found that this resulted in very few ever getting back to the forward units. The farther they went back the longer they stayed and the less likely were they ever to be fit to return to their units. Then some were held in the Field Ambulances for a few days and returned to their units direct. It was found that this was satisfactory in many cases, especially in those men suffering from exhaustion and not specially prone to psychological upset.

At Alamein a Rest Centre was established by 4 Field Ambulance in an ideal situation on the coast, and exhaustion cases were sent there. Of 33 admissions, 11 were evacuated to hospital and 22 went back to their units; nearly all of these men were working in their units three months later.

In Italy these cases were normally retained and treated in the Field Ambulances if conditions were satisfactory, and considerable numbers were thereby saved to forward units.

The essential preliminary treatment was rest, and this was generally ensured by adequate doses of sedatives. Luminal up to gr. iii daily was usually given. If possible hot showers were provided and ample nourishing food. Enemas were given and purgatives as required, as constipation was common. When adequate rest had been obtained, occupation was essential and strict discipline was enforced. The days' timetables were carefully arranged so as to balance rest and healthy occupation.

Interviews were arranged by the medical officers and the condition of the patient discussed fully and explained and all reassurance given. Normally in four or five days' time the man was fit to return to his unit. Cases not responding were evacuated to the base hospital. It was realised that few of the cases sent to Base would return as front-line troops. The best results were obtained in cases not psychologically unstable who were suffering from temporary exhaustion.

In the 2 NZEF there were never any special exhaustion centres, such as the British Army instituted, where psychiatrists undertook the treatment of cases referred from the forward units. The same type of treatment, however, was carried out in the divisional area by the utilisation of the Field Ambulances, generally the resting Field Ambulance, being employed as a Rest Centre for this purpose. There are no records of the percentage of cases sent back to the combatant units. A considerable percentage, probably the majority, were referred to the Base for grading and then placed in some suitable occupation.

More elaborate forms of treatment were carried out in the special British forward centres, but not in the New Zealand units. Continuous sleep treatment for three to five days was utilised at one time, but the results were not very satisfactory. Narco-synthesis was also used extensively in some centres, the patient re-enacting his experiences whilst under sedation. Lieutenant-Colonel John Russell, who acted as psychiatric adviser to 2 NZEF, was not in favour of this form of treatment and thought that the purpose could be better served by frank and dispassionate discussion with the patient. He did not believe that the patients forgot their experiences, but that they tried to hide them. Lieutenant-Colonel Russell was quite satisfied with the results obtained in the Division by simple methods, particularly the early treatment of exhaustion by adequate sedation and supportive measures.

Treatment: At the Base

The more severe cases from the forward areas were sent back to the base hospitals for further treatment. They included the exhaustion cases not responding to the four or five days' rest, and the more severe anxiety states. The cases, though not severe, deemed no longer suitable for front-line service were sent for grading direct to the base camp.

The hospital cases were given further sedation and rest, followed by reassuring interviews. Adequate dosage of sedatives was necessary. There was a tendency always to give too little: 3 grs. of phenobarbitone soluble intramuscularly was necessary for severe anxiety states and morphia in doses of ½ gr. with .01 gr. of hyoscine. Such dosage would in most cases ensure rest where repeated smaller doses might have little effect, and repetition was often unnecessary.

Cases evacuated to hospital were considered very largely to be cases unlikely to return to combatant duties. At the same time it was just as necessary for these cases to be reassured and built up. Frank discussion was most necessary at this stage, and it was found that a large proportion of cases, in discussing their condition, did fully appreciate it and, realising that they were unable to face battle conditions, wished to do what they could. Any indication of such desire was grasped with both hands by the examiner and encouragement given. In the absence of any such indication by the patient it was explained to the patient how his particular breaking point was reached, and he was shown how just as good and useful a job in many ways could be done in other units not actually in the front line. It was surprising the number of patients whose immediate response was: ‘The last thing I'd like to do is to go back to New Zealand like this. If I could only do a decent job I'd do it.’ The rest was easy. A large proportion of cases of neurosis were satisfactorily placed in suitable employment at Base and on the Lines of Communication and presented no further problem. Quite a proportion of them were not even graded, but were transferred to non-combatant duties on personal application along with a medical recommendation.

In the management of cases of war neurosis the building up of the patient's self-respect was one of the most important therapeutic measures. A person might be an inferior type of individual, he might have broken down earlier than a normal person should have done; but if that person was to be reconditioned or rehabilitated, he had to be led to see that it was no fault of his own and that he could yet show how he could overcome his difficulties and still do a good job. The soldier's self-respect was in this way preserved, which was all-important.

Under war conditions overseas the problem was a very impersonal one. Fighting troops were the first necessity. If a man proved he was of no use in a combatant unit then a decision had to be made whether he could be of use in another unit overseas. If he was not to be of use, then he was returned to New Zealand. On the whole it seemed to work out in a reasonably successful manner. (The Consultant Psychiatrist MEF, Brigadier James, stated that 40 per cent of psychiatric casualties could have been prevented by the careful selection of recruits, and that 35 per cent of all cases were caused by actual battle conditions. Of the total British cases 75 per cent were retained in the Middle East, and at a late period both armed and unarmed pioneer units were formed so as to utilise these men.)

No special organisation was set up within 2 NZEF to deal with psychiatric casualties. Use was made of British psychiatric units for the more serious cases.

PSYCHIATRIC EXAMINATIONS OF SOLDIERS FOR COURTS MARTIAL

Psychiatric Examinations of Soldiers for Courts Martial

There was, however, one not unimportant psychiatric service which was well carried out from 1941 onwards in the Middle East (and may be said actually to have commenced in the United Kingdom towards the end of 1940). The majority of soldiers awaiting trial by Field General Courts Martial for certain classes of military offence, particularly those involving failure to carry out assigned duties, were reported upon prior to court martial by one or other of the two medical officers with 2 NZEF who were qualified whole-time psychiatrists prior to enlistment. These reports were of considerable assistance to those responsible for the administration of military justice. Indirectly the psychiatric services rendered on these occasions contributed to complex stabilising factors underlying the maintenance of morale. In many cases the reporting officers found evidence of significant personality, intellectual, or other disabilities. Many of those so reported on were either regraded, recorded, or repatriated. Medical disposal of this group, who would otherwise have returned to unit after completion of punishment, was of considerable benefit to 2 NZEF. Furthermore, the possibility of simulation in these cases was reduced to a minimum.

Major G. B. Palmer reviewed a series of psychiatric reports made from October 1940 until February 1945. In the series rather more than 200 cases were reported on, either prior to FGCM and civil proceedings, or subsequent to completion of sentence, or for the purpose of determining whether a soldier undergoing sentence merited repatriation on medical grounds. They included one capital case, a soldier who stood trial at the Old Bailey in 1940 for the murder of a comrade, and who was found 'not guilty on the grounds of insanity' after a jury disagreement in the first trial.

By and large, very few of those examined were found to be suffering from a psychosis or gravely psychopathic personality. Those with positive psychiatric findings fell into four main groups:

(1) A very small group with evidence of early psychosis or gross psychopathic personality (usually aggravated by alcohol).

(2) A much larger group with clear evidence of borderline intelligence or less—classified in 2 NZEF as dullness and backwardness—with an antecedent history of some civilian instability with frequent shift of occupation, etc. They were obviously unable to adapt satisfactorily to army requirements. This group featured largely among those apprehended for offences associated with drunkenness, with or without AWL or technical desertion.

(3) Another small group with psychopathic personality disorder aggravated in some instances with alcohol.

(4) Situational stresses arising from changed status, for example, on promotion or reversion.

Major Palmer reported:

On the whole the sound common sense of unit C.O.'s insured an early elimination of psychopathic personalities. Incipient psychotic disturbances were similarly recognised as being medical aberrations in the early stages.

Soldiers whose inefficiency was primarily due to mental dullness and backwardness were by no means so readily detected. Though they might have done quite well in a fairly static or simple military environment such as that of a pioneer corps, they were quite unequal to the exacting demands of mobile warfare or work in technical units. They often resorted to alcohol for which they had little 'head' and were most inept in keeping out of trouble. The extraordinary latitude permitted where alcohol was concerned in most 2 N.Z.E.F. units often led to these cases being tolerated, without any suspicion of the underlying 'cause' being aroused, for much longer than was desirable. Very often it was disciplinary proceedings which attracted attention to the underlying intellectual handicap.

Among cases seen or reported on were several officers, only two of whom were required to face disciplinary proceedings, though their conduct might have been an occasion for other inquiry. Prior to the beginning of 1944 there may have been rather less attention given to the predictable capacity of the Middle East O.C.T.U. graduate to adapt himself to the new requirements of his commissioned status. In a number of instances good junior N.C.O.'s became indifferent W.O.'s and inadequate 2nd Lieutenants. The effect of marriage on such newly commissioned officers was sometimes seemingly disastrous from the viewpoint of their military efficiency.

Simulation of psychiatric symptoms in an attempt to evade disciplinary proceedings was not frequent among troops examined, and few can have been successful in sustained simulation. Some true neuroses had accepted summary jurisdiction in earlier offences.

It may be of interest to note that during the period 1946 to 1949 some 18 cases who had been examined in connection with F.G.C.M. proceedings were subsequently seen by me in New Zealand in Mount Eden Prison. Almost without exception these fell in the group of dullness and backwardness with associated alcoholism and psychopathic personalities. They were no more successful in civilian life than they were in the army.

BOARDING IN 2 NZEF

Boarding in 2 NZEF

Overseas early in the war it was found necessary to board psychotic and psychoneurotic cases. Many psychotic cases had gone overseas not having disclosed their mental history. Many of the psychologically unstable had reacted quickly to the dislocation of their normal lives and the trying conditions in the base camp. The Board of Inquiry, as already recorded, gave their opinion of the problems.

When 2 NZ Division became engaged in active warfare cases arising in the forward areas were sent back to the base hospitals and camps for boarding. The decision was made that no boarding should be carried out in the divisional area, though the cases referred to the Base were carefully selected by the ADMS and his officers. A very severe culling took place in the forward areas as it was felt that these cases were a menace to the morale of the fighting troops. The officers commanding units were only too ready to be quit of these men.

Opinion was in accord with the War Office report of 1922, which said: 'The occurrence of psychoneurotic conditions militates against the efficiency of the Army, swells the sick returns, increases the amount of hospital accommodation and transport required, and absorbs the time and attention of the medical personnel.'

From May 1941 to December 1942, 920 psychoneurotic cases were medically boarded in 2 NZEF, 40 per cent being placed on the New Zealand roll and 50 per cent being down-graded for base employment. The boards were held either at the base hospital or in the base camp, specially selected boards being appointed for the camp. Efficient boarding was thus ensured. The small proportion sent back to front-line units consisted of the milder cases, many of them also being key personnel.

In the case of those graded for the Base the greatest difficulty was to provide satisfactory, congenial, and agreeable work. Difficulties arose when the man was given monotonous and depressing jobs in the camp. This generally led to exacerbation of his symptoms.

A strong appeal was made by the Consultant Physician to have men given congenial and interesting work: 'These men were still maladjusted, still required help and encouragement, and the greater the care and common sense devoted to them at this stage, the lesser the problem of final rehabilitation'.

'It does no good to add insult to injury and uncongenial employment in occupations which are not befitting, are degrading, demoralising, depressing, and aggravate the disability. If no suitable occupation is available for a graded man it would be far better to send him home before he further deteriorates and before he has transferred his trouble to others'.

It was recommended that men graded for the Base should be kept in hospital doing occupational therapy till satisfactory jobs were arranged for them at the Base, and that all the New Zealand cases should be segregated at a special depot and should carry on occupational therapy till they boarded the hospital ship.

A special officer was appointed at the base camp to arrange for the better employment of graded men, especially the anxiety neurosis cases, and this, to some extent, alleviated the position, but there was not much choice in the way of congenial occupation at a base camp. Graded men tended to accumulate in large numbers at Base, and at different times arrangements were made to send any surplus back to New Zealand, as it was held that deterioration took place in many of the men and that they would be better employed in their ordinary civilian capacity. A large number were sent back to New Zealand from Maadi Camp in the last year of the war for this reason.

Pacific Experience

Of 1272 medical cases evacuated to the 2 NZ Casualty Clearing Station from 3 NZ Division in the Solomons over a period of eight months, 10.4 per cent were cases of psychoneurosis. The diagnoses of these cases were as follows:

Anxiety neurosis	89
Neurasthenia	18
Headaches	9
Effort syndrome	7
Conversion hysteria	7
Vaso-vagal attacks	3
Total	—
	133

Of these 133 cases, 85 were evacuated from 2 NZ Clearing Station to 4 NZ General Hospital.

Broadly speaking, two types of psychoneurotic reaction were seen—the anxiety state and conversion hysteria. Mixed reactions were common.

Of the 133 psychoneurotics seen at 2 NZ Casualty Clearing Station in Guadalcanal, only seven could be classified as battle casualties, and six of these were youthful soldiers between the ages of twenty and twenty-five. In the Pacific the hospital admission rate for psychoneurotics fell abruptly as soon as rumours of impending military action began to circulate throughout the force. The incidence of neurosis in 3 NZ Division decreased when the division moved from New Caledonia to the forward area in the Solomon Islands during August and September 1943. It had been doing garrison duty in New Caledonia for seven to eight months—a duty in which boredom was inevitable. In September and October came the attacks on Vella Lavella and Treasury Islands, and in these two months only 13 cases, including the 7 battle casualties, were evacuated from the division. From November 1943 until the beginning of February 1944 service in these islands amounted to garrison duty only, and during this time twenty to twenty-four cases were evacuated each month. In the middle of February 1944 came the attack on Nissan Island, and in March it was known to the troops—although no official statement was made at that time—that many of them were likely to return to New Zealand in the near future. During the months of March, April, and May 1944 the monthly rate of evacuation for neurosis rapidly fell.

Experience in hospitals, which served large numbers of base troops in addition to divisional troops, suggested that the incidence of neurosis was just as high amongst men who had seen no action as it was amongst fighting troops.

The wastage of manpower due to psychoneurosis is shown by the following figures. Twenty-six unselected cases of anxiety neurosis that were evacuated from 2 NZ Casualty Clearing Station in Guadalcanal to 4 NZ General Hospital were followed in their subsequent army career:

Number of cases who eventually returned to their units	Nil
Number of cases regraded II for base duties	8
Number of cases regraded III for return to New Zealand	18
Average length of time spent in medical units	46.5 days

The actual number of days spent in medical units varied from 17 to 130. Most of this time was spent in a General Hospital.

In the Pacific area during the eighteen months' campaign 26 per 1000 became unfit for Grade A1 duties because of psychoneurosis and 10 per 1000 were sent back to New Zealand.

Forty per cent of anxiety cases unassociated with battle stress were fit to resume Grade A1 duties.

NEUROSIS IN THE NAVY

Neurosis in the Navy

From September 1939 to December 1946 there were 182 cases of neuro-psychiatric and mental disturbances invalided from the Royal New Zealand Navy, on home and overseas service, representing a ratio of 4.2 per 1000 per annum. Cases of schizophrenia, melancholia, acute depression states, and psychopathic personality totalled 49; anxiety states, 75; neurasthenia, 24; hysteria, 18; and functional dyspepsia, 16. Most of the cases in the first group were detected during training or in the early stages of service, when abnormal conduct or failure to respond to instruction and discipline prompted investigation. The group of functional nervous disorders presented one of the most difficult problems of naval service medicine during the war. From the point of view of service efficiency, the prompt discharge of all such cases had much to recommend it; but medical officers had to be constantly on their guard against establishing an easy way out for those who for one reason or other were anxious to avoid their obligations. Some of the milder cases were found suitable employment in base establishments.

Careful analysis of the cases of neurosis in the Navy showed that only a very small proportion could be attributed directly to the extra hazards of war, such as the mining or torpedoing of their ships, aircraft accidents, exposure to gunfire or bombing. Fifty-three were home service only and eighty had overseas service. Furthermore, the greater number did not break down in the early stages of service or on their first experience of trying or arduous conditions, but after lengthy periods of service. Apart from the actual strain of war experience, important contributing factors were domestic and economic problems. Naval medical officers noted variations in the incidence of neurosis in different ships in which they served. There was a great depth of meaning in the old naval term 'a happy ship', implying a unit in which there was mutual trust and respect between officers and men, and dependent to a great extent on officers and senior ratings who not only knew their jobs but who also had a sympathetic understanding of the men under them and could get the best out of them.

DEVELOPMENT OF NEUROSIS IN THE FIRST FURLOUGH DRAFT, 2 NZEF, IN NEW ZEALAND

Development of Neurosis in the First Furlough Draft, 2 NZEF, in New Zealand

In 1943 the members of the first three echelons of 2 NZEF returned to New Zealand on furlough with the intention that most of them would return to the Middle East for further service. They were far from any theatre of war and were with relatives and friends, but they became the cause of heated public argument against returning men with long overseas service to any theatre of war. For six months they remained in doubt as to their fate, and in the meantime each man was medically boarded at least once. Some hundreds were found medically unfit for further overseas service on account of anxiety neurosis, the chief symptoms being headaches, lack of concentration, insomnia, and irritability, with the usual objective signs.

PROCEDURE ON RETURN TO NEW ZEALAND

Procedure on Return to New Zealand

Cases, especially Army, arriving from overseas by hospital ship were treated as follows:

(a) Psychotics were admitted to hospital direct from the ship.

(b) Anxiety neuroses and allied conditions were admitted to the Casualty Clearing Hospital at Wellington and kept together in one ward. Here they were examined by psychiatrists of the Mental Hospital Department. Each case was seen individually for at least half an hour so that the psychiatrist could gather sufficient information to enable him to make a recommendation regarding disposal.

Usually discharge and continued observation at the psychiatric clinic nearest his home was recommended.

Psychotics were never admitted direct from ship to mental hospital, but were held at Wellington hospital, according to the recommendations of the psychiatrists, and only later drafted to mental hospitals if that was required.

TREATMENT ON RETURN TO NEW ZEALAND

Treatment on Return to New Zealand

In the treatment of the neuroses it was felt that once the man was returned it was important to discharge him to civil life as early as possible. Treatment of the condition while holding the man in the Army was frustrated by the fact that the essential factor causing the condition was still present. Therefore the man was early relieved of any further concern regarding further service, possibly overseas.

Once discharged the patient became the responsibility of War Pensions, and under the direction of this department treatment was continued. It was feared that there might be very many recommendations for treatment at Queen Mary Hospital, Hanmer, coming from general practitioners, and a rule was laid down that patients could only be referred to Hanmer if recommended by a psychiatrist.

Actually, during the war years the number of pensioners in Hanmer never exceeded 25 at any one time, though some additional servicemen of Army, Air Force, and Navy were admitted. The average period in hospital was three months. The hysterics were the most difficult cases to treat.

Treatment was carried out at clinics in all main centres by medical officers attached to mental hospitals and by one or two other specialists, who were already officers of their local hospitals and were conducting clinics. With the ever-increasing numbers of patients a great strain was placed on the shoulders of the doctors, but in spite of this several new clinics were opened.

In a survey in 1944 the medical officer in charge of treatment, War Pensions Branch, considered that at least 95 per cent of all neurosis cases were back at work.

In 1950 there were very few men not working at some job, probably less than 2 per cent, and even cases at Hanmer were often only there temporarily, having required a period of treatment but being ready to resume work immediately on discharge.

Up till 31 December 1949, the following were the totals of cases coming before the War Pensions Branch of the Social Security Department:

	Neurosis	Psychopathic Personality	Mentally Retarded	Psychotics
Army, overseas	5792	207	170	377
Army, NZ only	774	43	57	58
Air Force, overseas	607	59	1	31
Air Force, NZ only	239	66	4	34
Navy, overseas	146	1	0	6
Navy, NZ only	31	0	0	6
	—	—	—	—
Totals	7589	376	232	512

Thus there were at that date 5792 cases of neurosis arising from the Army overseas, compared with 607 in the Air Force and 146 in the Navy overseas. Since the percentage of personnel in the three services was Army 71 per cent, Air 23 per cent, and Navy 6 per cent, the Army overseas shows relatively a much higher percentage of cases than the Air Force and the Navy.

Until 1947, for all disabilities causing down-grading, approximately one in every six or seven was due to anxiety neurosis. In 1950 cases were still arising which were accepted as due to service, but by that time the new applications on account of some organic disability were becoming relatively more frequent.

From 2 NZEF in the Middle East the number invalided for functional nervous disease was only some 1900. The increase after demobilisation has been almost wholly due to neurosis. This post-war development of neurosis was peculiar to Europeans and did not apply to Maoris, and only a few Maoris were returned to New Zealand from the Middle East suffering from nervous exhaustion or anxiety neurosis.

ASSOCIATION OF NEUROSIS WITH HEAD INJURY

Association of Neurosis with Head Injury

Comparatively few cases of concussion among service personnel had any sequelae due to physical injury, but Dr D. Macdonald Wilson, in a survey of 953 cases of head injury in servicemen of the Second World War, drew attention to the marked incidence of neurosis in these cases. The men had been discharged from the service or had subsequently applied for pension on account of symptoms relating to head injury. Dr Wilson's opinion after a perusal of all the files was that comparatively few cases of concussion have any sequelae due to physical injury. He entirely agreed with the opinion held in the Middle East that 'post-concussional syndrome' was due wholly to neurosis. It was only in the severe cases of concussion that definite sequelae developed, and in those cases obvious physical changes were present. The large majority of the other cases cleared up quickly following discharge to civil life. Neurosis was prevalent among ex-servicemen where there was an object such as release from service or obtaining a pension.

Simple Concussion

The 600 cases discharged from the service for this disability or applying for pension are tabulated according to the arm of the service. In parentheses are the numbers alleging pre-enlistment injury.

	Overseas	NZ Service
Army	333 (66)	114 (31)
Air	65 (13)	66 (17)
Navy	7 (0)	9 (2)
J Force	4 (2)	

A study of the files has shown that the vast majority do not suffer any physical injury from concussion. Some of them never suffered from concussion, but were neurosis cases diagnosed early in the war as 'post-concussion syndrome'.

There were 686 admissions to hospital for cerebral concussion in the Middle East from 1942 to 1945. Only 117 of these applied for pension in New Zealand. A further 47 who had been in hospital prior to 1942 also applied, as also did 104 who had never been in hospital for concussion. Many discharged for symptoms relating to head injury ceased to have any symptoms after gaining their discharge. The men applying for pension for concussion have mostly been found to have no sequelae due to physical injury and nearly all cases are pure neurosis.

Classification of these 268 cases applying for pension is:

Degree of Concussion	Number	Receiving Pension in 1950	Assessment
Slight	114	41	Most below 20 per cent
Moderate	36	12	Most below 20 per cent
Severe	11	7	30–75 per cent
No history	74	26	
Alleged pre-enlistment	33	5	
	—	—	

Except those who received severe concussion, of whom six had obvious physical sequelae, the fitness of the pensioners bore little relationship to the degree of concussion.

THE PENSIONS ASPECT

The Pensions Aspect

Approximately 250,000 men enlisted in the New Zealand Forces in the Second World War. Of these, up till 1948, there had been 7308 discharged with a diagnosis of neurosis and 4160 of these had been awarded a pension. Neurosis, therefore, had incapacitated 3 per cent, and pensions for neurosis had been granted to 1.75 per cent of all enlisted men. (In the United Kingdom neurosis affected 2.8 per cent and pensions for neurosis were awarded to 0.8 per cent of enlisted men.) The expenditure on war pensions takes a sizeable portion of the national budget, and it has been estimated that 10 per cent of the cost of war pensions is due to neurosis. In 1947 the annual cost in New Zealand was estimated at a quarter of a million pounds.

There was a rather easy attachment of the diagnosis of 'Anxiety Neurosis' to cases after discharge. There was also a tendency to give the diagnosis and a small pension to any man complaining of loss of sleep, nerves, or worry because of some other disability—hence the large number of cases. By 1950 most of the cases in receipt of pensions were assessed at 15 to 20 per cent disability. This appeared to stabilise the ex-serviceman of this class with the assurance that he was protected.

A survey of 2073 War Pensions files of anxiety neurosis cases by Dr Macdonald Wilson at the end of 1953 disclosed that 335 applicants had never been granted a pension, that in 1155 cases the pension had ceased, and that only 583, or 28 per cent, were then on pension. Only 53, or 2.55 per cent, of the cases were deemed not to be satisfactorily rehabilitated.

Transition to Civilian Life

The policy of the War Pensions Branch of the Social Security Department in the management of war neurosis cases was to give the benefit of any doubt to the soldier, but at the same time to encourage employment at as early a stage as possible. There was also close co-operation with the Rehabilitation Department. In spite of this sympathetic treatment many of the cases still showed signs of neurosis a considerable time after their return to New Zealand. The most common symptoms were irritability, a feeling of tiredness after a day's work, difficulty in concentrating on any job where mental attention was required, lack of desire to meet people or go out to social engagements and pictures. These symptoms were present to a greater or lesser degree in practically all soldiers who had been overseas for any length of time. Settling down of the soldier was made difficult, particularly in the nervous neurotic type, if civilian life had to be taken up in overcrowded and unsuitable home surroundings.

According to the records of the War Pensions Branch there were never more than thirty cases of war neurosis receiving treatment as inpatients of hospitals or institutions at any one time; most cases soon returned to full employment, when their pensions ceased. Only a small proportion of all the neurosis cases remained unemployed for any length of time, and in most of these there were some special circumstances. The successful rehabilitation of nearly all of the cases was a creditable record for those responsible for their management in New Zealand.

EXPERIENCE IN ENGLAND

Experience in England

Investigations in England had shown that 70 per cent of psycho-neurotic casualties were constitutionally predisposed. They fell into three types:

(a) Those displaying intellectual inferiority (high grade mental defectives).

(b) Those having inherited traits from neurotic parents (shown by family history).

(c) Those with neurotic traits from unfortunate home surroundings and environment.

The elimination of members of these three groups from front-line troops was done by selection. It was noted that in the First World War there were one million neurotic casualties (30–34 per cent) in the British Army where selection was not practised. In the United States Army where selection was practised there were 9 per cent neurotic casualties.

Selection was adopted in Britain in 1942. It was first started in OCTUs. Every candidate for the officers' training course went through a routine method of selection—four days in selection school, where he underwent intelligence and aptitude tests and field tests. Finally a psychiatric specialist interviewed him.

Later each ordinary recruit went through selection, and many of the constitutionally predisposed were put in Category 3 at the start. This elimination of the unfit proved most satisfactory. (For 2 NZEF there was no selection.)

At the beginning of July 1942 the General Service Selection procedure was introduced into the Army, and by the end of 1942 all men were taken into the General Service and were posted to duties in the Army only after testing.

The Directorate for Selection of Personnel undertook a complete job-analysis of the multitudinous tasks in the different arms of the service, and as a result was able to lay down the standards of intelligence and other aptitudes necessary for each job, thus providing a basis for the correct posting of men in certain proportions to each type of unit. The accomplishment of this work produced a revolutionary change in the Army's utilisation of manpower and has set a standard which will, we hope, certainly be applied in industry and in social life in the post-war world. The matching of men to suitable work is as valuable a means of psychiatric prophylaxis as anything that could well be devised.

The psychiatrists and psychologists worked together—the psychiatrists seeing all men in the lower groups and the difficult cases referred to them by the psychologists.

The psychopathic tenth, those with a constitutional predisposition, with a neurotic history, personal or family, were apt to break down following dislocation of their life and the boredom so often present in the Army. As regards treatment, military occupations were more valuable than the ordinary methods of occupational therapy. The army physical training instructors were especially useful. Special placing of the neurotics in suitable army occupations was most beneficial; only 9 per cent so placed proved failures and 70 per cent very successful. In the acute war neurosis resulting from enemy action the results were even better, provided treatment was undertaken early.

Education by psychiatrists in the Army by lectures and contacts with regimental, legal, and administrative officers proved highly beneficial. Courses in psychiatry for medical officers were of great value.

Recommendations for Future Management

Selection of Recruits: The utilisation of a psychiatrist for the medical boarding of recruits has been held to be impracticable and is probably undesirable. Some simple intelligence test is, however, desirable to eliminate the most dull and backward. This type made unsatisfactory soldiers as they gave considerable trouble and were very liable to be absent without leave, both at the Base and in the forward areas. The Pulheems system of boarding should help in this regard.

In camps the junior combatant officers and the RMO should evaluate the recruits and so discover any who are mentally inadequate. A check should also be made with records of the Division of Mental Hygiene of the Health Department to see that no psychiatric cases are accepted for the services.

The Psychiatrist: This specialist could be usefully employed as a consultant in the mobilisation camps in New Zealand to examine and report on any doubtful cases. He would also be of great value overseas in the same consultant capacity, both in the forward areas and at the base camps and hospitals.

Base Camps in New Zealand: Here the mentally abnormal and backward should be eliminated from Grade A units and utilised in labour groups or in other corps in conformity with their capacity. At the same time every effort should be made to counteract the influence of boredom and separation from home conditions which have such a deleterious effect on those constitutionally liable to anxiety states. Work should be made as interesting as possible and many other interests and recreations provided. The man should be made to feel responsible for the good of his camp and his unit.

Overseas: Morale and interest and activity must always be promoted as well as discipline and smartness. The soldier must be kept interested and informed concerning events and made to feel an important cog in the wheel.

The majority of the cases of anxiety neurosis at first arose at the Base, but later most were due to battle stress. Prevention is the best approach to the problem. This entails constant effort to keep men occupied and interested in useful work and the provision of healthy forms of recreation.

Repatriation should be arranged for all cases proving useless to the force and not reacting favourably to treatment.

The cases arising in the forward areas, many of which will be cases of physical and nervous exhaustion, demand different treatment. They should be treated in the first instance in the forward areas at the Field Ambulance level, thus retaining contact with their normal atmosphere and units. Sometimes a very short rest in an ADS will be sufficient, but normally these cases should be treated in a Divisional Rest Station set up by one Field Ambulance not otherwise actively employed. A psychiatrist could be stationed here during active periods so as to be available for the treatment of the cases and to give advice to the unit.

It is of the utmost importance that the cases should not be evacuated to the base hospitals unless they are considered to be of no further use as combatant troops. They should be rested and reassured and returned to their own unit and their own comrades. In the case of men with long service in the forward areas a transfer to base work, or even repatriation, may be advisable. This is especially applicable to Maori troops, who are normally unfitted for base duties especially after serving in combatant units for some time.

The treatment given at a Divisional Rest Station should consist essentially in rest and sedation. Adequate dosage of sedatives must be given to ensure sleep, but prolonged sedation was not found advisable. Narco-synthesis or the re-enacting of the experiences under sedatives was not held to be desirable in these cases. Patient discussion and explanation by the RMO, the medical officers at the Rest Centres or the psychiatrist, is held to be both preferable and sufficient. Dehydration should be counteracted and the diet should be liberal and appetising. A seaside location with swimming is ideal if climatic conditions are suitable. The mild cases should be ready for return to their units in less than a week.

From observation of convalescents with psychiatric disability passing through Base Reception and Convalescent Depots over a number of years, Major Blake

Palmer is firmly convinced that provision should be made for a Psychiatric Unit with any future expeditionary force. This could be done in one of two ways:

(a) By the formation of a Psychiatric Wing attached to the forward General Hospital. The unit could be modelled on those operating with 2 British General Hospital at Tripoli or 8 British General Hospital at Barletta. Such a New Zealand Psychiatric Wing should be so organised as to permit of a mobile team comprising one trained psychiatric medical officer, an NZMC assistant, and nursing personnel whose NCOs should preferably have state psychiatric nursing registration and rank appropriate to this qualification—on the analogy of the Sister with state general nursing registration or the physiotherapist. Minimum rank for such qualified nursing personnel should be staff-sergeant. This mobile team could be attached for service with Casualty Clearing Station, or could work in exceptional circumstances at a Divisional Rest Centre organised by a Field Ambulance.

(b) A separate unit could be formed analogous to the Field Surgical Unit, Blood Transfusion Unit or VD Treatment Centre. There is much to be said in favour of the independent unit. It is indeed the method of choice. When working with a General Hospital the Psychiatrist, as CO of a unit, can better represent the special requirements of his organisation, which do not invariably find a ready acceptance as they differ from those of the Medical Division in many respects.

REHABILITATION

Rehabilitation

When psychoneurotics are returned to New Zealand provision should be made for examination by a psychiatrist and advice and guidance given during the difficult period of settling back again into civilian life. The Rehabilitation Department did invaluable work in this direction in the guidance and help of returned men and in the provision of training centres where men could learn fresh trades suited to their disabilities, physical or nervous. Congenial work, not a pension, is the best form of treatment as it encourages the re-establishment of self-esteem and confidence.

APPENDIX A — STATISTICS RELATING TO NERVOUS DISORDERS, 2 NZEF, MEF AND CMF

Appendix A

Statistics relating to Nervous Disorders, 2 NZEF, MEF and CMF

Admissions to Medical Units for Disease, July 19411–December 1945

Anxiety neurosis	1696, or 2.11 per cent of all admissions
Nervous and physical exhaustion	1013, or 1.26 per cent of all admissions

Comparative Table of Admissions

	1943	1944	1945
Anxiety neurosis	471	658	176
Mental cases	188	275	146
Nervous and physical exhaustion	329	558	114
Nervous	314	344	278

Cases of Physical Exhaustion Admitted to 2 NZ Division Medical Units in Italy

18 November 1943–17 November 1944	603
18 November 1944–30 September 1945	160

Invalids Evacuated to New Zealand, 1940–45

Anxiety neurosis	692
Nervous exhaustion	163
Schizophrenia	84
Psychopathic personality	72
Depression	94
Other nervous disease	822
	—
Total	1927
Total sickness cases were	6076

Comparative figures of 1 NZEF, May 1916–Dec 1918, were:

Nervous system and shell shock	1370
Mental	175
	—

Total	1545
Total sickness cases	13,587

APPENDIX B — TABLE COMPARING BATTLE CASUALTIES WITH EXHAUSTION AND NEUROSIS CASES

Appendix B

Table Comparing Battle Casualties with Exhaustion and Neurosis Cases

Monthly Rate per 1000 of Hospital Admissions, 2 NZEF, MEF and CMF

	Battle Casualties	Exhaustion and Neurosis
Jun 1942	1.55 (Minqar Qaim)	1.01
Jul 1942	50.26 (Battle for Egypt)	7.98
Aug 1942	19.47	5.59
Sep 1942	15.34	2.46
Oct 1942	4.99	1.39
Nov 1942	47.39 (Alamein)	0.51
Dec 1942	8.36	1.11
Jan 1943	3.52	1.53
Feb 1943	0.97	1.16
Mar 1943	15.52 (Mareth)	4.01
Apr 1943	21.52	4.63
May 1943	2.66	3.21
Jun 1943	0.00	1.37
Jul 1943	0.00	1.50
Aug 1943	0.00	1.74
Sep 1943	0.00	1.29
Oct 1943	0.00	1.02
Nov 1943	1.60	1.84
Dec 1943	29.98 (Sangro)	2.59
Jan 1944	4.60	1.59
Feb 1944	8.61	2.97
Mar 1944	25.02 (Cassino)	9.08
Apr 1944	4.40	3.44
May 1944	8.86	2.81
Jun 1944	5.24	1.64

Jul 1944	16.69 (Florence)	2.68
Aug 1944	9.67	2.94
Sep 1944	15.33 (Rimini)	3.12

APPENDIX C — PSYCHIATRIC AND NEUROSIS CASES, 2 NZEF, SURVEY AT FEBRUARY 1943

Appendix C

Psychiatric and Neurosis Cases, 2 NZEF, Survey at February 1943

	Diagnosis in Sample of 650 Cases	
Mania	2	76 = 11.7 per cent
Simple depression	16	
Mental dullness and backwardness	47	
Paranoia	2	
Schizophrenia	6	
Psychosis—alcoholic	2	
Delusional insanity	1	
Epilepsy	3	
Anxiety neurosis	416 = 63 per cent	
Nervous or physical exhaustion	33	
Hysteria	41 = 6.3 per cent	
Psychopathic personality	21	
Temperamental instability	10	
Headaches—persistent 9		
Headaches post-concussional 6	15	
Neurasthenia	13	
Obsessional neurosis	1	
Dyspepsia, nervous	21	
	—	
	650	

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CHAPTER 20 — ESSENTIAL HYPERTENSION

Contents

WAR SURGERY AND MEDICINE

[SECTION]

[A War Pensions Survey by Dr D. Macdonald Wilson]

IMMEDIATELY following the First World War the outpatient departments of our New Zealand hospitals were thronged by ex-servicemen suffering from either neurasthenia or disordered action of the heart. The neurasthenia or 'shell shock' case, as he was called, was there with his restlessness, lack of ability to concentrate, worries over trifles, insomnia, headache, tremors, and increased superficial reflexes. Beside him stood the man whose heart beat rapidly without any exertion, the pulse rate often only counted with difficulty, whose distress resulted from the pounding of his heart and discomfort in the chest. On examination he was found perspiring in the armpits and fingers, the apex beat of the heart diffuse and flapping. In a search for some organic changes in the heart by palpation and percussion the heart was sometimes described as dilated, with the apex beat outside the nipple line and with a systolic apical bruit.

With the discharge of these men from the Army and their rehabilitation they disappeared from the clinics like the snow in summer. In a very short time the vast majority of these ' **DAH**' cases had settled to normal, a few had become definitely neurotic and developed other protean symptoms, while a few others have continued to suffer from functional tachycardia, or neuro-circulatory asthenia as it is now called. Following the 1914–18 War came the investigation of the heart by X-ray and the electrocardiograph, which brought home to the profession the limitations of percussion and the stethoscope.

The modern medical graduate in examining a patient records the blood pressure as routinely as he does the pulse rate. But this was not always so. In New Zealand as late as the year 1930 physicians often examined and reported upon the cardiovascular condition of a war pensioner without recording or referring to the blood pressure. Amongst military files of the 1914–18 War routinely examined, a few records are found of the blood pressures observed at general hospitals of the 1st New Zealand Expeditionary Force in England in 1918. However, there was no general use of the sphygmomanometer, and indeed often the systolic pressure only was recorded. Also there are a few files with the blood pressure recorded at the Trentham Military Hospital in 1922. From 1918 to 1922 the Army treated service patients at Trentham in what was one of the best organised hospitals New Zealand has ever known. It was not until about 1924 that the general hospitals began to use the sphygmomanometer, and at that time the aneroid type was used, but only to record the blood pressure of cases suspected of hypertension and not as a routine procedure. During the year 1924 only one case diagnosed as hypertension was admitted to Wellington Hospital, while in 1930 the number had risen to ten, three of these associated with another condition, namely pregnancy, diabetes, or syphilis. In 1936 some 56 inpatients were treated. Therefore, when any investigation is made into the possible longevity of people suffering with what is considered an abnormally high blood pressure, it must be remembered that few records exist in New Zealand prior to 1930.

The War Pensions Branch of the Social Security Department has a complete 'follow-up' of its patients from the date of enlistment until death. If placed on a satisfactory permanent pension, the pensioner may be lost sight of for a time, but if he enters hospital or applies for increased pension because of any worsening of his condition new medical reports are added to his file. Should any ex-serviceman, not a pensioner, enter hospital or apply for a sickness benefit, his service file is consulted to see if his disability might be related to his war service. Again, on the death of every ex-serviceman his service file is referred to the War Pensions Board for a decision regarding the attributability or not of his death to service.

First World War Cases (Carbery Series)

Any detailed investigation into the incidence of hypertension amongst servicemen of the 1914–18 War is impossible, because indexed records to files were not kept and, as already pointed out, the sphygmomanometer was not in general use before 1930.

However, in 1932 the late Dr Carbery of War Pensions Branch became interested in the subject of hypertension, and for several years he indexed the files of ex-servicemen routinely seen by him which recorded an abnormally high blood pressure. These files have been available and, after excluding cases of nephritis and toxic goitre, these being the only two conditions in the series likely to affect the blood pressure, some 499 cases remained for this survey.

In making this survey, and as a basis for comparison, a case is described as one of hypertension only when on two or more successive occasions the diastolic pressure has risen to over 100 mm. of mercury, with the systolic at 160, or when the diastolic has reached 90, with the systolic above 160.

Having checked the cases on the Carbery list by the above standard, all cases were then checked by the suggested figures of Master, Dublin, and Marks, the results of whose exhaustive survey appeared in the Journal of the American Medical Association. They consider there are so many variations of the normal that hitherto abnormalities have probably been accepted at too low a figure.

These observers suggest the following as the minimum figures for hypertension in the several age groups:

Age Group	Systolic	Diastolic
40–44	165	100
45–49	170	104
50–54	175	106
55–59	180	108

60–64	190	110

Using these figures as a gauge only some six cases accepted on the Carbery list would have been excluded. These six cases include two who died of a cardiac condition when aged seventy-five and seventy-seven years, with blood pressures of 190/90 and 175/110 respectively. Considering the ages of the patients, these blood pressures are not abnormal. Also one case aged sixty-three with B.P. 172/106 and the other three cases with systolic pressures of 170 and diastolic varying from 90 to 105 could all be considered not unduly high for their age groups.

Investigation of the 499 cases on the Carbery list reveals that in the year 1952, 211 are still living and 288 are dead. All 499 cannot be accepted as cases of hypertension because the readings recorded are too low according to the present-day conception of this condition. Also, as the pressure finding may have been recorded on the occasion of an examination not for pensions purposes or for a pensioned disability, a second recording has never been entered on the medical file. Measured either by our own or the American standards, only 143 of the 211 living can be accepted as hypertension cases.

First World War Cases of Hypertension Still Alive

In the following table 130 out of the 143 living cases of hypertension are studied. The remaining 13 are not included in the table as they were not deemed to be suffering from hypertension until after the year 1940. The ages of these 13 now (1952) range from fifty-five to sixty-five, and hypertension has been present for periods of one to eleven years. The table gives the age groups to which the 130 cases belong in 1952, average periods in years to date of the existence of hypertension, the standard deviation of each average, and the longest and shortest period of hypertension exhibited by a patient in each age group.

Table I

Age Groups	50–55	56–59	60–65	66–70	71–75	76–79	80–85
Number of cases	2	28	37	29	25	6	3
Average period of longevity to 1952	16	17	17	19	17	17	21
Standard deviation	0	3	3	5	5	2	7
Longest recorded period of longevity	16	24	23	34	24	20	30
Shortest recorded period of longevity	16	13	12	14	12	15	15

These patients are all living in 1952, and it may come as a surprise to many that such long periods of longevity are compatible with definite hypertension.

Notes of some illustrative cases are given:

Case 336: Born 1895. Bootmaker prior to 1914.

1916 Tonsillitis. 1918 suffered from Inflammation Connective Tissue of neck, impetigo and influenza with bronchopneumonia.

1919 Lungs clinically negative. ‘Some irritability of heart.’

1921 Effort syndrome. Apex Beat of heart inside N.L. Complained of palpitation and dizziness. Exercise tolerance test was 84–120–144–84. No complaint of breathlessness.

1921 Was better and pension ceased.

The Department had no further knowledge of this man until 1928 when he reported again with tachycardia (**D.A.H.**). Blood pressure was systolic 185 and diastolic 88. Urine negative. There was evidence of neurasthenia.

1930 B.P. 185/92. P.R. 128.

1931 He complained of headaches. B.P. 205/110. Pulse Rate 144, after exercise 156 and returned after 1 minute to 126.

1932 180/92. 1933 180/90. Main symptoms are those of neurosis.

1934 Admitted to Mental Hospital as a Voluntary Boarder.

1936 B.P. 168/110. Complained of giddiness, headaches and insomnia.

1943 B.P. 190/120. Admitted to Hospital for investigation of chest and mental condition.

1945 B.P. 192/116.

In 1951 he is in receipt of a total permanent pension for hypertension and neurasthenia.

[This patient, aged 57, has a record of blood pressure higher than the average normal for 24 years. His symptoms are mainly those of a neurosis rather than those of hypertension.]

Case 337: Born 1880. Bushman prior to enlistment.

1917 Suffered from 'Pyrexia of Unknown Origin' (P.U.O.). This was usually 'Trench Fever'.

1918 Influenza, Debility.

1919 Complains of cough and diagnosed C.P.D.I. ('Chronic Pulmonary Disease Indeterminate'). Heart Negative. Pulse Rate 96–108–96.

1920 Cough.

1921 Bronchitis and Emphysema.

1922 Bronchitis and 'Known to take too much alcohol.'

1928 B.P. 200/120. Pulse Rate 108–144–90. X-Ray: Heart and Lungs Normal.

1930 B.P. 208/158. P.R. 95–130–144–96.

1931 B.P. 212/114. There is again reference to 'alcohol'.

1932 B.P. 200/130.

1933 B.P. 218/108.

1934 B.P. 212/110. Urine negative for albumen and sugar.

1935 B.P. 240/120.

1937 B.P. 220/120. Urine Negative.

1938 B.P. 220/130. Urine Negative. Some neurosis present.

1940 B.P. 240/116.

1945 B.P. 204/120.

1950 B.P. 260/140.

In 1952, at the age of 72, he lives quietly at home suffering dizzy attacks at times but no headaches and no epistaxis. His heart is enlarged on clinical examination.

[For 24 years this man has had a systolic blood pressure of 200 or more and diastolic of 110 or more. It was first taken in 1928 and found to be 200/120, so the presumption is that it was abnormally high for an unknown period before then. He has had no special medication or surgery for the condition.]

First World War Cases of Hypertension—Deaths

It has been stated above that 288 of the 499 cases collected by Dr Carbery from 1932 to 1940 have died between then and 1952. Screening these 288 dead cases as was done with the living, 245 can be accepted as having suffered from definite hypertension. Some few cases have been included in the list of whom there was only one recorded abnormally high blood pressure, but death occurred shortly afterwards from either a cardiac or cerebral accident. There are many deaths from coronary disease without any previous hypertension and therefore the etiological relationship, if any, between mild hypertension and coronary disease requires further investigation.

Deaths from hypertension occur as the result of cardiac or cerebral accidents or renal failure.

The following table shows details of the 245 deaths from hypertension according to immediate causes of death, the average ages at death, the standard deviations from the average ages, and the extremes of age at death.

Table II

	Deaths from Cardiac Causes	Deaths from Cerebral Accidents	Deaths from Renal Failure	Deaths from Causes Unrelated to Cardio-Vascular Disease
Number of cases	122 (50 per cent)	63 (26 per cent)	15 (6 per cent)	45 (18 per cent)
Average age at death	61 years	61 years	49 years	63 years
Standard deviation from average age	8	8	6	7
Extremes of age in each group	42–77 years	40–76 years	39–58 years	51–76 years

In the above cases deaths from cardiac and cerebral accidents occurred at the same average age. On the other hand, deaths from renal failure occurred at a much earlier age. Renal failure is the common termination of malignant hypertension.

When noting the ages and age groups referred to above, it must be remembered that all these cases are drawn from a body of exservicemen whose greatest numbers in 1920 belonged to the age group 25 to 40 years. Therefore by 1952 the mass of this population belongs to the 57 to 72 age group.

In the group of 245 deaths under review, 2 cases died before 1930 and 46 between 1932 and 1939. The hypertension was recorded only a short time before death in these cases, and thus it is impossible to determine the period during which this condition existed. Some details regarding these 48 deaths are as follows:

Table III

Cause of Death	Number	Average Age	Extremes of Age
Cardiac accidents	30	56	42–72
Cerebral accidents	10	54	40–62
Renal failure	4	42	39–45
Conditions unrelated to cardiovascular disease	4	56	51–61

Regarding the remaining 195 cases, the following table gives the number of deaths in each year, the average age at death, the standard deviation of the average age, the minimum and maximum age at death each year, the average known period of duration of hypertension, and the number of these 195 dying each year of conditions unrelated to cardio-vascular disease.

Table IV

Year of Death	Number of Deaths	Average Age at Death	Standard Deviation	Minimum and Maximum Age at Death	Average Duration Period of Blood Pressure	Number of Deaths not due to Cardio-Vascular Disease
1940	16	57	6	47–66	7.25 years	5
1941	12	61	8	46–77	7.3 years	1
1942	13	56	5	49–65	8.5 years	2
1943	12	58	8	47–70	9 years	3
1944	15	61	2	50–71	9.8 years	2
1945	13	60	8	49–74	10.7 years	5
1946	17	61	9	49–8	10.8 years	4
1947	11	63	2	55–73	11.8 years	3

1948	13	64	4	54–72	12.8 years	0
1949	16	64	7	51–76	[a]14.5 years	7
1950	21	62	8	51–75	14.6 years	4
1951	26	67	7	56–76	[b]15.6 years	5
1952	10	64	5	57–73	[c]14.1 years	0

Of the Carbery list, only 43 deaths remain to be noted. These are not included as hypertension cases because the records held do not disclose blood pressures even as high as S. 160 and D. 100 on two occasions. The following table analyses these 43 deaths according to age groups and cause.

Table V

Age Group at Death	46–50	51–55	56–60	61–65	66–70	71–75	76–80	Total
Deaths from cardio-vascular disease	1	2	5	5	5	2	1	21
Deaths from other causes	2	7	3	3	5	1	1	22

In Table II it is shown that 82 per cent of patients suffering from definite hypertension died from cardiovascular disease. Of the 43 not accepted as hypertension cases, the deaths from cardiovascular disease were 21 or 49 per cent.

Study of Large Group of Ex-servicemen Dying from All Causes

Before making any further observations on the cases in the Carbery list, it may be of interest to note the ages at death of 2226 ex-servicemen of the 1914–18 War dying of all causes during 1951 and 1952.

Table VI—Reported Deaths from all Causes of 1 NZEF Personnel During 1951 and 1952

Age Group	45–50	51–56	56–60	61–65	66–70	71–75	76 and over	Total
Died of cardio-vascular disease	4	77	255	279	222	159	98	1094
Died from other causes	5	83	281	256	233	167	107	1132
Totals	9	160	536	535	455	326	205	2226

The cardio-vascular deaths represent 49 per cent of the total, which actually is the same percentage as in the 43 cases in Table V. The nine youngest cases at death were all 48–50 years of age and represent the comparatively small group who served at an early age in the last year of the war, either in the Navy or who joined the Army giving a false age. These details are taken from copies of death certificates supplied by medical practitioners.

It will be noted from Table I that in 130 living cases of hypertension, the condition has existed for various periods, the shortest twelve years and longest thirty-four years. From Table III it is learnt that in only 68 out of 195 cases which have died did the period of hypertension last for less than ten years. Thus in this group of 325 cases, 79 per cent lived for more than ten years, while 166, or 51 per cent, lived for at least fifteen years, and of that 166 some 130, who have already averaged over seventeen years, are still living.

It must be remembered that when the Carbery list was compiled after 1930 the population from which it was drawn had already, in the main, reached middle age, and consisted only of males who had during the 1914–18 war years been selected for their medical fitness.

The complete 'follow-up' of all cases in this Department has enabled the duration period of the hypertension to be stated in most cases. A perusal of death certificates confirms how rarely the general practitioner can state definitely the duration period of the hypertension when a cause of death.

Deaths of Returned Servicemen in 1952

During 1952, 164 deaths occurred amongst returned servicemen of the 1914–18 War certified due to hypertension. Not being war pensioners, nothing was known to the Department of these cases until notifications of death were received. The numbers of deaths in each age group and immediate cause of death are given in the following table.

Table VII

	Age Group							
Cause of Death	50–55	56–59	60–65	66–69	70–75	76–79	80	Totals
Cardiac accident	7	15	27	17	13	5	2	86
Cerebral accident	3	14	23	16	15	2	2	75
Renal failure		1		1				3 *

It will be noted how few deaths in this series occurred from renal failure. Malignant hypertension is relatively more frequent in the younger age groups. Only two of the death certificates mention malignant hypertension, with one cerebral death (aged

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* 1 Death—age unknown.

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sixty-seven) and one cardiac death (aged sixty-two). There may have been other cases, but the certifying doctors did not differentiate the type of hypertension except in these two instances. Another very noticeable fact was that the doctors could seldom commit themselves to state a definite duration period for the hypertension. In one case twenty years was given, another fifteen years, and in two cases ten years, but otherwise a short or indefinite period was stated.

The impression gained was that the certifying doctor very often had only known the patient for a relatively short period. Thus the periods of possible longevity quoted above in so many cases may cause some surprise.

Survey of Unselected Group of Living Pensioners of 1914-18 War

During the survey of this selected group of 499 cases from the 1914–18 War servicemen it occurred to the writer that a knowledge of blood-pressure conditions in an unselected group of living returned servicemen from the 1914–18 War might be of interest. Some 938 files were examined. While these cases were unselected in the sense that records were routinely taken from files only when the patient applied to the Department for treatment, it must be remembered that all cases suffered from some type of disability and were males past middle age.

Of the 938 files, six related to cases already in the Carbery list and are therefore excluded. A further 145 files contained no record of any blood-pressure readings. These were cases where the only disabilities known to the Department were war wounds of the limbs, skin conditions, and eye, ear, nose, and throat disabilities where there had been no general examinations and consequently no records of blood pressure made by the specialists.

In all 787 cases had blood-pressure records. None of these patients, when the blood pressures were taken, was suspected of suffering from hypertension, and the blood-pressure record was merely a routine entry. While in many cases there is no recent reading recorded, it must be remembered that all cases are living, and if there is no record the pensioner has not complained of symptoms suggesting to the specialist that investigation of the blood pressure should be undertaken.

Of the 787 cases, 669 had normal blood-pressure readings. Systolic pressures were not above 160 nor diastolic above 100. In 214 of the cases the blood pressure had not been taken since 1942. None of the 669 cases at the time of recording of the blood pressure suffered from, and in 1952 none complained of, symptoms suggestive of hypertension, while the youngest is now over fifty years of age.

While some suffer from more than one disability, the following are the major disabling conditions:

	Cases
Diseases of lungs	207
War neurosis	121
DAH	25
Peptic ulcer	37
Rheumatic diseases of all types	68
GS Wounds	122
Other diseases	89
	669

One hundred and eighteen cases out of the 787 have at some period between 1930 and 1952 exhibited a blood pressure with the systolic above 160 or the diastolic above 100.

The following table gives the year and age group of the patient when the high pressure was first recorded:

Table VIII

	Age Group							
Year	41–45	46–50	51–55	56–60	61–65	66–70	71–75	Total Each Year
1930				1				1

1934				2		1		3
1935			2					2
1936	3	1	1	1				6
1937								0
1938		2						2
1939	2						2	
1940	2	1	1					4
1941	1			1	1		3	
1942		2		1	1			4
1943		1	1	2				4
1944				1		2		3
1945		1	3	1	4	1		10
1946		3	1	4				8
1947		3	1	4	4		12	
1948			1	2	1			4
1949		1		4	1	2		8
1950		1	2	8	3	4		18
1951			3	6	2	1	2	14
1952			3	4	3			10
	—	—	—	—	—	—	—	—
Total	7	14	21	38	20	16	2	118

If the cases are screened for hypertension on the American minimum systolic and diastolic pressures quoted above, it is found that 86 of the 118 cases would be considered to have shown definite evidence of hypertension. Seventy-seven of these 86 cases are drawn from 96 cases in Table VIII varying in age from forty-one to sixty-four, already accepted by the 160 S. and 100 D. standard, and the remaining 9 drawn from 22 cases varying in age from sixty-five to seventy-five years.

Thus the records of 787 servicemen who have been suffering disabilities of various types since 1918 approximately, reveal that 86 have shown evidence of hypertension up till the year 1952. Three cases developed acute nephritis in recent years, and the blood pressure has been abnormal only since these illnesses. They cannot be classified as cases of essential hypertension, and therefore the total of essential hypertension cases is 83. Two hundred and fourteen cases have not had the blood pressure taken during the past ten years, but in 1951 and 1952 complain of no symptoms suggestive of hypertension. Their disabilities are mainly the end results of war wounds and eye, ear, and nose conditions.

Second World War Cases of Hypertension

Turning now to the 1939–45 War, a survey has been made regarding the incidence of essential hypertension amongst servicemen during and since the war.

The men who proceeded overseas were all expected to be medically fit, and it is of interest to learn something of the incidence of abnormally high blood pressure likely to occur in such a male population.

The survey made of cases occurring amongst the personnel of the 1914–18 War covered only a certain few, who were all aged from forty to seventy-six years. Now it is possible to get a comprehensive idea of the incidence of hypertension occurring in personnel of the 1939–45 War from the year 1939 when the first recruit was examined.

In the medical examination of the recruit for the 1914–18 War the recording of the blood pressure played no part, whereas in the 1939–45 War it was an integral part of the examination, and indeed the acceptance or rejection of an otherwise apparently fit man might depend solely upon the blood-pressure reading.

The following instruction was issued to medical examiners of army recruits in 1939:

Blood Pressure—A systolic blood pressure persistently over 160 m.m. Hg. and/or a diastolic of over 100 and/or under 50 should not be above Grade II.

In 1942 this instruction was amended to read, 'a systolic blood pressure persisting as high as 160 m.m. Hg. and/or a diastolic of over 100 and/or under 50 should not be above Grade II. Before concluding, especially in a young man apparently otherwise healthy, that the blood pressure is abnormal, the readings should be repeated at least three times at intervals of five minutes, the man resting at ease on a couch during this period.'

The man who could not reach Grade I standard of fitness was considered to be physically unfit for full training and service overseas. The age limits for service overseas were twenty-one and forty years. It should be noted that the above instruction regarding the blood pressure was applied to all age groups.

The American observers already quoted consider that for the age groups eighteen to thirty-nine the minimum systolic hypertension reading is from 145 to 160, with the diastolic also rising with the age from 95 to 100.

It is not known how many recruits were accepted for overseas service whose blood pressure was persistently at the maximum of the allowable figures, but the standard laid down was not a cause of much invalidity in the Army overseas. Only 29 men with hypertension and 44 with effort syndrome were evacuated to New Zealand from the Middle East and Italy out of a total 6076 medical cases boarded as unfit for further service overseas. Colonel J. R. Boyd, Consulting Physician to 2 NZEF MEF, advises that to his knowledge there were no deaths from essential hypertension either in the Middle East or Italy. [1] This represents a wastage out of approximately 80,000 troops. The number of young recruits otherwise fit who were declined for service solely because of hypertension is unknown, but it is gathered that there could not have been many.

Recruits were first accepted into the services in September 1939, and from that date until 1952 some 309 cases who saw overseas service have been diagnosed on discharge from the services as suffering from hypertension. As their medical examination on enlistment was the first health record known of each individual, there is set out in the following table the age group at enlistment and year of enlistment relating to each man.

Table IX

	Age Group										
Year	18	19	20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	Total Each Year
1939			2	19	13	23	8	3	1	1	70
1940		3	3	33	21	31	35	15	5	5	151
1941	1	1	1	11	8	8	9	4	1	1	45
1942	1	1		2	7	11	12	5			39
1943				1			1				2
1945					1						1

1936 Serving in Air Force on outbreak of war								1			1
	—	—	—	—	—	—	—	—	—	—	—
Total	2	5	6	66	50	73	65	28	7	7	309

It will be seen upon reference to Table IX that some 13 men were younger and 42 older than the official age allowable for overseas service. Actually the 18 to 20 year group were examined as Territorials serving within New Zealand and escaped the examination prior to embarking overseas when 21 years of age. The 42 in the 41–55 group represent personnel for special duty, men who gave a false age on enlistment, and a group of Grade II men sent to the Pacific in 1943 as garrison troops. Considering the comparatively few of this age group who served overseas, it is noticeable how many appear amongst the hypertension cases. Inquiry will be made into the subsequent medical history of these 309 cases, when it will be found that not all can be held to be suffering from essential hypertension.

Deaths—Second World War Cases

In a follow-up of these 309 cases until 1952 it is found that 34 have died.

The following table gives the ages at, and year of, death of 34 cases of hypertension.

Table X

Year	Age Group: 29	31	35	36	37	38	39	40	41–45	46–50	53	58	62	67	Total Each Year
1946								1				1			2
1947						1			2						3
1948			1						1						2
1949		1							2				1		4
1950									1						1
1951	1	1		1	1		1		3	4	2				14
1952				1		1			1	4				1	8
Total	1	2	1	2	1	2	1	1	10	8	2	1	1	1	34

If Table X is studied beside Table IX, it will be noted that the numbers in the older age groups preponderate amongst the deaths. All statistics amongst civilians show a similar incidence, and there is nothing to indicate that war service produces a higher mortality rate amongst younger people from hypertension. The majority of the men who served overseas in the 1939–45 War are still in 1952 under the age of forty-five, and yet 24 out of the thirty-four deaths occurred amongst the forty-years-old and older.

Seventeen cases ranging in ages from twenty-nine to sixty-seven died from cardiac accidents, 9 from cerebral vascular accidents in ages thirty-one to forty years, and 4 from renal failure (1 associated with diabetes), from thirty-eight to sixty-two years of age. Four, ages thirty-two to fifty, died of conditions unrelated to the hypertension, but the death of one dying of ruptured aneurysm of the Circle of Willis and one from bilateral thrombosis of the renal arteries, with renal failure, might be considered accelerated by the hypertension. Two cases died from the results of accidents.

Fifteen of these 34 dead were rejected by medical boards as unfit for overseas service, three on account of age and twelve because of abnormally high blood pressure. However, for one reason or another, they were sent overseas. A further case, included because he had been officially diagnosed as a case of hypertension, scarcely warranted the diagnosis. The following is a brief history of the case:

1942 Enlisted when aged 44. B.P. S. 150, D. 76.

1945 Discharged on account of nasal sinusitis. B.P. S. 180, D. 100.

1947 B.P. S. 145, D. 90. 1948 S. 145, D. 90.

1951 Found dead. Coroner's verdict was death due to coronary thrombosis.

If these 16 cases are excluded, it would seem that 18 men fit on enlistment during the war years and on return to New Zealand have since died from the effects of essential hypertension. The following table gives particulars of these 18 cases embracing the age at and year of enlistment, the systolic and diastolic pressure recorded at the enlistment medical examination, the year of discharge from the service with systolic and diastolic pressures recorded at the discharging medical board, the year of death, and age at death.

Table XI

No.	Age at Enlistment	Year Enlisted	S	D	Year Discharged	S	D	Year Died	Age at	Cause of Death

									Death	
1	19	1941	152	74	1946	120	70	1951	29	Coronary infarction.
2	20	1940	140	90	1945	150	86	1951	31	Pontine haemorrhage.
3	22	1940	135	80	1945	150	100	1949	31	Cerebral haemorrhage.
4	23	1939	140	80	1945	164	92	1952	36	Ruptured cerebral aneurysm.
5	26	1940	134	70	1945	140	90	1952	38	Cerebral haemorrhage.
6	27	1941	140	80	1944	135	90	1951	37	Ventricular hypertrophy-malignant hypertension.
7	27	1940	135	65	1944	140	98	1948	35	Cerebral haemorrhage.
8	31	1940	140	70	1944	130	94	1947	38	Renal failure.
9	33	1940	120	80	1944	140	95	1949	42	Cerebral haemorrhage.
10	33	1941	150	95	1944	140	90	1951	43	Ventricular hypertrophy-malignant hypertension.
11	33	1941	150	85	1945	150	90	1951	43	Ventricular fibrillation.
12	35	1939	140	85	1945	148	90	1948	44	*Accident.
13	36	1941	120	78	1945	140	80	1948	43	Coronary disease.
14	36	1942	120	85	1944	125	80	1952	46	Pontine haemorrhage.
15	37	1941	158	95	1945	150	110	1952	48	Cardiac infarction.
16	37	1940	134	86	1944	158	108	1947	44	Uraemia.
17	39	1940	130	90	1945	140	86	1951	50	Myocardial degeneration.
18	39	1940	148	82	1944	190	110	1951	50 *	Accident.

If Table XI is examined it will be noted that all cases had a normal blood pressure on enlistment. Even the recruit aged

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* These two deaths occurred as the result of accidents and not due to cardio-vascular causes.

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twenty, with a diastolic pressure of 90, comes within the possible normal of the

American observers quoted above. However, on discharge cases 3, 7, 15, 16, and 18 all had diastolic pressures of hypertension for their ages. There is little that looks ominous in the blood pressures on discharge except in case 18, but it will be noted that whereas on enlistment only three cases exhibited a diastolic pressure of 90 or more, no fewer than 13 do so at discharge. The state on enlistment is the first knowledge of the patient, and his discharge state serves as a convenient follow-up check.

To present a picture showing the rapid deterioration until death in these cases recordings of blood pressures are given in four of the cases:

1. 1941, 152/74; 1944, 150/80; 1946, 120/70; 1950, 230/130; 1951, In Hospital 215/140. Died coronary infarction.

3. 1940, 135/80; 1945, 150/100; 1946, 230/120; 1947, 250/180; 1949, 250/170. Died cerebral haemorrhage. In 1948 underwent Bilateral Thoraco-Lumbar sympathectomy. He stated he was relieved of headaches but hypertension persisted. This man was 5′ 8½′′ in height and in 1940 weighed 192 Ib. and was described as 'obese'.

4. 1939, 140/80; 1943, 190/120 Anxiety neurosis; 1944, 190/85; 1945, 164/92. 1952, Died from ruptured cerebral aneurysm of Circle of Willis.

16. 1940 Height 6 ft., Weight 223 Ib. B.P. 134/86.

1944 158/108 W. 221 Ib. 4.9.44 210/120 No complaints. 5.10.44 Headaches and giddiness 180/120. 30.11.44 In-patient for Essential Hypertension. Fundi vessels show early arterio-sclerosis.

1945 200/150; 1946 204/150; 1947 276/160 Died Uraemia and Malignant Hypertension.

These details serve to emphasize the known fact that malignant hypertension may manifest itself without much warning and terminate in death in a brief period. Except in three cases where there was obesity and one case with associated diabetes, there is no apparent cause for the onset and aggravation of the hypertension. Compared with the incidence of malignant hypertension in the civil population, army service does not produce any increase. Amongst the 34 deaths which have occurred, only one man had reported sick overseas and been evacuated back to New Zealand on account of hypertension. Having given a false age, he had proceeded overseas when aged forty-six, and within a few months was medically boarded because of being easily fatigued and blood pressure S. 172, D. 120. In 1950 the B.P. was S. 210, D. 110, and in 1951 he died of coronary thrombosis, aged fifty-seven. The records of any enlistment medical examination are missing from his file. The man who developed diabetes in 1947 was the only prisoner of war amongst these cases. He was a prisoner in Italy for two and a half years, being repatriated in 1943. His first symptoms of thirst and polyuria occurred in 1947 after being back in New Zealand four years.

Living Cases from Second World War

If a follow-up check is made of the 275 living of the 309 cases originally diagnosed as hypertension after Second World War service, it is found that 120 can be excluded as they are not hypertension cases. These are all cases which were diagnosed as hypertension when discharged from the forces, their pressures being only slightly or moderately above the normal. All subsequent recordings, usually over a period of years, have been normal and the individuals complain of no symptoms and are following their normal employment. Therefore a table is given of cases which, on the last evidence available, had abnormally high blood pressures. The age group at date of enlistment is given for each man. This table of 189 cases of recognised hypertension includes the deaths and should be compared with Table IX above, as Table XII gives a truer picture of the incidence of hypertension.

Table XII

	Age Group										
Year	18	19	20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	Total Each Year
1939			1	9	1	15	3	3		1	33
1940		2	3	18	11	20	28	9	2	5	98
1941	1	1		6	5	8	4	4	1	1	31
1942	1	1			5	7	9	3			26
1943							1				1
	—	—	—	—	—	—	—	—	—	—	—
Total	2	4	4	33	22	50	45	19	3	7	189

It should be pointed out that in 34 of the 155 living cases the blood pressure at enlistment was higher than the recommended limits for normal, and that in all but 9 of these cases the blood pressure was again abnormally high on discharge.

However, it must not be thought all these 155 living cases suffer from a disabling condition. Actually 87 of them suffer no disability and are engaged in normal employment, in hard manual work, trades, farming, and, in a few cases, clerical and professional work. There are cases where the systolic pressure remains over 160 or diastolic over 100, but all less than 175 systolic or 115 diastolic pressure. Possibly if some of these cases had been followed up longer it would have been found that their pressures had fallen as in other cases, and none has reported with symptoms suggesting any worsening of his health. These 87 cases of symptomless raised blood pressure are found in the age groups as follows:

2 aged 18 years.

26 aged 21–25 years.

13 aged 26–30 years.

19 aged 31–35 years.

16 aged 36–40 years.

11 aged 41–50 years.

Thirty-four cases suffer from severe hypertension, the systolic being 200 or more or the diastolic pressure above 100.

Seven of these cases have arisen amongst those who were in the age group 19–25 at enlistment. Two of these were aged only nineteen years, and their particulars are as follows:

Case 423: Enlisted 1941 aged 19 years in the Air Force. B.P. on enlistment was 185/110. At discharge from the service in 1944, B.P. was 195/115. Later in 1944 the pressure is again recorded as 185/110. He was suffering no symptoms of ill health and was occupied as an engineer.

Case 474: Enlisted 1942 aged 19 years in the Air Force. B.P. on enlistment was 170/95. At discharge in 1945 B.P. was 175/105. In 1946 B.P. was recorded as 210/105. He complained of no symptoms and was occupied as a grocer.

According to the rules laid down for the medical examination of army recruits neither of these should have been accepted for service because of the blood-pressure readings at the initial examinations. However, both recruits served their full term of duty without illness and apparently without any detriment to themselves.

Four of these 34 serious cases have arisen in the enlistment 26–30 age group, 9 in the 31–35 group, 7 in the 36–40 group, and 7 in the 41–50 group. Four cases have been treated with Hexamethonium and two have undergone splanchnectomy.

Many cases in the whole series of Second World War cases were discovered at routine examinations on return to New Zealand, the patient being unaware of any disability. The following case is an example:

Case 396: Enlisted 1940 aged 32. B.P. 158/85. Served overseas and at his medical examination on return in 1944, B.P. was 200/100. Subsequent reports on the B.P. are 1944 190/110, 1945 200/110, 1947 210/130, 1948 220/130, 1949 210/130. He is employed and has no symptoms.

More will be said subsequently regarding the incidence of hypertension amongst the Maoris, but in the meantime the following case is quoted.

Case 260: Enlisted 1940 aged 28. Height 5′ 8′′. Weight 301 Ib. The blood pressure is recorded as 165/95 and there was a faint trace of albumen in the urine. Proceeding overseas he suffered a G.S.W. with fractured femur in Greece and was a prisoner of war until 1945. The fracture finally united with 3½′′ shortage in the limb.

1946 B.P. 160/120. Some albumen in urine.

1947 B.P. 160/116. Albumen still present.

1948 Electro-cardiograph normal. Weight 329 lb., B.P. 170/130. He has no complaint relating to the cardio-vascular system.

This case is included in the essential hypertension list, as so far as is known there was no pre-war nephritis and the kidney function appears normal. Attention is drawn to the weight of the patient.

A further two cases are noted as they have some bearing on theories relating to the etiology of essential hypertension.

Case 270: Enlisted 1941 aged 30 years, B.P. 140/90.

1944. Suffered haematuria with headaches-and blurring of vision. B.P. 180/135 and there was albuminuria. Hydronephrosis was diagnosed and B.P. eventually rose to 260/150. He developed ileus following pyelography and the B.P. fell to 130/90.

1944 Right Nephrectomy was performed. The B.P. fell after operation to 140/90 but subsequently rose to 180/120.

1950. B.P. is 175/130. The function of the left kidney is normal. He is employed.

Case 79: Enlisted 1939 aged 35 yrs. Gave a history of accidentally ruptured kidney in 1932. B.P. on enlistment was 170/90 and he was placed in Grade II on account of the blood pressure and he appeared 'highly strung'. However, he proceeded overseas to the Middle East and in 1942 was admitted to Hospital with renal colic.

1943. Returned to New Zealand with a Furlough Draft. Complained of pain in the right kidney area stating it had been present since his injury in 1932. B.P. 170/100. Investigation by dye test showed the Right kidney not functioning properly.

1946. Some evidence of an Anxiety State B.P. 156/108.

1948. B.P. 150/110.

1949. 170/110 and later 200/120.

1950. Right nephrectomy was performed and three months after the operation the B.P. was 140/90. In 1952 he is employed as a factory hand and suffers no disablement.

Only one case suffers from a cardiovascular accident:

Enlisting in 1940 at the age of 52, he was accepted for overseas service, his B.P. being 160/100. In 1944 he was medically boarded overseas as he was considered too old for service in the field and his B.P. was found to be 180/110. In 1945 he was medically examined, complained of no disablement and his blood pressure was 140/85. In 1950 he suffered a cerebral thrombosis.

To summarise, approximately 130,000 served in the three New Zealand services overseas and approximately 100,000 of these in the Army. Of the 309 cases quoted, all served in the Army except 19 in the Air Force and 6 in the Navy. Up till the year 1952, 189 cases of known essential hypertension have occurred amongst the personnel of these overseas forces whose enlistments took place mainly between 1939 and 1943. Thirty-four of the 189 cases have died between the years 1941 and 1952.

Study of General Group with Overseas Service in Second World War

Just as a survey was made of files of living servicemen of the 1914–18 War as each applied for treatment, so a similar survey was made of the files of the 1939–45 War. The object in view was to obtain information regarding the blood pressure in a body of men who were not under observation for known hypertension. To this end over 2000 files were routinely perused, including some 15 of the 309 cases just reviewed, and they are therefore not included. Also a great number of cases have been under observation only for conditions such as eye, ear, nose and throat disabilities or wounds of limbs, where no record of the blood pressure has been entered since the final service medical board. They are excluded as it was desired to report only on cases in which there was some 'follow-up' history subsequent to service life. Cases of hypertension discovered before or at discharge have already been discussed. To get a picture of present conditions in a population, all of whom had been medically examined according to the same standards on entry to the service, only the files of servicemen who served overseas in the Army have been used. This survey is taken from the medical files of 1936 servicemen who served overseas during the 1939–45 War and who applied for treatment during a period of some months in 1951 and 1952.

The earliest date upon which the medical history of any man is first known is the enlistment examination, and the survey will be made of the cases according to the years of enlistment. Thus it was found that of the 1936 cases 432 were enlisted in 1939, 1021 in 1940, 235 in 1941, 188 in 1942, 28 in 1943, 18 in 1944, and 14 in 1945.

In collecting material for the survey, notes were taken of all cases in whom the diastolic pressure had risen to 90 or over at any time since the date of enlistment or the systolic pressure to over 160. Of the 432 cases enlisted in 1939, in 333 the diastolic blood pressure has never been as high as 90 at any of several readings taken during the intervening years nor the systolic pressure as high as 160.

Thus of the 1939 enlistment group, 99 have since enlistment exhibited a diastolic pressure of 90 or more. The following table shows at a glance the age group to which each of the 99 belonged in 1939 and the year in which a diastolic pressure of 90 or more was first recorded.

Table XIII

Year B.P.	Age Group								Tota Each
Recorded	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	Year
1939	18	17	14	9					58
1940			1						1
1941									
1942		1	1	1					3
1943			2	2				1	5
1944		2			1				3
1945	1	1		1					3
1946			2	2		1			5
1947					1				1
1948				1	1				2
1949			3	3	1		1		8
1950			1		1	1			3
1951		1	1	2	2				6
1952			1						1
Total	19	22	26	21	7	2	1	1	99

It will be noted from Table XIII that 58 of these 99 cases had a diastolic pressure of 90 or more on enlistment. Of these 58 cases, 24 had a diastolic pressure less than 90 at all subsequent examinations, while the other 34 have remained between 90 and 100. The systolic pressure in these 58 cases has averaged 138, with an extreme maximum of 170 (on one occasion only) and the minimum 110.

Of the 99 cases the diastolic pressure has been above 100 in six only. It is a striking fact when the age groups of these 99 cases is studied in Table XIII that not one of these six cases had a diastolic pressure over 100 before he was thirty-eight years of age.

As these cases represent the highest pressures found in the 1939 enlistment group of 432, a few details are quoted of two of them:

(1) Aged 34 in 1939. B.P. 150/88.

1943 B.P. 182/104 while a prisoner of war in Germany.

1944 Recording while a prisoner of war. 160/95. 180/95. 138/88.

120/88. The last two were taken after prolonged rest.

1945 Repatriated to the United Kingdom. 142/100.

1950 Under treatment at Hanmer. 162/98.

1952 Has been a V.B. in a Mental Hospital on two occasions and leucotomy recommended.

(5) Aged 40 in 1939. B.P. 130/80.

1946 155/110. Suffers from chronic indigestion and cholecystitis.

1947 160/110.

1949 160/110.

1950 180/125. Appears to be a definite case of Hypertension but he was aged 47 before the diastolic rose above the 100 in 1946.

As stated above, 1021 of the cases studied enlisted in 1940, and it is found that 253 of these have recorded a diastolic pressure of at least 90 on some occasion from the date of enlistment until 1952.

The following table gives the age group to which the individual belonged in 1940 and the year when the diastolic of 90 or more was first noted:

Table XIV

Year B.P. Noted	Age Group 18-20	21-25	26-30	31-35	36-40	41-45	46-50	51-52	Total Each Year
1940	10	58	41	35	14	5	2		165
1941									
1942					1	1			2
1943			1						1
1944		1	2	1	4	2			10
1945		3	7	3	1	1			15
1946			1	3	1	1			6
1947			3	1	1				5
1948			3	2	3	2	1		11
1949			1	1			3		5
1950			1	5		4	4		14
1951				1	5	4	4	2	16
1952					2		1		3
Totals	10	62	60	52	32	20	15	2	253

It will be noted from Table XIV that 165 out of the 253 cases exhibited a diastolic blood pressure of 90 or more when first examined upon enlistment in 1940. A subsequent follow-up check discloses that 149 of these 165 had a diastolic pressure of less than 90 at all subsequent examinations. The systolic pressure has never been above 160 and seldom as high, except in one where a reading of 186/74 was recorded on one occasion. In the remaining 16 cases the diastolic pressure has varied between 90 and 100, but never above 100, while the average systolic was 145, the highest being 160.

Fifty-seven cases whose diastolic pressure was below 90 on enlistment in 1940 have since exhibited a diastolic pressure of 90 to 100, with a systolic pressure not above 160 on at least one occasion.

Twenty-one cases have exhibited a diastolic pressure at times rising above the

100 to 109 with a systolic pressure not above 160, but the diastolic pressure subsequently reverted to under 100.

In only 11 cases has the diastolic pressure risen to 110, but except in two cases this was at the most recent examination in 1951 or 1952, and time will tell if this pressure will revert as none of these cases suffers any symptoms of hypertension at present.

One case aged forty-seven in 1948 has the following readings: 1940, 150/90; 1942, 150/95; 1946, 150/90; 1948, 178/110; 1949, 180/100; 1951, 180/110. Disability is bronchitis.

One case aged thirty-five in 1940 with B.P. 160/100; 1946, 145/90; 1949, 148/110; and 1951, 180/110. Suffers from deafness and hysteria.

Enlistments during the year 1941 provided 235 cases of this survey, and it was found that 51 of these have exhibited a diastolic pressure of 90 or more some time since that date. Thirty-two of the 51 had a diastolic pressure of 90 to 100 on enlistment, but in 24 of these all subsequent diastolic pressures have been under 90. Eight of the 32 cases have persisted with a diastolic pressure of 90 to 100 with the systolic pressure ranging from 130 to 160.

Nineteen cases have shown a diastolic pressure of 90 or more only since the initial enlistment examination, but in only four cases has the diastolic been higher than 100 on any one occasion.

In one case, although taken on several occasions during the intervening years, the diastolic pressure did not rise above 90 until 1951, when the patient, aged twenty-nine, had a B.P. 170/110 but was found to be suffering from diabetes and chronic dyspepsia.

In two cases the systolic pressure rose to 170 and 180 respectively, each with a diastolic of 105 in 1951, and it remains to be seen if the pressures will revert. However, the age of one is sixty-five, so perhaps a pressure of 180/105 is scarcely abnormally high. The second case was aged twenty-nine in 1951 and suffers from rheumatic carditis.

The fourth case enlisted in 1941, aged thirty-three and B.P. 138/72. He was discharged in 1942 with B.P. 130/80. In 1950 B.P. was 130/90. He was operated upon for left carotid aneurysm, which was followed by a right hemiplegia. 1952 B.P. 168/110.

From the 1942 enlistments 188 cases appear in this series, of whom 48 have had diastolic pressures 90-100 on some occasions since enlistment. In 26 cases the diastolic pressure was 90-100 on enlistment, and 19 of these have never again had the diastolic as high as 90. Of the remaining 7 cases, in 5 the diastolic pressure has persisted at 90, but never been higher. One case, aged forty-seven, has a blood pressure of 160/100 in 1952, and the remaining one is quoted below. The remaining 22 cases of the 48 have all exhibited a diastolic pressure from 90 to 100 at some period between 1942 and 1952, but in only one has the diastolic pressure ever been above 100, while in 19 cases it has never been above 90.

Details of the two cases exhibiting diastolic pressures over 100 are as follows:

One case enlisted 1942, aged 30, with B.P. 136/88; 1944, 136/86; 1950, 170/130; 1952, 160/110.

One case enlisted 1942, aged 47, B.P. 136/94; 1943, 140/90. Suffered pneumonitis with debility. 1944, 140/92. 1946, diagnosed Tabes Dorsalis B.P. 140/80. 1947, 134/90; 1948, 150/100 - 170/100; 1949, 180/110; 1950, 190/120; 1951, 180/110.

Sixty cases appeared in the series from the enlistment years 1943–45. This decrease in numbers actually corresponds with the decreased numbers entering the Army compared with the years 1939–42. Twenty-four of these sixty cases exhibited a diastolic pressure of 90 at the enlistment examination, but none had such a high diastolic pressure on any subsequent occasion.

Thus a review has been made of the recorded blood-pressure readings of 1936 service patients of the 1939–45 War to learn the incidence of hypertension amongst the group generally. The cases were unselected from the applications for treatment, but were all suffering some war disability, were all males ranging in ages in 1951 from twenty-five to fifty-five approximately, and had all been medically examined and pronounced physically sound between the years 1939 and 1945. In addition to these 1936 cases a further 15 cases of hypertension included in the accepted cases reviewed earlier also routinely came before the reviewer.

From the details given above it will be seen that these 1936 cases produced 8 cases of hypertension, 1 of these being associated with diabetes, 1 with rheumatic carditis, and 1 with a right carotid aneurysm.

In addition, there were 13 cases of potential hypertension, these cases having a diastolic pressure of over 100, with systolic of 160 or more only on the last and recent occasion. Therefore, subsequent examinations will disclose if the diastolic rise is permanent. Of the 8 cases, 2 are aged twenty-nine (one with associated diabetes and one with carditis), 1 is thirty-eight, 4 range from forty-four to forty-eight, and the other is aged fifty-three. Thus the essential hypertension without any associated cause occurred mainly after middle age. This survey has shown that, in a survey of 1951 files, 23 definite cases of hypertension have arisen when the 15 already accepted cases are added.

Home Service Personnel

It is not proposed to survey the cases which have occurred in service personnel who served in New Zealand only, as individuals of both sexes, diverse ages, and various degrees of physical fitness were all enlisted for office and non-combatant jobs required in camp. Many suffered from hypertension when enlisted, but the standard of health required for much of the Home Service duty allowed anyone who was fit to earn his living in civil life, even if only in a sedentary occupation, to be accepted.

Some 194 were discharged from Home Service with a diagnosis of 'Hypertension', but 69 have in this survey been excluded because the diagnosis was made without sufficient observation or evidence. These 69 include two cases who have died subsequent to discharge from cardiac accidents, but they were both over fifty years old and neither had any blood-pressure record of systolic above 160 nor diastolic pressure above 90.

One hundred and twenty-five are accepted as true hypertension cases, and of these, 83 are living and 42 are dead. Particulars of these 125 cases are given in Tables XV and XVI.

Table XV

Eighty-three cases of hypertension occurring in Home Service personnel of the 1939–45 War, giving the numbers in each age group in 1952 and the average known duration in years of the hypertension, with the extreme ranges in each age group.

Age Groups	29	30	32	36-40	44-45	46-50	51-55	56-60	61-65	66-70	71-75
Number of cases	1	1	1	4	8	17	16	16	9	8	2
Average duration of hypertension in years	7	10	7	11	8.5	9.5	10.5	9.5	10.5	10	12.5
Extremes of periods noted in each age group				8-12	3-10	4-12	1-12	7-12	8-12	7-12	12-13

The majority of cases, especially in the older age group, were suffering from hypertension when enlisted, but as the duration periods are only calculated from the earliest known date, the duration periods in most cases are actually longer than the table suggests.

Table XVI

The number of cases, age groups at death, and average duration periods of hypertension in 42 cases of hypertension that have died since discharge from Home Service in the 1939-45 War.

Age Groups	34	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75
Number of cases	1	2	5	7	11	6	6	3	1
Average duration period of hypertension in years	2	2	6	7	6·5	6	7	8	6
Extremes of periods		1–3	1–10	1–11	1–12	3–8	3–12	1–12	

The duration periods shown are only approximate as again hypertension was often present on enlistment.

Table XVII

Herein is shown the causes of death in

each age group of the above 42 cases.

Age Groups	34	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75	Totals
Cardiac accidents		2	3	4	4	3	6	2	1	25
Cerebral vascular accidents			2	2	3	1				8
Renal failure	1				3					4
Other causes				1	1	2		1		5
	—	—	—	—	—	—	—	—	—	—
Totals	1	2	5	7	11	6	6	3	1	42

In Table X and Table XVI the numbers and age groups at death are given of personnel who served overseas and in New Zealand only, and it is remarkable how closely they resemble each other. In the overseas personnel in the vast majority of cases only the younger and fit men were included. For service in New Zealand large numbers of personnel aged from forty-five to sixty-five and known to be hypertension cases were enlisted, in addition to younger territorials (18–21 years) and men down-graded for various physical causes. Approximately 70,000 served in New Zealand only, with, of course, a much higher percentage of females than in the overseas forces.

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[1] Deaths in 2 NZEF in Middle East and Italy possibly, but not necessarily, related were: coronary thrombosis, 1; coronary atheroma, 1; myocarditis, 6; endocarditis, 2; heart failure, 4; subarachnoid haemorrhage, 4; cerebral haemorrhage, 4.

[a] If one case of 4 years' duration omitted, average would be 15.3 years.

[b] If 3 cases, 1, 3 and 7 years' duration omitted, average would be 17.4 years.

[c] If 2 cases, 1 and 7 years' duration omitted, average would be 16.6 years.

DISCUSSION

Association of Neurosis with Hypertension

It is a remarkable fact that while anxiety neurosis was the commonest single cause for down-grading on discharge from the Army following the 1939–45 War, the somatic symptoms complained of never localised themselves to the heart as they did in the previous war. To date some 7600 cases of anxiety neurosis have been treated which arose during or were the result of the 1939–45 War, whereas only 241 cases discharged for 'Effort Syndrome', Da Costa's Syndrome, 'DAH' or neurocirculatory asthenia have been discovered.

Therefore, in a survey of cases drawn from servicemen of either war it is not surprising to find that many have suffered or are suffering from one of the functional disorders so prevalent. Anxiety neurosis is responsible for 18 per cent of all disabilities of the 1939–45 War. However, it would be a mistake to assume that these diseases affect the incidence of hypertension.

This survey is based upon information gained from the files of patients who apply for treatment. The types of service patient who most frequently seek treatment are, amongst the older patients of the First World War, the chronic bronchitic and the neurasthenic with his protean symptoms, and up till the present the anxiety neurosis case of the Second World War. Therefore, if the hypertension cases are found mostly in these types of case seeking treatment, a false deduction might be made regarding the relative frequency as compared with healthy individuals or those suffering from other diseases.

In the list of Carbery cases cited above as definite cases of hypertension, 13 per cent suffered at some time from neurasthenia, 24 per cent from DAH, and 63 per cent from neither disability.

Amongst the deaths, those who had suffered from neurasthenia died at an average age of sixty-five years while the DAH and other cases each died at an average age of sixty-two.

It was noticeable that only a few of the DAH cases had been pensioned continuously since 1918, whereas most of the cases had been described as normal in the years from 1918 to 1922. Only in subsequent years had they re-applied for pension because of shortness of breath. While in the great majority of cases the blood pressure was recorded for some years before there was any abnormal rise, in the others it was noted high on the patient's re-application for pension, but in no case was the patient under forty years of age when the hypertension first appeared.

Of the 787 First World War files examined, 669 cases were found to have had no abnormal blood-pressure record. The following list gives the number of cases under each disability which have had abnormally high blood pressures.

Diseases of the lungs	27
War neurosis	21
DAH cases	2
Peptic ulcers	11
Rheumatic diseases	11
Trauma (GSW and AI)	26
Other diseases	20
	—
	118

By the New Zealand standard of S. 160 and D. 100, 118 or 15 per cent of the 787 cases suffer from abnormally high blood pressure. By the standard used by the American observers, 86 or 9.15 per cent of the 787 cases suffer from hypertension.

By comparison with the above, 21 of 142 war neurosis cases, or 14.8 per cent, suffer from high blood pressure, or by the American standards 12 of the neurosis cases would be accepted as hypertension cases and this represents 8.45 per cent.

Two of the 27 DAH cases, or 7.4 per cent, have high blood pressure, but these two cases are each sixty-one and seventy years of age.

There have been mentioned above 164 cases of servicemen, non-pensioners, who died of blood pressure during 1951–52. Examination of their files shows that none ever suffered from neurosis, and in five cases only was there any record of DAH. In three cases the condition had ceased in 1918, one was pensioned until 1919, and one until 1924. One died aged fifty-seven, two at sixty-four, and two at seventy-one years of age, four from cardiac and one from cerebral vascular accidents.

In 787 cases whose ages varied from approximately fifty years to seventy-five years, 9.15 per cent or 15 per cent were found to have an abnormally high blood pressure, according to whichever standard is used. These were all males and had various disabilities, but 15 per cent does not seem to be unduly high for the age groups and is probably representative of any similarly aged cross-section of the ordinary male civilian population. Actually the cases who had suffered from either neurosis or DAH showed a slightly lower incidence of hypertension.

There is no evidence from this survey of 1914–18 War cases that either war neurosis or DAH is an etiological factor in the production of hypertension. Generally speaking, the neurasthenic case of the 1914–18 War who did not rehabilitate himself is now a case of inadequate personality content to allow others to provide for him. He suffers no tension and, if mental tension is a cause of arterial hypertension one is not surprised to find there is no increased incidence of this condition amongst this type of individual.

However, stress has been laid upon the fact that in the survey of 1914–18 War cases only files of individuals past middle life were included. Thus, perhaps, if a survey had been made twenty or thirty years ago, different conclusions might have been drawn. Therefore examination of files of the 1939–45 War at this early period is useful to bridge that period missing after the first war.

Over 6000 cases of anxiety neurosis have occurred amongst army personnel who served overseas, but there has never been any suggestion of an increased incidence of abnormally high blood pressure amongst these patients even during the early stages or later relapses of their 'Anxiety' periods, when it would be expected their mental tension was greatest.

Amongst the 34 deaths from hypertension which have occurred, 3 cases had suffered from an anxiety state during some of the years following discharge and are represented by cases 4, 7, 9 in Table XI.

Of the total 309 cases reported as possible hypertension cases, 26, or 8.4 per cent, had suffered from anxiety neurosis, and of the actually accepted 189 cases, 18, or 9.5 per cent. When it is remembered that 18 per cent of all disabilities was anxiety neurosis, a not undue proportion of these cases is found to develop hypertension. Further, even during the war and since, the age groups found to supply the hypertension cases follow the same pattern as has long since been found amongst the ordinary civil population.

Amongst the 1936 Second World War files surveyed, 28 per cent suffered from anxiety neurosis. It has been shown that from these 1936 cases there are only 8 cases of hypertension, with 13 potential cases. There were approximately 500 cases of neurosis amongst the 1936 cases, and they produced only 1 case of hypertension and 3 potential cases.

That excitement may produce a temporary rise in the blood pressure is well illustrated by the following 46 cases. In 1943 some 3000 overseas servicemen, presumably fit men, were returned to New Zealand for furlough with the expectation that they would be returned overseas again. However, various factors, political and sentimental, delayed their final disposal, and in the meantime several hundred were discharged on account of anxiety neurosis. As the immediate cause of the neurosis was inactivity and anxiety as to their disposal, this group made a very rapid recovery in most instances once they were rehabilitated back into civilian life. These cases were not found to be suffering from hypertension. On the other hand, some 46 cases, not exhibiting anxiety symptoms, were discharged on account of hypertension. On the pressure reading at the discharging medical examination all but three would be accepted as having abnormally high blood pressure for their age group by the American standards. After discharge, in 35 cases out of the 46, the follow-up readings during the next two or more years were all normal and the men working normally without symptoms. In five cases the men returned to work, symptomless, but with a diastolic pressure 110 to 115 when last recorded in 1944. In two cases they were overweight, one 207 lb. with height 6 ft. 1½ in., and the other 217 lb. with height 5 ft. 11 in.

In six cases the blood pressures have remained abnormally high, having first been discovered at routine boarding. These cases have all been considered in the general survey.

Incidence Amongst Maoris

Dr Bridgman of the Rotorua Hospital and Dr Sligo of Tauranga Hospital, who both see a great many Maori patients, have stated that they seldom see a Maori suffering from essential hypertension.

In this survey only five Maori cases are found amongst the 1939–45 War records, while one appears amongst the Carbery list.

One case who saw overseas service enlisted in 1943, aged 21 years with a B.P. 150/90. His weight was 138 lb. and height 5′ 2½′′. At discharge in 1946 he had no complaints but his B.P. was 186/120 but on resting reverted to 160/100. In 1947 the B.P. was 130/80 and he was engaged as a carpenter.

One case enlisted in 1940 aged 28 years, height 5′ 8′′, weight 301 lb., and B.P. 160/90. Details have already been stated above. In 1948 his weight was 329 lb.

One case, served in N.Z. only, enlisted 1940 aged 25 years. Height was 5′ 5′′, weight 178 lb., and B.P. 148/95.

1945 B.P. 142/110. Weight 195 lb. He suffered no symptoms of hypertension but was discharged for deafness in both ears.

One case, served in N.Z. only, enlisted 1940 aged 22 years. Height 5′ 10 ½′′, weight 235 lb. B.P. 165/115.

1944 Discharged with no complaints of ill-health. B.P. 180/105. Weight 243 lb.

1945 Weight 252 lb., B.P. 160/100.

One case, served in N.Z. only, enlisted in 1941 aged 53 years, weight 238 lb., height 5′ 8′′, and B.P. 204/128.

1943 B.P. 180/160. Feels in good health. Discharged on account of deafness.

One case, served in the 1914–18 War. Enlisted 1918 aged 28 years. Height 5′

9''. Weight 196 lb. He suffered a G.S.W. leg and ankle.

1933 Suffering from chronic ulcers on leg.

1934 Weight 238 lb. B.P. 180/100

1938 Weight 238 lb.

1949 Died of cerebral haemorrhage.

Only the first case does not exhibit a condition of overweight, and after his discharge the blood pressure fell to normal. All other five cases exhibit obesity, and it appears possible that this plays a very important part in producing hypertension in a race which ordinarily is not at present very susceptible to the condition.

Only eight females occur in this survey, and as their numbers do not materially affect the figures and findings the survey is referred to as one of a male population. Only one female case served overseas, and she was enlisted at the age of fifty-three with a B.P. 170/110.

SUMMARY

SUMMARY

A survey has been made of the incidence of hypertension amongst service personnel of both world wars. Files relating to 1450 men of the First World War have been studied, while 309 files of cases of the Second World War diagnosed as hypertension and 1936 other files of men routinely applying for treatment for other conditions have been examined.

Cases are quoted who have a long period of longevity while suffering from simple essential hypertension. There is evidence that individuals may have very high blood pressures and feel no effects while going about their ordinary vocations. Doctors should avoid creating invalidity and in their handling of patients be guided by the symptoms suffered, rather than the high pressure recordings on the sphygmomanometer.

All the evidence is against any suggestion that DAH or neurocirculatory asthenia or war neurosis has any effect on the etiology or incidence of hypertension.

Amongst service personnel there is no tendency for hypertension to occur at any earlier age than amongst the civil population. Cases who have undergone the same medical screening for service, trained and undergone the same living conditions as thousands of their comrades, and whose blood pressures continue for years within normal limits, may suddenly without warning show evidence of malignant hypertension without any known cause.

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CHAPTER 21
Skin Diseases

THE code of instructions to the civilian medical boards examining recruits in 1939 was not very specific regarding the question of skin disease. It directed that men with mild cases of psoriasis could be placed in grades otherwise suited to their physical fitness, but severe cases were to be placed in Grade III (fit for sedentary occupations). The revised code in 1942 was more specific by stating that men suffering from chronic or recurring skin diseases affecting areas of the body liable to aggravation by climate or conditions of military service were not to be placed in Grade I. This implied a knowledge by the board members of the effect of military service and particular climates.

Under the later ruling there were approximately 0–62 per cent of recruits examined who were rejected from Grade I on account of skin disease.

Reboarding in New Zealand Camps

In camps in New Zealand the number of those who were downgraded for skin disease seems to have approximated 1 per cent of the total who were reboarded. In an analysis made in 1943 it was found that nearly two-thirds of these cases had skin trouble before enlistment, but no note had been made on the boarding form by the civilian board. The chief troubles were eczema, acne, psoriasis, and recurring tinea, with the older age group predominating.

Middle East Experience

In 2 NZEF in the Middle East up to February 1942, of the 2000 men who had been invalided back to New Zealand approximately 3 per cent had been returned because of skin disease.

In 1943 it was calculated that cases of skin disease accounted for 10 per cent of the total hospital admissions for the whole of the Middle East Forces. The 2 NZEF had its share of skin complaints along with other Allied forces. Some of the conditions proved difficult to clear up in the tropical climate, and resulted in numbers of men being invalided back to New Zealand. Common causes of invaliding were ‘sweat dermatitis’ and seborrhoeic eczema. By February 1942, 55 men with skin disease had been returned to New Zealand and the number had increased to 326 by the end of the war. Of the complete total, there were 165 cases of eczema and 70 of dermatitis.

Statistics for hospital admissions in 2 NZEF, MEF and CMF, from July 1941 to December 1945 show the commoner diagnoses to be: dermatitis 494, dermatitis seborrhoeica 380, dermatitis chemical allergic 81, eczema 415, impetigo contagiosa 542, tinea 319, urticaria 200, herpes zoster 194, ecthyma 162, psoriasis 138. Inflammation of the areolar tissue, boils and abscesses, cellulitis, etc., were more numerous but are not dealt with as skin infections. (See Appendix.)

The common skin diseases which affected troops in the Middle East were predominantly the same as those occurring in New Zealand, but their course and severity were often influenced by climate, and generally accepted principles of treatment sometimes required modification. Excessive sweating in hot weather predisposed some men to certain skin troubles. Mechanical irritation by sand in desert areas aggravated many skin diseases. The large number of flies increased the risk of spread of infection, hence most skin lesions were best kept covered. Heat and relative humidity influenced treatment. In a hot, dry climate lotions and paints can rarely be used for long periods; rapid drying causes cracking of the surface, with exudation of serum, which readily becomes infected. Pastes are usually the best media for applying medicaments to moist or weeping lesions, even in the acute stages.

Desert Sores

Some of these points were found out by experience in dealing with desert sores in 1940. This diagnosis was often loosely applied to any localised septic lesion of the skin, occurring under desert conditions. It was thought to be a disease peculiar to the Middle East, but proved to be a staphylococcal impetigo modified by the local conditions. Streptococci were also found in the sores and were, some thought, largely responsible for the infection.

The lesions favoured the parts of the limbs exposed to dust and sand, and under conditions of poor resistance sometimes spread into the deeper layers of the skin, where they ulcerated and formed ecthyma. In almost every theatre of war in hot climates, ecthymatous sores were a constant trouble and caused marked discomfort, a serious loss of efficiency (especially among armoured vehicle personnel), and some sick-wastage.

When the First Echelon was at Baggush in September 1940 desert sores became prevalent. These septic sores were infrequent at Gerawla, where there was little dust and much sea bathing. At Baggush there was much dust and the troops were farther from the sea. The passage of motor transport in the coastal area of the Western Desert raised a fine, flour-like dust which pervaded everywhere and infected cuts, abrasions, and insect bites. It easily penetrated through the meshes of an ordinary gauze bandage and dressing, and in addition to being a means of reinfection it mechanically irritated exposed tissues. Acting on these facts, some of the New Zealand medical officers found dressings of an occlusive nature most successful. Where ordinary eusol and flavine dressings were found ineffective, dressings of saline or sodium sulphate covered with elastoplast for several days promoted healing. Such treatments became standard. Two important principles were to avoid doing anything mechanically or by the use of chemical agents which would damage the islets of epithelium on which healing so much depended, and to avoid maceration of the skin surrounding the sore as this led to extension. In Palestine an AAMC committee reached similar conclusions regarding the sores, and developed a similar treatment. Knowledge of effective methods of treatment limited the number of evacuations from the Division to base hospitals.

In the summer of 1941, when the New Zealand Division was in the Western Desert again, desert sores again proved troublesome. When RMOs were circularised with details of a new occlusive treatment found effective in 7 Armoured Division, admissions to medical units decreased. The treatment involved the use of an ointment made by crushing a tablet of sulphapyridine in 2 oz. of paraffin molle flavine and the covering of the sore with elastoplast or sticking plaster for three to five days.

In September 1942, after the Division had been fighting continuously in the Desert for two and a half months, there was an increase in septic skin conditions entailing admissions to hospital. In the belief that if the undue dryness of the skin caused by sun, wind, and dust could be relieved the incidence of desert sores would drop, the British authorities made a move to issue a cold cream to the troops as a prophylactic agent. But the Battle of Alamein led to such a fast advance that the cold cream never reached the units where it was most needed. In Italy in the cooler climate these septic skin conditions were much reduced in incidence. The introduction of sulphonamides, and later of penicillin, helped to obviate in the Middle East the enormous sick-wastage which had occurred in the war of 1914–18, though injudicious use of local sulphonamide treatment not infrequently led to sensitisation and the development of an eczema.

Eczema and Dermatitis

Climatic dermatitis was always present in New Zealand general hospitals, especially in Egypt. Most common was a chronic sweat dermatitis, in which a patient seemed to develop a hypersensitivity to his own sweat. Also common in 2 NZEF were seborrhoeic infections, and when these became eczematised they formed another large group of incapacitating skin eruptions. There were also miscellaneous other dermatoses of lower incidence in which heat was an aggravating factor. Under military conditions in the Middle East the feet were the commonest sites affected by skin diseases. Many men were incapacitated in the summer by sweat dermatitis of the feet alone.

Heat-sensitive cases responded well to hospital treatment, and could be cleared up rapidly with X-rays, but no treatment would prevent relapses on return to the former environment. Cases of sweat dermatitis were benefited by the frequent removal of perspiration by showers and baths, but the more severe cases were best protected from soap and water. This could be prevented by anointing these areas with soft paraffin before a shower.

Some of the victims of dermatitis could possibly have been recognised before they were sent to a tropical climate—for instance, a man with a mild patch or two of scaly dermatitis on the feet, which has always been worse in hot weather; the man who gets sweat intertrigo in his flexures every summer; the man with chronic severe dandruff and recurrent eruptions on the ears. Such soldiers should not be posted to tropical localities.

Skin Disorders of the Feet

The commonest disturbances of the skin of the feet were, in order of frequency: first, hyperidrosis; second, eczema; third, pyogenic infections; and a bad fourth, tinea.

Hyperidrosis (Excessive Sweating)

Causes: In most cases the patient was a 'seborrhoeic' subject. It will be helpful to explain exactly what is meant by this term, which is a bad one, since only a minority of these people have oily skins. The seborrhoeic diathesis is an inborn constitution in which the skin is deficient in several respects. Its resistance to infection is low, resulting in furunculosis, sycosis barbae, chronic blepharitis, styes, dandruff, seborrhoeic dermatitis, acne, and intertrigo. It tends to become hypersensitive, resulting in eczema, especially 'seborrhoeic' and 'dysidrotic' eczema. And its secretions are apt to be excessive, resulting in hyperidrosis, and in a few cases, seborrhoea.

The mucous membranes are often similarly defective, particularly in the respiratory tract (causing chronic rhinitis, sinusitis, tonsillitis, and bronchitis) and the alimentary tract (causing chronic gastritis and other dyspepsias). These foci of sepsis aggravate the skin condition, and in some cases of hyperidrosis and eczema removal of them will give relief.

Seborrhoeic subjects are frequently of a psychoneurotic temperament, and since the sweat glands of the hands and feet are under direct nervous control, this makes matters worse. Hyperidrosis is also common in those with flat feet.

Clinical Features: The appearance of the hyperidrotic foot is characteristic. Constantly moist with sweat, the skin becomes macerated. It takes on a sodden, dead-white appearance, for which the maximum sites are the pressure areas—across the anterior arch, especially the ball of the big toe, and on the heels; and the parts of greatest sweat stagnation—between the toes. It is this whitish colour that leads to this condition being called 'tinea', and in the fifth toe cleft the appearances may be identical. Some cases show in addition a hyperkeratosis of the pressure areas, which may be very marked.

Treatment and Disposal: As a routine method the following was the most satisfactory:

Twice a day wash the feet in soap and water, and then soak for fifteen minutes in 1 in 4000 potassium permanganate solution (if possible warm). Allow this to dry thoroughly. Then dust liberally with powder—e.g., Acid. Salicyl. 3 per cent Talc (French chalk) or Acid. Boric. Put on clean socks containing some of this powder.

If there is no improvement try acid. Tannic 10 per cent in spirit, applied as a paint, instead of the permanganate soaks.

It is only where there is added hyperkeratosis that Whitfield's ointment should be used (or better, an ointment containing salicylic acid alone 3–6 per cent). This can be applied each night until the keratosis is reduced.

It was felt that men whose condition could not be controlled by the above methods should be forwarded to Base, where more constant attention was possible, for consideration of regrading.

Eczemas

Causes: The seborrhoeic constitution was again the commonest factor underlying cases of eczema. A characteristic variety was the chronic sweat dermatitis, or 'dysidrotic eczema', which affects seborrhoeics especially. It was uncommon for an eczema to have its origin in a fungous infection.

Clinical Features: In a dysidrotic eczema the eruption runs closely parallel to the amount of sweating which occurs. The milder cases clear up entirely in the winter, only to recur when the hot weather comes round again.

There are the following three sites of predilection:

1. The dorsum of the toes and of the foot in their neighbourhood. This is greatest in the region of the big toe. This distribution distinguishes it from tinea, which affects the under surface of the toes and is greatest in the region of the little toe.
2. The instep.
3. The hollow of the ankle behind the malleoli, more on the inner, and often continuous with the lesions on the instep.

The lesions of eczema are papules, vesicles, and scales. These may become confluent, giving rise to raw, weeping areas and large, red scaly patches. Itching is generally severe.

Treatment: As a routine the milder cases may be treated with calamine or lead and calamine lotion. Severer cases should be dressed daily with Lassar's Paste. In the chronic stages the best routine dressing is coal-tar paste—3 per cent of prepared coal tar in Lassar's Paste.

In dysidrotic cases the feet should be washed frequently to remove sweat, but in all eczemas the actual affected areas should first be protected from soap and water by the application of vaseline. A bland dusting powder should be used in the socks.

The prognosis in cases of dysidrotic eczema severe enough to be incapacitating was poor. Hospital treatment and X-ray therapy cleared them up, but they rapidly recurred when the soldier returned to duty in hot weather. It was best for them to be regraded.

Pyogenic Infection

This was usually a complication of hyperidrosis or eczema. When severe, or with inguinal adenitis or fever, they were treated in bed. The milder cases, such as a few pustules in an area of eczema, did well with dressings of Pasta Flava—Hyd. Ox. Flav. 2 per cent (or Acriflavine –1 per cent) in Lassar's Paste.

Severe cases with suppurating ulcerated areas were best treated with four-hourly dressings of tulle gras, covered with compresses of eusol or saline, and cotton wool.

Tinea

Compared with eczematous conditions, tinea was uncommon. It accounted for a minority of foot eruptions, and was much less common in the groin than non-specific intertrigo. The important practical point is that these conditions are aggravated by fungicidal applications, whereas the soothing treatment for eczemas does not irritate tinea, and indeed usually benefits it by helping the natural resistance of the skin to overcome the infection. Where microscopic examination does not show fungus, or where microscopes are not at hand, it is safer to treat foot outbreaks, for instance, with soaks of 1:5000 potassium permanganate than to use Whitfield's ointment. In the groin these remarks are especially applicable since tinea cruris is easily confirmed microscopically and the skin in this region is easily irritated.

A possible exception to the above is Castellani's fuchsin paint, a fungicidal preparation which is much milder than one would judge from its formula. It is highly effective as a fungus-killer, and even in non-fungous intertrigos is a valuable measure for the first ten to fourteen days of treatment.

In recent years preparations of higher fatty acids have come into prominence as non-irritating fungicides. These were not developed in time for use in the recent war, but it is certain they will fill a place in tropical dermatology in the future.

Etiological Factors

Most chronic skin diseases in the army were due to a lowering of resistance to infection, so that the common saprophytes of the skin became pathogenic. This was especially true in hot climates, and in an investigation of 200 patients admitted to 1 NZ General Hospital Lieutenant-Colonel R. G. Park, in 1944, pointed out the commonest causes to be—other infective processes, psychoneurosis, a large number of sources of external irritation, and inborn susceptibility.

Other Infections

It is an accepted fact that one infective disease will predispose to others. Either acute intercurrent infections or chronic foci of sepsis were found in about 20 per cent of the cases examined. Usually when the infection subsided the skin cleared up, but sometimes it did not seem to be able to recover its resistance, particularly where there was a long period of post-infective debility. In the Middle East such cases were common after infective hepatitis.

Psychoneurosis

Approximately 25 per cent of the cases investigated had some underlying mental stress, and these cases fared relatively poorly in the Middle East. Many men gave the history that their skin trouble began only after their nervous symptoms, and that any exacerbation of the latter seemed to make their skins worse. This suggested that the decline in mental wellbeing played a part in lowering the resistance to infection, rather than being merely an accompaniment or a result of it.

External Factors

Friction was a common local precipitating factor in many chronic infective conditions. Examples were the persistent beard eruptions which were particularly stubborn under the customary military shaving conditions of cold water and blunt blades; army boots were the chief factor in many seborrhoeic eczemas of the feet; seborrhoeic dermatitis was on occasions due to woollen underclothes, and heavy socks gave rise to a particularly obstinate eruption around the ankles; watch straps and tightly fitting garments were trouble-some in hot weather as a cause of active seborrhoeic eruptions; adhesive strapping was a common irritant and was not favoured as a dermatological dressing; dust and dirt were such potent allies of the skin organisms that even previously normal men became susceptible to boils and desert sores in the Western Desert, especially when water was limited and sea bathing not possible.

The Constitutional Factor

By no means every soldier, however, who had been subjected to the conditions already mentioned became afflicted with skin disorders. It was necessary for the victim to have some natural inborn susceptibility as well. This was a varying factor in every case, and the chief and only factor in a few people—those who are born with inferior skins and have them all their lives. In chronic cases admitted to 1 General Hospital a previous history of civilian skin infection was elicited in 30 per cent.

The recognition of this constitutional type could have eliminated some men who were sent overseas. Its main features were:

1. A long history of the above varieties of chronic skin infections in civilian life, particularly if they have been worse in the hot weather.
2. A similar poor resistance to general infective diseases and to infections of the

mucous membranes of the nose, throat, ears, etc.

3. A number of associated non-infective disorders, of which the chief is hyperidrosis (especially of the hands and feet).
4. A family history of any of the above.

The Middle East environment owed its deleterious effects to a combination of heat, dry atmosphere, dust, sand, dirt, and lack of water, together with the cutaneous, internal, and psychological stresses of military service away from home in a trying part of the world. In the environment many skin conditions were slow to heal and prone to recur, entailing much hospitalisation. The more serious cases were evacuated to New Zealand, and it was felt at times that a more liberal policy of invaliding might well have been adopted so that men could have been returned to New Zealand where they would probably have given efficient service in a different climate.

In Italy

In Italy the skin diseases proved to be similar in kind and incidence to those encountered in the Middle East. They were largely related to field conditions. Chronic ulcers were common, and in the summer there were lesions which closely resembled desert sores. Furunculosis was one of the most common infections.

Late in 1944 a new development was the local use of penicillin for infective conditions. It was specific against staphylococcal and streptococcal conditions such as impetigo and boils, but did not affect the many varieties of seborrhoeic dermatitis. In this respect it was similar in effect to the sulphonamides.

Sensitisation to Sulphonamides and Penicillin

As with the sulphonamides, cases of contact dermatitis followed the local application of penicillin. After incubation periods of five to seven days some patients developed dermatitis, which cleared when the penicillin application was stopped. Reapplication of penicillin caused an immediate recurrence. Penicillin, therefore, presented a similar allergic problem as did the sulphonamides—namely, that the local application of a life-saving chemotherapeutic agent for trivial skin conditions can set up sensitisation which hinders its subsequent use for serious infections. With penicillin, however, the sensitivity of such cases to injections appeared to be lower than was the case with sulphonamides. The contra-indications to its local use were therefore less obvious, but the occurrence of these sensitivities indicated that the drug should not be applied to the skin for periods longer than three to four days at a time.

In 1945 cases were still seen from time to time in 2 NZEF of sensitisation dermatitis produced by local application of sulphonamide. In the British forces its use for these purposes was prohibited, but it seemed that some of the newer New Zealand RMOs were still unaware of this state of affairs. By this time the knowledge of the local use of sulphonamides on the skin had advanced. It was found possible to apply them to cutaneous lesions without danger of sensitisation, so long as a small dose was given simultaneously by mouth.

Scabies and Pediculosis

Throughout the time 2 NZEF was in the Middle East and Italy there were cases of scabies and pediculosis (as there was in any other force, the Army in New Zealand included), but the incidence was not high until in the latter stages in Italy. In the winter of 1944 the incidence in the Division increased, but the highest figures were reached in the months of May to October 1945. This was in spite of the showering and disinfestation facilities available. It must be ascribed to free mingling with the local population and lack of discipline. When the remnants of the Division were in the Florence area in October 1945 these infestations reached their peak incidence of 131 cases of scabies and 165 of lice for the month. At this stage units were widely dispersed and had independent showering arrangements. Patients were admitted to hospital who had not bathed for some time. It was necessary for HQ 2 NZEF to issue a directive to all unit commanders to ensure better discipline in the matter of personal hygiene. The resulting action led to a prompt reduction in the incidence of both scabies and pediculosis, there being only sporadic cases more in keeping with the good record of 2 NZEF as regards personal hygiene, and relative freedom from infestation and skin troubles attributable to a lack of personal cleanliness. In this connection considerable assistance was rendered through the facilities acquired and developed by 4 Field Hygiene Company in regard to showering and disinfestation. Equipment for such purposes should be freely available in any military force.

It was common in military practice to find cases of dermatitis mistaken for scabies and made worse by anti-scabietic therapy. This was a type of disseminated papular dermatitis commonly seen in hot weather, particularly related to sweating. The chief point in diagnosis is that the lesions do not involve the areas of predilection to scabies.

Experience of Pacific Force

In the Pacific Islands skin diseases were proportionately a greater medical problem than they were in the Middle East. The incidence steadily increased as 3 NZ Division moved northwards towards the Equator. Skin disease in the Solomon Islands was the chief cause of attendance at the RAPs, and formed the greater part of the medical work of the Field Ambulances. Only the more chronic and more severe cases were evacuated to 2 NZ CCS, and yet these amounted to 449 in eight months. In one period of five months (March–August 1943) there were 202 cases, including 40 outpatients, treated at 4 NZ General Hospital at the Base in New Caledonia. The majority of cases were of eczema and dermatitis, with a fair proportion of ecthyma, and a lesser number of cases of tinea, acne vulgaris, and other infections. The more serious cases admitted to the General Hospital were treated as inpatients for an average period of approximately one month. Even then patients who were not down-graded had to be thoroughly tried out before allowing them to return to full duty. Many lesions tended to break out again when the soldier started to work and sweat in the hot sun. In the case of dermatitis of the foot, for example, the patient had to be given a trial of work while wearing heavy boots and socks.

Early in January 1944 the high incidence of skin disease in 3 NZ Division began to cause concern and brief surveys of conditions in the Vella Lavella and Treasury Islands were made by a skin specialist. It was found that the percentage of unit strength attending RAPs daily on account of skin disease during the month of December 1943 was as follows: Treasury Islands, 6–20 per cent; Vella Lavella, 6–10 per cent; Guadalcanal 1–6 per cent. These percentages do not refer only to new cases, but to all cases requiring treatment at each sick parade.

The causes of skin disease were found to be, in descending order of importance: sweat, trauma and infection, lack of washing facilities, infestation by larval mites, fungoid infection, standing in sea-water, sodden clothing, and sensitisation. Exposure to sunlight and diet did not appear to be factors. The incidence of skin disease was highest during the early periods of camp construction. As jungle undergrowth was cleared away and proper camps and tracks were established the situation improved.

Skin trauma could be prevented to a certain extent by suitable clothing, viz., shirt with long sleeves, trousers tucked into battle-dress anklets, boots and socks, and this was the order of dress during jungle manoeuvres. To combat sweat reactions, men were encouraged to wash frequently in fresh water whenever it was obtainable, and to apply dusting powder before dressing. They were also taught to report even a minor skin abrasion as soon as possible. Medical orderlies were taught to use aseptic technique when dressing these septic cases, for streptococcal infection was readily spread from one case to another.

In the Treasury Islands the incidence was much higher on Stirling than on Mono Island, and larval mites appeared to be the chief cause of skin lesions on the lower limbs. The presence of the larval mite on Stirling Island was apparently known to the natives, who avoided living there. Mosquito repellent (No. 612) applied to the exposed skin was found to be a successful prophylactic against these mites.

Both in New Caledonia and the Solomon Islands there were numerous species of ‘poisonous’ trees and plants, which produced dermatitis on first contact with the skin. The foliage and wood-sap were highly irritant, and produced erythema and oedema followed by vesiculation and exudation. Other cases of eczema and dermatitis were the result of (a) sweat, (b) products of bacterial or fungoid infection, (c) chemical substances used in skin treatment, such as sulphanilamide, iodine, sulphur, acriflavine.

Ecthyma, a streptococcal and often staphylococcal infection involving the whole thickness of the skin, was exceedingly common in the tropics, both amongst natives and whites. As the ‘desert sore’ it was common in the Middle East, and as the ‘tropical ulcer’ it was even more common in New Caledonia and the Solomon Islands, where the hot, humid climate favoured bacterial growth. In the early spreading stage a haemolytic streptococcus was often isolated in pure culture, but in the chronic ulcer stage staphylococci, diphtheroids, and non-haemolytic streptococci were found in addition. In a number of cases virulent Klebs-Loeffler bacilli were isolated from the ulcer and sometimes from the patient's throat as well. No complications were observed amongst these latter cases in 2 NZ CCS, though peripheral neuritis was reported by Allied medical officers.

RNZAF in Pacific, 1943–45

In the RNZAF in the Pacific more men were unfit and more time was lost from skin diseases than from any other type of disease. Twenty-eight per cent of the medical admissions in the area were on account of skin diseases—somewhat more than a quarter of the total illness.

On the whole, skin cases were off duty for longer than those suffering from other types of illness. More than a third—34 per cent of those unfit for more than three weeks—were hospitalised because of skin diseases.

Skin diseases also accounted for a large number of medical repatriations—125 out of 967 repatriations, or 13 per cent.

To give figures showing the widespread incidence of skin disease: in the first eight months of 1945 there were 1000 cases of skin disease in the force of 7800. Nearly a hundred of these cases were in hospital for more than three weeks before returning to duty, and a further 79 had to be repatriated. On the other hand, during the same period there were only 49 cases of malaria—of these there were only 4 cases who were in hospital for more than three weeks, and a further 6 who had to be repatriated.

The incidence of skin disease was therefore twenty times greater than the incidence of malaria in 1945. Skin diseases represented the major problem for military personnel serving in the tropical Pacific.

Forty-nine per cent of the admissions for skin diseases were on account of infected wounds, ulcers, cellulitis, etc.; dermatitis, impetigo, eczema, etc., accounted for 27 per cent; boils and carbuncles for 12 per cent; tineal conditions for 6 per cent; paronychia for 3 per cent; and other conditions for 3 per cent of admissions.

Nearly half the hospitalisation for skin conditions was due therefore to infected wounds, ulcers, and cellulitis. These cases were also slower in responding to treatment than dermatitis, eczematous conditions, etc., and accounted for nearly 60 per cent of the 'skins' requiring more than three weeks in hospital.

On the other hand, nearly all cases of infected wounds and ulcers cleared up satisfactorily without having to be repatriated. During the whole period the RNZAF forces were in the Pacific only 13 men had to be sent back to New Zealand on account of ulcers and infected wounds, whereas 112 men had to be sent back with other skin conditions. From the point of view of permanent loss of manpower, dysidrotic and tineal conditions were much more serious than infected wounds.

Treatment in New Zealand of Ex-overseas Invalids

In most of the cases of skin disease returned to New Zealand the cause was the tendency of the lesions of the individuals concerned to become chronic under the climatic conditions. In New Zealand their condition was naturally much improved and subsequent treatment was more or less in line with civilian cases and general civilian practice.

Prognosis: From experience of pensions cases since the war it has been necessary to revise the optimistic prognosis, often given overseas, that eruptions would clear on return to New Zealand and removal from military conditions. It has turned out that in many of these cases military life has merely pulled the trigger, and that non-specific sensitivity has kept the disease going as a chronic disorder. The psychological stresses of rehabilitation, replacing those of active service, have undoubtedly contributed to this chronicity.

Pensions

By 31 March 1951 the total of skin diseases recorded by the War Pensions Board had risen to 2890, the bulk of these being from overseas service, including service in the Pacific Islands and elsewhere. For diseases of the areolar tissue there were only 60 cases recorded.

Skin diseases are the most unsatisfactory of all the lesser ailments. This is due largely to the relative lack of knowledge of skin diseases in general and the obscurity of diagnosis. The only skin diseases that seem to have been finally disposed of by the Pensions Department are:

Tinea: These cases recurred for a year or two, and some cases were very persistent, attending hospital for twelve to eighteen months. Most of these cleared up with X-ray treatment.

Tropical Sores: From the Pacific theatre there were many cases but these cleared up rapidly on return to New Zealand.

Of the cases still on pension there are many which seem to have developed an allergic condition and tend to recur. Many cases, again, develop skin disease some time after their return to New Zealand, but are granted a pension if there is any history of skin disease overseas, though the conditions may not be at all similar.

Recommendations

In any future intake of recruits medical boards must be more particular in their inquiries into the skin condition of the recruit in civilian life. A follow-up is then necessary in camps to ensure that men are not sent overseas with skin diseases which are mild in New Zealand, but which would deteriorate in tropical or other conditions. The aid of a consultant skin specialist might well be made use of. In addition, each hospital unit in an overseas force should have a skin specialist on its staff.

The whole question of the boarding of recruits with mild degrees of skin pathology is of the greatest importance. These conditions are very common, especially in the adolescent, when they might almost be looked upon as a phase in development. If some skin abnormality is considered sufficient to make a man unfit for service in the Army, then there will be at once a great waste of manpower in men otherwise quite fit for service, and, in the adolescents, in men who will overcome their skin trouble naturally by the mere effluxion of time. Many of the diseases again cause little or no disability, and in times of stress could be disregarded by the man; and in possibly the majority of men in the Army the conditions are disregarded.

There is an inherent danger in specialisation in that the skin specialist, like his colleagues in other departments, is apt to pay too much attention to the minor disabilities, especially when they prove refractory and impossible to cure. If specialists had the care and boarding of every case there might be a grave danger of decimating the Army. On the other hand, their advice regarding treatment and the disposal of serious cases is, of course, invaluable.

X-ray Therapy

It was forcibly brought out in statistics that skin diseases formed a high percentage of all illnesses in the Army. In such circumstances it is surprising that the most valuable dermatological weapon of all, X-ray therapy, should have been conspicuous by its absence. There was no therapy plant available in the 2 NZEF, and indeed in the whole of the Middle East Force there was only one. It is not claimed that radiotherapy will make men fit for the Army if they are unfit for it. But the cost of such apparatus in each General Hospital, and the provision of trained men to operate it, would have been paid for hundreds of times over in the saving of time spent by patients in hospital and off duty. Moreover, if many patients invalided home could have had the benefit of X-ray therapy early in the course of their disorders, instead of waiting until they were chronic, there would now be less money paid out in pensions.

2 NZEF, MEF and CMF
Admissions to Hospital, July 1941 To December 1945

(1) Diseases of the Skin:	
General	271
Dermatitis	494
Urticaria	200
Pruritis	8
Eczema	415
Impetigo contagiosa	542
Sycosis	14
Herpes zoster (shingles)	194
Cheiropompholyx	18
Psoriasis	138
Ichthyosis	4
Keratosis	12
Ecthyma	162
Lupus vulgaris	3
Erythema	27

Leishmaniosis (dermal)	3
Trichophytosis (ringworm)	14
Tinea circinata	21
Tinea barbae	9
Tinea unguium (nails)	2
Tinea cruris	106
Tinea interdigitalis	181
Acne	65
Hyperidrosis	55
Epidermophytosis	55
Diseases of the nails	13
Diseases of the sebaceous glands	86
Dermatitis seborrhoeica	380
Diseases of the sweat glands and ducts	25
Diseases of the hair and follicles	36
Sycosis (hair and follicles)	52
Alopecia (baldness)	1
Paronychia (whitlow)	323
Ingrowing toenails	362
Hypertrophy of nails	5
Tumours and cysts	397
Dermatitis—chemical allergic	81

(2) Diseases of the areolar tissue—general	31
Cellulitis	638
Boils and abscesses	1568
Carbuncles	245
Myxoedema	1
Foreign bodies	3
Oedema	17
Inflammation areolar tissue	3308

Invalids Evacuated to New Zealand, 1940–45

SKIN CASES—	
Eczema	171
Dermatitis	72

Other	78
Total	321

2 NZEF (IP)

Grading of Patients who after Adequate Treatment were Not Fit for Full Duty, i.e., Grade I

(Total treated, 202)

Type of Case	Number Regraded			
	1A	2	3	4
Eczema-dermatitis	3	5	26	
Acne vulgaris	1	3	4	
Seborrhoeic dermatitis			4	
Pyogenic infections			3	
Psoriasis		1	2	
Urticaria		2	1	
	—	—	—	—
Total	4	11	40	

Skin Cases treated at 2 NZ Casualty Clearing Station, Pacific, From 14 September 1943 Till 20 May 1944

Type of Case	Number Admitted	Evacuated to Hospital
Eczema-dermatitis	243	174
Ecthyma	81	49
Tinea	34	15
Acne vulgaris	25	20
Boils	23	14
Impetigo contagiosa	12	4
Cheiropompholyx	8	8
Sycosis barbae	6	6
Septic sores	5	
Miliaria papulosa	4	
Urticaria	4	1
Psoriasis	2	2
Herpes zoster	1	
Pruritis ani	1	
	—	—
Total	449	293

Reference

R. G. Park New Zealand Medical Journal, April 1943 and June 1944.

[SECTION]

THE code of instructions to the civilian medical boards examining recruits in 1939 was not very specific regarding the question of skin disease. It directed that men with mild cases of psoriasis could be placed in grades otherwise suited to their physical fitness, but severe cases were to be placed in Grade III (fit for sedentary occupations). The revised code in 1942 was more specific by stating that men suffering from chronic or recurring skin diseases affecting areas of the body liable to aggravation by climate or conditions of military service were not to be placed in Grade I. This implied a knowledge by the board members of the effect of military service and particular climates.

Under the later ruling there were approximately 0–62 per cent of recruits examined who were rejected from Grade I on account of skin disease.

REBOARDING IN NEW ZEALAND CAMPS

Reboarding in New Zealand Camps

In camps in New Zealand the number of those who were downgraded for skin disease seems to have approximated 1 per cent of the total who were reboarded. In an analysis made in 1943 it was found that nearly two-thirds of these cases had skin trouble before enlistment, but no note had been made on the boarding form by the civilian board. The chief troubles were eczema, acne, psoriasis, and recurring tinea, with the older age group predominating.

MIDDLE EAST EXPERIENCE

Middle East Experience

In 2 NZEF in the Middle East up to February 1942, of the 2000 men who had been invalided back to New Zealand approximately 3 per cent had been returned because of skin disease.

In 1943 it was calculated that cases of skin disease accounted for 10 per cent of the total hospital admissions for the whole of the Middle East Forces. The 2 NZEF had its share of skin complaints along with other Allied forces. Some of the conditions proved difficult to clear up in the tropical climate, and resulted in numbers of men being invalided back to New Zealand. Common causes of invaliding were 'sweat dermatitis' and seborrhoeic eczema. By February 1942, 55 men with skin disease had been returned to New Zealand and the number had increased to 326 by the end of the war. Of the complete total, there were 165 cases of eczema and 70 of dermatitis.

Statistics for hospital admissions in 2 NZEF, MEF and CMF, from July 1941 to December 1945 show the commoner diagnoses to be: dermatitis 494, dermatitis seborrhoeica 380, dermatitis chemical allergic 81, eczema 415, impetigo contagiosa 542, tinea 319, urticaria 200, herpes zoster 194, ecthyma 162, psoriasis 138. Inflammation of the areolar tissue, boils and abscesses, cellulitis, etc., were more numerous but are not dealt with as skin infections. (See Appendix.)

The common skin diseases which affected troops in the Middle East were predominantly the same as those occurring in New Zealand, but their course and severity were often influenced by climate, and generally accepted principles of treatment sometimes required modification. Excessive sweating in hot weather predisposed some men to certain skin troubles. Mechanical irritation by sand in desert areas aggravated many skin diseases. The large number of flies increased the risk of spread of infection, hence most skin lesions were best kept covered. Heat and relative humidity influenced treatment. In a hot, dry climate lotions and paints can rarely be used for long periods; rapid drying causes cracking of the surface, with exudation of serum, which readily becomes infected. Pastes are usually the best media for applying medicaments to moist or weeping lesions, even in the acute stages.

DESERT SORES

Desert Sores

Some of these points were found out by experience in dealing with desert sores in 1940. This diagnosis was often loosely applied to any localised septic lesion of the skin, occurring under desert conditions. It was thought to be a disease peculiar to the Middle East, but proved to be a staphylococcal impetigo modified by the local conditions. Streptococci were also found in the sores and were, some thought, largely responsible for the infection.

The lesions favoured the parts of the limbs exposed to dust and sand, and under conditions of poor resistance sometimes spread into the deeper layers of the skin, where they ulcerated and formed ecthyma. In almost every theatre of war in hot climates, ecthymatous sores were a constant trouble and caused marked discomfort, a serious loss of efficiency (especially among armoured vehicle personnel), and some sick-wastage.

When the First Echelon was at Baggush in September 1940 desert sores became prevalent. These septic sores were infrequent at Gerawla, where there was little dust and much sea bathing. At Baggush there was much dust and the troops were farther from the sea. The passage of motor transport in the coastal area of the Western Desert raised a fine, flour-like dust which pervaded everywhere and infected cuts, abrasions, and insect bites. It easily penetrated through the meshes of an ordinary gauze bandage and dressing, and in addition to being a means of reinfection it mechanically irritated exposed tissues. Acting on these facts, some of the New Zealand medical officers found dressings of an occlusive nature most successful. Where ordinary eusol and flavine dressings were found ineffective, dressings of saline or sodium sulphate covered with elastoplast for several days promoted healing. Such treatments became standard. Two important principles were to avoid doing anything mechanically or by the use of chemical agents which would damage the islets of epithelium on which healing so much depended, and to avoid maceration of the skin surrounding the sore as this led to extension. In Palestine an AAMC committee reached similar conclusions regarding the sores, and developed a similar treatment. Knowledge of effective methods of treatment limited the number of evacuations from the Division to base hospitals.

In the summer of 1941, when the New Zealand Division was in the Western Desert again, desert sores again proved troublesome. When RMOs were circularised with details of a new occlusive treatment found effective in 7 Armoured Division, admissions to medical units decreased. The treatment involved the use of an ointment made by crushing a tablet of sulphapyridine in 2 oz. of paraffin molle flavine and the covering of the sore with elastoplast or sticking plaster for three to five days.

In September 1942, after the Division had been fighting continuously in the Desert for two and a half months, there was an increase in septic skin conditions entailing admissions to hospital. In the belief that if the undue dryness of the skin caused by sun, wind, and dust could be relieved the incidence of desert sores would drop, the British authorities made a move to issue a cold cream to the troops as a prophylactic agent. But the Battle of Alamein led to such a fast advance that the cold cream never reached the units where it was most needed. In Italy in the cooler climate these septic skin conditions were much reduced in incidence. The introduction of sulphonamides, and later of penicillin, helped to obviate in the Middle East the enormous sick-wastage which had occurred in the war of 1914–18, though injudicious use of local sulphonamide treatment not infrequently led to sensitisation and the development of an eczema.

ECZEMA AND DERMATITIS

Eczema and Dermatitis

Climatic dermatitis was always present in New Zealand general hospitals, especially in Egypt. Most common was a chronic sweat dermatitis, in which a patient seemed to develop a hypersensitivity to his own sweat. Also common in 2 NZEF were seborrhoeic infections, and when these became eczematised they formed another large group of incapacitating skin eruptions. There were also miscellaneous other dermatoses of lower incidence in which heat was an aggravating factor. Under military conditions in the Middle East the feet were the commonest sites affected by skin diseases. Many men were incapacitated in the summer by sweat dermatitis of the feet alone.

Heat-sensitive cases responded well to hospital treatment, and could be cleared up rapidly with X-rays, but no treatment would prevent relapses on return to the former environment. Cases of sweat dermatitis were benefited by the frequent removal of perspiration by showers and baths, but the more severe cases were best protected from soap and water. This could be prevented by anointing these areas with soft paraffin before a shower.

Some of the victims of dermatitis could possibly have been recognised before they were sent to a tropical climate—for instance, a man with a mild patch or two of scaly dermatitis on the feet, which has always been worse in hot weather; the man who gets sweat intertrigo in his flexures every summer; the man with chronic severe dandruff and recurrent eruptions on the ears. Such soldiers should not be posted to tropical localities.

SKIN DISORDERS OF THE FEET

Skin Disorders of the Feet

The commonest disturbances of the skin of the feet were, in order of frequency: first, hyperidrosis; second, eczema; third, pyogenic infections; and a bad fourth, tinea.

HYPERIDROSIS (EXCESSIVE SWEATING)

Hyperidrosis (Excessive Sweating)

Causes: In most cases the patient was a 'seborrhoeic' subject. It will be helpful to explain exactly what is meant by this term, which is a bad one, since only a minority of these people have oily skins. The seborrhoeic diathesis is an inborn constitution in which the skin is deficient in several respects. Its resistance to infection is low, resulting in furunculosis, sycosis barbae, chronic blepharitis, styes, dandruff, seborrhoeic dermatitis, acne, and intertrigo. It tends to become hypersensitive, resulting in eczema, especially 'seborrhoeic' and 'dysidrotic' eczema. And its secretions are apt to be excessive, resulting in hyperidrosis, and in a few cases, seborrhoea.

The mucous membranes are often similarly defective, particularly in the respiratory tract (causing chronic rhinitis, sinusitis, tonsillitis, and bronchitis) and the alimentary tract (causing chronic gastritis and other dyspepsias). These foci of sepsis aggravate the skin condition, and in some cases of hyperidrosis and eczema removal of them will give relief.

Seborrhoeic subjects are frequently of a psychoneurotic temperament, and since the sweat glands of the hands and feet are under direct nervous control, this makes matters worse. Hyperidrosis is also common in those with flat feet.

Clinical Features: The appearance of the hyperidrotic foot is characteristic. Constantly moist with sweat, the skin becomes macerated. It takes on a sodden, dead-white appearance, for which the maximum sites are the pressure areas—across the anterior arch, especially the ball of the big toe, and on the heels; and the parts of greatest sweat stagnation—between the toes. It is this whitish colour that leads to this condition being called 'tinea', and in the fifth toe cleft the appearances may be identical. Some cases show in addition a hyperkeratosis of the pressure areas, which may be very marked.

Treatment and Disposal: As a routine method the following was the most satisfactory:

Twice a day wash the feet in soap and water, and then soak for fifteen minutes in 1 in 4000 potassium permanganate solution (if possible warm). Allow this to dry thoroughly. Then dust liberally with powder—e.g., Acid. Salicyl. 3 per cent Talc (French chalk) or Acid. Boric. Put on clean socks containing some of this powder.

If there is no improvement try acid. Tannic 10 per cent in spirit, applied as a paint, instead of the permanganate soaks.

It is only where there is added hyperkeratosis that Whitfield's ointment should be used (or better, an ointment containing salicylic acid alone 3–6 per cent). This can be applied each night until the keratosis is reduced.

It was felt that men whose condition could not be controlled by the above methods should be forwarded to Base, where more constant attention was possible, for consideration of regrading.

ECZEMAS

Eczemas

Causes: The seborrhoeic constitution was again the commonest factor underlying cases of eczema. A characteristic variety was the chronic sweat dermatitis, or ‘dysidrotic eczema’, which affects seborrhoeics especially. It was uncommon for an eczema to have its origin in a fungous infection.

Clinical Features: In a dysidrotic eczema the eruption runs closely parallel to the amount of sweating which occurs. The milder cases clear up entirely in the winter, only to recur when the hot weather comes round again.

There are the following three sites of predilection:

1. The dorsum of the toes and of the foot in their neighbourhood. This is greatest in the region of the big toe. This distribution distinguishes it from tinea, which affects the under surface of the toes and is greatest in the region of the little toe.
2. The instep.
3. The hollow of the ankle behind the malleoli, more on the inner, and often continuous with the lesions on the instep.

The lesions of eczema are papules, vesicles, and scales. These may become confluent, giving rise to raw, weeping areas and large, red scaly patches. Itching is generally severe.

Treatment: As a routine the milder cases may be treated with calamine or lead and calamine lotion. Severer cases should be dressed daily with Lassar's Paste. In the chronic stages the best routine dressing is coal-tar paste—3 per cent of prepared coal tar in Lassar's Paste.

In dysidrotic cases the feet should be washed frequently to remove sweat, but in all eczemas the actual affected areas should first be protected from soap and water by the application of vaseline. A bland dusting powder should be used in the socks.

The prognosis in cases of dysidrotic eczema severe enough to be incapacitating was poor. Hospital treatment and X-ray therapy cleared them up, but they rapidly recurred when the soldier returned to duty in hot weather. It was best for them to be regraded.

PYOGENIC INFECTION

Pyogenic Infection

This was usually a complication of hyperidrosis or eczema. When severe, or with inguinal adenitis or fever, they were treated in bed. The milder cases, such as a few pustules in an area of eczema, did well with dressings of Pasta Flava—Hyd. Ox. Flav. 2 per cent (or Acriflavine –1 per cent) in Lassar's Paste.

Severe cases with suppurating ulcerated areas were best treated with four-hourly dressings of tulle gras, covered with compresses of eusol or saline, and cotton wool.

TINEA

Tinea

Compared with eczematous conditions, tinea was uncommon. It accounted for a minority of foot eruptions, and was much less common in the groin than non-specific intertrigo. The important practical point is that these conditions are aggravated by fungicidal applications, whereas the soothing treatment for eczemas does not irritate tinea, and indeed usually benefits it by helping the natural resistance of the skin to overcome the infection. Where microscopic examination does not show fungus, or where microscopes are not at hand, it is safer to treat foot outbreaks, for instance, with soaks of 1:5000 potassium permanganate than to use Whitfield's ointment. In the groin these remarks are especially applicable since tinea cruris is easily confirmed microscopically and the skin in this region is easily irritated.

A possible exception to the above is Castellani's fuchsin paint, a fungicidal preparation which is much milder than one would judge from its formula. It is highly effective as a fungus-killer, and even in non-fungous intertrigos is a valuable measure for the first ten to fourteen days of treatment.

In recent years preparations of higher fatty acids have come into prominence as non-irritating fungicides. These were not developed in time for use in the recent war, but it is certain they will fill a place in tropical dermatology in the future.

ETIOLOGICAL FACTORS

Etiological Factors

Most chronic skin diseases in the army were due to a lowering of resistance to infection, so that the common saprophytes of the skin became pathogenic. This was especially true in hot climates, and in an investigation of 200 patients admitted to 1 NZ General Hospital Lieutenant-Colonel R. G. Park, in 1944, pointed out the commonest causes to be—other infective processes, psychoneurosis, a large number of sources of external irritation, and inborn susceptibility.

OTHER INFECTIONS

Other Infections

It is an accepted fact that one infective disease will predispose to others. Either acute intercurrent infections or chronic foci of sepsis were found in about 20 per cent of the cases examined. Usually when the infection subsided the skin cleared up, but sometimes it did not seem to be able to recover its resistance, particularly where there was a long period of post-infective debility. In the Middle East such cases were common after infective hepatitis.

PSYCHONEUROSIS

Psychoneurosis

Approximately 25 per cent of the cases investigated had some underlying mental stress, and these cases fared relatively poorly in the Middle East. Many men gave the history that their skin trouble began only after their nervous symptoms, and that any exacerbation of the latter seemed to make their skins worse. This suggested that the decline in mental wellbeing played a part in lowering the resistance to infection, rather than being merely an accompaniment or a result of it.

EXTERNAL FACTORS

External Factors

Friction was a common local precipitating factor in many chronic infective conditions. Examples were the persistent beard eruptions which were particularly stubborn under the customary military shaving conditions of cold water and blunt blades; army boots were the chief factor in many seborrhoeic eczemas of the feet; seborrhoeic dermatitis was on occasions due to woollen underclothes, and heavy socks gave rise to a particularly obstinate eruption around the ankles; watch straps and tightly fitting garments were trouble-some in hot weather as a cause of active seborrhoeic eruptions; adhesive strapping was a common irritant and was not favoured as a dermatological dressing; dust and dirt were such potent allies of the skin organisms that even previously normal men became susceptible to boils and desert sores in the Western Desert, especially when water was limited and sea bathing not possible.

THE CONSTITUTIONAL FACTOR

The Constitutional Factor

By no means every soldier, however, who had been subjected to the conditions already mentioned became afflicted with skin disorders. It was necessary for the victim to have some natural inborn susceptibility as well. This was a varying factor in every case, and the chief and only factor in a few people—those who are born with inferior skins and have them all their lives. In chronic cases admitted to 1 General Hospital a previous history of civilian skin infection was elicited in 30 per cent.

The recognition of this constitutional type could have eliminated some men who were sent overseas. Its main features were:

1. A long history of the above varieties of chronic skin infections in civilian life, particularly if they have been worse in the hot weather.
2. A similar poor resistance to general infective diseases and to infections of the mucous membranes of the nose, throat, ears, etc.
3. A number of associated non-infective disorders, of which the chief is hyperidrosis (especially of the hands and feet).
4. A family history of any of the above.

The Middle East environment owed its deleterious effects to a combination of heat, dry atmosphere, dust, sand, dirt, and lack of water, together with the cutaneous, internal, and psychological stresses of military service away from home in a trying part of the world. In the environment many skin conditions were slow to heal and prone to recur, entailing much hospitalisation. The more serious cases were evacuated to New Zealand, and it was felt at times that a more liberal policy of invaliding might well have been adopted so that men could have been returned to New Zealand where they would probably have given efficient service in a different climate.

In Italy

In Italy the skin diseases proved to be similar in kind and incidence to those encountered in the Middle East. They were largely related to field conditions. Chronic ulcers were common, and in the summer there were lesions which closely resembled desert sores. Furunculosis was one of the most common infections.

Late in 1944 a new development was the local use of penicillin for infective conditions. It was specific against staphylococcal and streptococcal conditions such as impetigo and boils, but did not affect the many varieties of seborrhoeic dermatitis. In this respect it was similar in effect to the sulphonamides.

SENSITISATION TO SULPHONAMIDES AND PENICILLIN

Sensitisation to Sulphonamides and Penicillin

As with the sulphonamides, cases of contact dermatitis followed the local application of penicillin. After incubation periods of five to seven days some patients developed dermatitis, which cleared when the penicillin application was stopped. Reapplication of penicillin caused an immediate recurrence. Penicillin, therefore, presented a similar allergic problem as did the sulphonamides—namely, that the local application of a life-saving chemotherapeutic agent for trivial skin conditions can set up sensitisation which hinders its subsequent use for serious infections. With penicillin, however, the sensitivity of such cases to injections appeared to be lower than was the case with sulphonamides. The contra-indications to its local use were therefore less obvious, but the occurrence of these sensitivities indicated that the drug should not be applied to the skin for periods longer than three to four days at a time.

In 1945 cases were still seen from time to time in 2 NZEF of sensitisation dermatitis produced by local application of sulphonamide. In the British forces its use for these purposes was prohibited, but it seemed that some of the newer New Zealand RMOs were still unaware of this state of affairs. By this time the knowledge of the local use of sulphonamides on the skin had advanced. It was found possible to apply them to cutaneous lesions without danger of sensitisation, so long as a small dose was given simultaneously by mouth.

Scabies and Pediculosis

Throughout the time 2 NZEF was in the Middle East and Italy there were cases of scabies and pediculosis (as there was in any other force, the Army in New Zealand included), but the incidence was not high until in the latter stages in Italy. In the winter of 1944 the incidence in the Division increased, but the highest figures were reached in the months of May to October 1945. This was in spite of the showering and disinfestation facilities available. It must be ascribed to free mingling with the local population and lack of discipline. When the remnants of the Division were in the Florence area in October 1945 these infestations reached their peak incidence of 131 cases of scabies and 165 of lice for the month. At this stage units were widely dispersed and had independent showering arrangements. Patients were admitted to hospital who had not bathed for some time. It was necessary for HQ 2 NZEF to issue a directive to all unit commanders to ensure better discipline in the matter of personal hygiene. The resulting action led to a prompt reduction in the incidence of both scabies and pediculosis, there being only sporadic cases more in keeping with the good record of 2 NZEF as regards personal hygiene, and relative freedom from infestation and skin troubles attributable to a lack of personal cleanliness. In this connection considerable assistance was rendered through the facilities acquired and developed by 4 Field Hygiene Company in regard to showering and disinfestation. Equipment for such purposes should be freely available in any military force.

It was common in military practice to find cases of dermatitis mistaken for scabies and made worse by anti-scabietic therapy. This was a type of disseminated papular dermatitis commonly seen in hot weather, particularly related to sweating. The chief point in diagnosis is that the lesions do not involve the areas of predilection to scabies.

Experience of Pacific Force

In the Pacific Islands skin diseases were proportionately a greater medical problem than they were in the Middle East. The incidence steadily increased as 3 NZ Division moved northwards towards the Equator. Skin disease in the Solomon Islands was the chief cause of attendance at the RAPs, and formed the greater part of the medical work of the Field Ambulances. Only the more chronic and more severe cases were evacuated to 2 NZ CCS, and yet these amounted to 449 in eight months. In one period of five months (March–August 1943) there were 202 cases, including 40 outpatients, treated at 4 NZ General Hospital at the Base in New Caledonia. The majority of cases were of eczema and dermatitis, with a fair proportion of ecthyma, and a lesser number of cases of tinea, acne vulgaris, and other infections. The more serious cases admitted to the General Hospital were treated as inpatients for an average period of approximately one month. Even then patients who were not down-graded had to be thoroughly tried out before allowing them to return to full duty. Many lesions tended to break out again when the soldier started to work and sweat in the hot sun. In the case of dermatitis of the foot, for example, the patient had to be given a trial of work while wearing heavy boots and socks.

Early in January 1944 the high incidence of skin disease in 3 NZ Division began to cause concern and brief surveys of conditions in the Vella Lavella and Treasury Islands were made by a skin specialist. It was found that the percentage of unit strength attending RAPs daily on account of skin disease during the month of December 1943 was as follows: Treasury Islands, 6–20 per cent; Vella Lavella, 6–10 per cent; Guadalcanal 1–6 per cent. These percentages do not refer only to new cases, but to all cases requiring treatment at each sick parade.

The causes of skin disease were found to be, in descending order of importance: sweat, trauma and infection, lack of washing facilities, infestation by larval mites, fungoid infection, standing in sea-water, sodden clothing, and sensitisation. Exposure to sunlight and diet did not appear to be factors. The incidence of skin disease was highest during the early periods of camp construction. As jungle undergrowth was cleared away and proper camps and tracks were established the situation improved.

Skin trauma could be prevented to a certain extent by suitable clothing, viz., shirt with long sleeves, trousers tucked into battle-dress anklets, boots and socks, and this was the order of dress during jungle manoeuvres. To combat sweat reactions, men were encouraged to wash frequently in fresh water whenever it was obtainable, and to apply dusting powder before dressing. They were also taught to report even a minor skin abrasion as soon as possible. Medical orderlies were taught to use aseptic technique when dressing these septic cases, for streptococcal infection was readily spread from one case to another.

In the Treasury Islands the incidence was much higher on Stirling than on Mono Island, and larval mites appeared to be the chief cause of skin lesions on the lower limbs. The presence of the larval mite on Stirling Island was apparently known to the natives, who avoided living there. Mosquito repellent (No. 612) applied to the exposed skin was found to be a successful prophylactic against these mites.

Both in New Caledonia and the Solomon Islands there were numerous species of 'poisonous' trees and plants, which produced dermatitis on first contact with the skin. The foliage and wood-sap were highly irritant, and produced erythema and oedema followed by vesiculation and exudation. Other cases of eczema and dermatitis were the result of (a) sweat, (b) products of bacterial or fungoid infection, (c) chemical substances used in skin treatment, such as sulphanilamide, iodine, sulphur, acriflavine.

Ecthyma, a streptococcal and often staphylococcal infection involving the whole thickness of the skin, was exceedingly common in the tropics, both amongst natives and whites. As the 'desert sore' it was common in the Middle East, and as the 'tropical ulcer' it was even more common in New Caledonia and the Solomon Islands, where the hot, humid climate favoured bacterial growth. In the early spreading stage a haemolytic streptococcus was often isolated in pure culture, but in the chronic ulcer stage staphylococci, diphtheroids, and non-haemolytic streptococci were found in addition. In a number of cases virulent Klebs-Loeffler bacilli were isolated from the ulcer and sometimes from the patient's throat as well. No complications were observed amongst these latter cases in 2 NZ CCS, though peripheral neuritis was reported by Allied medical officers.

RNZAF in Pacific, 1943–45

In the RNZAF in the Pacific more men were unfit and more time was lost from skin diseases than from any other type of disease. Twenty-eight per cent of the medical admissions in the area were on account of skin diseases—somewhat more than a quarter of the total illness.

On the whole, skin cases were off duty for longer than those suffering from other types of illness. More than a third—34 per cent of those unfit for more than three weeks—were hospitalised because of skin diseases.

Skin diseases also accounted for a large number of medical repatriations—125 out of 967 repatriations, or 13 per cent.

To give figures showing the widespread incidence of skin disease: in the first eight months of 1945 there were 1000 cases of skin disease in the force of 7800. Nearly a hundred of these cases were in hospital for more than three weeks before returning to duty, and a further 79 had to be repatriated. On the other hand, during the same period there were only 49 cases of malaria—of these there were only 4 cases who were in hospital for more than three weeks, and a further 6 who had to be repatriated.

The incidence of skin disease was therefore twenty times greater than the incidence of malaria in 1945. Skin diseases represented the major problem for military personnel serving in the tropical Pacific.

Forty-nine per cent of the admissions for skin diseases were on account of infected wounds, ulcers, cellulitis, etc.; dermatitis, impetigo, eczema, etc., accounted for 27 per cent; boils and carbuncles for 12 per cent; tineal conditions for 6 per cent; paronychia for 3 per cent; and other conditions for 3 per cent of admissions.

Nearly half the hospitalisation for skin conditions was due therefore to infected wounds, ulcers, and cellulitis. These cases were also slower in responding to treatment than dermatitis, eczematous conditions, etc., and accounted for nearly 60 per cent of the ‘skins’ requiring more than three weeks in hospital.

On the other hand, nearly all cases of infected wounds and ulcers cleared up satisfactorily without having to be repatriated. During the whole period the RNZAF forces were in the Pacific only 13 men had to be sent back to New Zealand on account of ulcers and infected wounds, whereas 112 men had to be sent back with other skin conditions. From the point of view of permanent loss of manpower, dysidrotic and tineal conditions were much more serious than infected wounds.

TREATMENT IN NEW ZEALAND OF EX-OVERSEAS INVALIDS

Treatment in New Zealand of Ex-overseas Invalids

In most of the cases of skin disease returned to New Zealand the cause was the tendency of the lesions of the individuals concerned to become chronic under the climatic conditions. In New Zealand their condition was naturally much improved and subsequent treatment was more or less in line with civilian cases and general civilian practice.

Prognosis: From experience of pensions cases since the war it has been necessary to revise the optimistic prognosis, often given overseas, that eruptions would clear on return to New Zealand and removal from military conditions. It has turned out that in many of these cases military life has merely pulled the trigger, and that non-specific sensitivity has kept the disease going as a chronic disorder. The psychological stresses of rehabilitation, replacing those of active service, have undoubtedly contributed to this chronicity.

PENSIONS

Pensions

By 31 March 1951 the total of skin diseases recorded by the War Pensions Board had risen to 2890, the bulk of these being from overseas service, including service in the Pacific Islands and elsewhere. For diseases of the areolar tissue there were only 60 cases recorded.

Skin diseases are the most unsatisfactory of all the lesser ailments. This is due largely to the relative lack of knowledge of skin diseases in general and the obscurity of diagnosis. The only skin diseases that seem to have been finally disposed of by the Pensions Department are:

Tinea: These cases recurred for a year or two, and some cases were very persistent, attending hospital for twelve to eighteen months. Most of these cleared up with X-ray treatment.

Tropical Sores: From the Pacific theatre there were many cases but these cleared up rapidly on return to New Zealand.

Of the cases still on pension there are many which seem to have developed an allergic condition and tend to recur. Many cases, again, develop skin disease some time after their return to New Zealand, but are granted a pension if there is any history of skin disease overseas, though the conditions may not be at all similar.

RECOMMENDATIONS

Recommendations

In any future intake of recruits medical boards must be more particular in their inquiries into the skin condition of the recruit in civilian life. A follow-up is then necessary in camps to ensure that men are not sent overseas with skin diseases which are mild in New Zealand, but which would deteriorate in tropical or other conditions. The aid of a consultant skin specialist might well be made use of. In addition, each hospital unit in an overseas force should have a skin specialist on its staff.

The whole question of the boarding of recruits with mild degrees of skin pathology is of the greatest importance. These conditions are very common, especially in the adolescent, when they might almost be looked upon as a phase in development. If some skin abnormality is considered sufficient to make a man unfit for service in the Army, then there will be at once a great waste of manpower in men otherwise quite fit for service, and, in the adolescents, in men who will overcome their skin trouble naturally by the mere effluxion of time. Many of the diseases again cause little or no disability, and in times of stress could be disregarded by the man; and in possibly the majority of men in the Army the conditions are disregarded.

There is an inherent danger in specialisation in that the skin specialist, like his colleagues in other departments, is apt to pay too much attention to the minor disabilities, especially when they prove refractory and impossible to cure. If specialists had the care and boarding of every case there might be a grave danger of decimating the Army. On the other hand, their advice regarding treatment and the disposal of serious cases is, of course, invaluable.

X-RAY THERAPY

X-ray Therapy

It was forcibly brought out in statistics that skin diseases formed a high percentage of all illnesses in the Army. In such circumstances it is surprising that the most valuable dermatological weapon of all, X-ray therapy, should have been conspicuous by its absence. There was no therapy plant available in the 2 NZEF, and indeed in the whole of the Middle East Force there was only one. It is not claimed that radiotherapy will make men fit for the Army if they are unfit for it. But the cost of such apparatus in each General Hospital, and the provision of trained men to operate it, would have been paid for hundreds of times over in the saving of time spent by patients in hospital and off duty. Moreover, if many patients invalided home could have had the benefit of X-ray therapy early in the course of their disorders, instead of waiting until they were chronic, there would now be less money paid out in pensions.

2 NZEF, MEF and CMF
Admissions to Hospital, July 1941 To December 1945

(1) Diseases of the Skin:	
General	271
Dermatitis	494
Urticaria	200
Pruritis	8
Eczema	415
Impetigo contagiosa	542
Sycosis	14
Herpes zoster (shingles)	194
Cheiropompholyx	18
Psoriasis	138
Ichthyosis	4
Keratosis	12
Ecthyma	162
Lupus vulgaris	3

Erythema	27
Leishmaniosis (dermal)	3
Trichophytosis (ringworm)	14
Tinea circinata	21
Tinea barbae	9
Tinea unguium (nails)	2
Tinea cruris	106
Tinea interdigitalis	181
Acne	65
Hyperidrosis	55
Epidermophytosis	55
Diseases of the nails	13
Diseases of the sebaceous glands	86
Dermatitis seborrhoeica	380
Diseases of the sweat glands and ducts	25
Diseases of the hair and follicles	36
Sycosis (hair and follicles)	52
Alopecia (baldness)	1
Paronychia (whitlow)	323
Ingrowing toenails	362
Hypertrophy of nails	5
Tumours and cysts	397
Dermatitis—chemical allergic	81

(2) Diseases of the areolar tissue—general	31
Cellulitis	638
Boils and abscesses	1568
Carbuncles	245
Myxoedema	1
Foreign bodies	3
Oedema	17
Inflammation areolar tissue	3308

Invalids Evacuated to New Zealand, 1940–45

SKIN CASES—	
Eczema	171
Dermatitis	72

Other	78
	—
Total	321

2 NZEF (IP)

Grading of Patients who after Adequate Treatment were Not Fit for Full Duty, i.e., Grade I

(Total treated, 202)

Type of Case	Number Regraded			
	1A	2	3	4
Eczema-dermatitis	3	5	26	
Acne vulgaris	1	3	4	
Seborrhoeic dermatitis			4	
Pyogenic infections			3	
Psoriasis		1	2	
Urticaria		2	1	
	—	—	—	—
Total	4	11	40	

Skin Cases treated at 2 NZ Casualty Clearing Station, Pacific, From 14 September 1943 Till 20 May 1944

Type of Case	Number Admitted	Evacuated to Hospital
Eczema-dermatitis	243	174
Ecthyma	81	49
Tinea	34	15
Acne vulgaris	25	20
Boils	23	14
Impetigo contagiosa	12	4
Cheiropompholyx	8	8
Sycosis barbae	6	6
Septic sores	5	
Miliaria papulosa	4	
Urticaria	4	1
Psoriasis	2	2
Herpes zoster	1	
Pruritis ani	1	
	—	—
Total	449	293

REFERENCE

Reference

R. G. Park New Zealand Medical Journal, April 1943 and June 1944.

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WAR SURGERY AND MEDICINE

[SECTION]

IN the Second World War the military authorities, and especially the New Zealand Medical Corps, became responsible for the health of all troops called up for the forces and thereby removed from their normal environment. In civilian life the men had had their health protected by health and sanitation services maintained by councils and other local authorities, and by national standards of hygiene controlled by the Department of Health, and they lived in good homes amply provided with washing, cooking, and sanitation facilities.

From their homes men went to mobilisation camps where provision had to be made for thousands of troops, all living in a new environment unavoidably crowded in comparison with civilian standards. Among other things, there had to be provided suitable sleeping quarters with ample air space for each man, clean cookhouses, good drainage and sanitation services, ablution and laundry facilities, adequate diet, suitable clothing and bedding, and camp hospitals. In the rush of the early days of the war it was not always possible to provide services of the highest standard, but these were improved as circumstances permitted.

All camps overseas had to have similar health services provided for them, and this was not always easy—water supplies might be scarce and impure, and in temporary camps only limited sanitary facilities could be provided. Additional hazards were imposed by different climatic conditions, and by endemic diseases unknown or rare in New Zealand—in the Middle East malaria, typhoid, typhus, dysentery and infective hepatitis, and in the Pacific all these plus dengue fever, hookworm, and other tropical diseases.

Preventive inoculations were given to guard against typhoid, paratyphoid, smallpox, and later typhus, but the whole army organisation had to make the maintenance of health and the prevention of disease one of its main concerns. The most important objective was the making of the individual soldier health-minded. And health, in the modern sense, is (as defined by the World Health Organisation) ‘a state of complete physical, mental, and social wellbeing, and not merely the absence of disease or infirmity’.

As has been stated in a hygiene manual:

The Army is a vast organisation, and in order to achieve its object with the greatest economy every man must not only be fully trained but must also be physically fit to carry out his duties in any part of the world. As the efficiency of a soldier depends so largely on his physical fitness, the importance of maintaining him in a good state of health cannot be overestimated.

The maintenance and promotion of the health of the troops and the prevention of disease are not the concern of the medical services alone, but are the duty of everyone in the Army, and can only be carried out if everyone is conversant with the laws of health, the scientific reasons for these laws, and the methods by which they can be put into practice.

Disease can easily be responsible for three to four times as many casualties as enemy action during a campaign, and it is only by ceaseless attention to sanitation that sickness can be combated and the Army maintained in a condition to carry out its object.

The aim of sanitation in the Army is military efficiency and therefore anything that will maintain or improve the health of the soldier and thereby aid his military efficiency must be regarded as coming within the scope of hygiene and sanitation.

In an Army on active service, diseases of all kinds become more prevalent for the following reasons:

1. Men are crowded together more closely and germs of disease can be more easily spread from sick to healthy men.
2. Men are not so resistant to disease, because their vitality is lowered through exposure to fatigue, mental strain, less satisfactory feeding and to unaccustomed climates.
3. The military situation may make it necessary to occupy unhealthy sites which would otherwise be avoided.

The chief causes of sickness in an army in the field are excremental diseases, such as dysentery, enteric fever and diarrhoea, and insect-borne diseases such as malaria and typhus fever, and virus diseases such as influenza and infective hepatitis.

It is essential that attention be paid to all the details of a soldier's life, namely his surroundings, clothing, food, work, recreation, and personal hygiene….

PLANNING FOR 2 NZEF

Planning for 2 NZEF

Planning for promotion of health and disease prevention must be made even before a military force is assembled. It becomes a responsibility of the heads of the medical services to interest themselves in camp construction, clothing and diet of troops, and, if need be, forcing other administrative officers to consider their opinions, as it is a common tendency for other officers to overlook the value of medical guidance. It was just such action which had to be taken by the Director-General of Medical Services in New Zealand in the early days of the war with the Quartermaster- General and Public Works Department in regard to sanitation arrangements in camp construction. Provision had to be made against overcrowding in sleeping quarters as this encouraged respiratory diseases. Means of keeping troops dry and warm had also to be provided.

In preparing a force for service overseas hygiene is even more important. Conditions on troopships present early problems, and then the difficulties likely to be encountered overseas must be appreciated and steps taken to meet them.

A high standard of hygiene means an immeasurable saving of manpower, especially in the Middle East. In the Second World War it can be claimed that the New Zealand force was hygiene-minded, and that its record as regards health arrangements was consistently good.

This record was not the result of chance. It was the result of a campaign, carefully prepared by the senior officers of the medical services and persistently carried out by medical officers, especially those charged with the particular responsibility of the control of hygiene units.

On 27 December 1939, prior to the sailing of the First Echelon, the GOC 2 NZEF held a conference with the DGMS (Army and Air), the ADMS and DADMS of the Expeditionary Force, and the CO 4 Field Ambulance. The consideration of hygiene matters was an important feature of the conference. It was agreed that the

Australian diet schedule be adopted for troopships, while the British standard ration was accepted for our troops in Egypt. As regards endemic diseases in Egypt, the importance of education in preventive measures was stressed, bearing in mind that intestinal disease was the main cause of illness in that area in the First World War. Decisions were made as to the policy to be followed on arrival of the Force in Egypt, including the keeping of all plates and cutlery in the messing building for sterilisation, the prohibition of itinerant vendors about camps, the sending of cooks to an army school of cookery in Egypt, the sterilisation of green vegetables and fruits in potassium permanganate (later changed to WSP), and the keeping of graphs to show the incidence of all infectious diseases. The problems were therefore clearly envisaged before the departure of the first troops from New Zealand, and measures to be taken for the prevention of disease were elaborated upon arrival in Egypt at Maadi Base Camp and other places. With the First Echelon a hygiene section (none of its men were specially qualified before entry to camp, however) was sent. Its OC, Captain B. T. Wyn Irwin, taught it its duties, and upon arrival in Egypt it became among the busiest units of the Force.

CLIMATIC CONDITIONS

Climatic Conditions

In 2 NZEF overseas the climatic conditions had to be closely studied and suitable health arrangements made for a force in the Middle East which grew to a strength of over 30,000. The geographical setting was immense, extending from Egypt to Greece and Crete (for a short time), from Egypt north to Syria, from Egypt west into the desert and along the North African coast for two thousand miles to Tunis, and then along the length of Italy; from winter to summer and back to winter, in blazing sun in an arid desert, and in mud and slush and snow along Italy's mountainous backbone. In its turn, the force in the Pacific had to contend with the sweating humidity of tropical islands.

General acclimatisation was a prelude to physical fitness in a new country. In Egypt, for instance, body and mind became attuned to the heat, glare, dust, and the harsh environment of the vast desert landscapes. In addition, most new arrivals gained a measure of immunity to some physical disabilities. Mild attacks of enteritis and other infections and sunburn under the comparatively good conditions of base camp life produced 'salted' troops not likely to be greatly inconvenienced by these almost unavoidable conditions in times of greater stress.

During the period of acclimatisation graduated work could be done in the heat and sun, beginning with periods of minutes and ending with whole days. Men became suntanned slowly and were later able to work hard in the sun, sometimes bare to the waist. It was still advisable to avoid the direct sun as far as possible in the very hot areas in the heat of the day, and to wear a hat when out in the sun. It was also necessary to arrange for an intake of salt sufficient to replace that lost by sweating.

At the other extreme, in Italy in winter it was necessary to take preventive measures against frostbite and trench foot, and down-draught oil-burning stoves were developed to keep buildings warm, tents being unsuitable in the mid-winter snowstorms.

MAADI CAMP

Maadi Camp

There can be no doubt that the pattern of the medical campaign was influenced partly by the fact that a number of the senior medical and combatant officers served in Egypt in the First World War. In addition, the first DMS 2 NZEF, Brigadier K. MacCormick, who had served in Egypt in 1914–15, has acknowledged the value to him of the facts recorded in The History of the New Zealand Medical Services in the Great War 1914–18 by Colonel Carbery. The health hazards of Egypt remained the same, albeit somewhat modified in the interim. The site of the New Zealand Base Camp at Maadi had distinct advantages over the site occupied at Zeitoun in the First World War. It was further from native habitations and was situated on a healthy plateau. Not least, the changeover to mechanisation in the Army and the absence of horses meant that the fly problem was not nearly as troublesome as in the First World War.

INDIVIDUAL PRECAUTIONS

Individual Precautions

The DGMS (Army and Air), Brigadier Bowerbank, prepared a series of lectures for senior medical officers of each transport to give to all troops of the First Echelon, and in a memorandum for combatant officers proceeding to Egypt the problem of hygiene was summed up on precautions in regard to the three 'Fs'—food, fluid, flies.

Right from the time of arrival of New Zealand troops in Egypt in February 1940 the DMS 2 NZEF was most insistent on the observance of the hygiene arrangements in every possible detail. In his representations he was always supported by the GOC, and the unrelaxing vigilance of regimental medical officers and personnel of the hygiene unit, under Captain Wyn Irwin, gradually educated the officers and men in the necessity for proper sanitary arrangements, so that observance of essential health precautions became almost habitual.

The New Zealand Force was able to draw upon the experience of British divisions already in Egypt, visits being paid to different formations, and advice was received from the Deputy Director of Hygiene, British Troops in Egypt. The GOC 2 NZEF and DMS 2 NZEF had decided in Sydney, after reading an account by Sir Aldo Castellani of hygiene measures adopted by the Italians in Abyssinia, to introduce into 2 NZEF certain measures such as the disinfection of hands after leaving latrines and before partaking of food.

CAMP BUILDINGS

Camp Buildings

The camp at Maadi was in the course of construction when the advance party of 2 NZEF arrived in January 1940, and presumably incorporated most of the established British ideas of army hygiene. The style of the latrines was chosen before the New Zealanders arrived, and the DMS pointed out on arrival that there were defects which would have to be watched if epidemics were to be avoided.

The building of cookhouses, messrooms, showers (wood with concrete floors) and latrines (mud-brick) was only partially completed by the time of the First Echelon's arrival; water was laid on to parts of the camp, and the troops slept in tents (eight men to a tent) on palliasses placed on bedboards raised above the sand. Later sufficient huts were erected to provide accommodation for normal base camp troops, but the men from the Division usually lived in tents when they returned to Maadi from time to time.

Disposal of Sullage Water

A major difficulty which needed to be overcome in Maadi Camp was the drainage and disposal of sullage water, as the ground was impermeable rock strata with only a shallow covering of sand. Several methods were tried, but after some months the only satisfactory means was found in the use of evaporation pans. These evaporation pans were made about sixty feet square, and in sets of four. They were fed with sullage water which had previously passed through grease traps. The method of operation was to flood two pans to a depth of about six inches, which water would evaporate in a day; then the other two pans would be flooded, while the dried deposit in the first pair was scraped up and sent to the incinerator. A later modification was to cultivate each pan, growing eucalyptus trees and crops such as cabbages, tomatoes, maize, etc. With a very large grease trap about 100 feet long, it was found that not much grease passed into the pans, and this did not interfere with evaporation or become a nuisance provided it was dug in sufficiently often to prevent fly-breeding. The pans were on the perimeter of the camp, so that all the water from cookhouses had to be piped to them through cement pipes and a close watch kept for any leaks.

LATRINES

Latrines

Again, the nature of the ground precluded the use of trench latrines, and a bucket system had to be used for urine and faeces, the buckets being emptied and then oiled twice a day by a native contractor. The solid matter was burnt in incinerators a mile and a half from the camp and the liquid was dumped some two miles farther away. Any solid matter not burnt was buried in conservancy pits approximately six feet square and eight or nine feet deep. The method of sealing the pits was to make a mortar of sand and used sump oil, and after covering the rubbish with at least three feet of soil, spreading the mortar over the surface to a depth of at least three inches, then heaping a mound of sand on top. This treatment was necessary to prevent fly breeding.

Incidentally, it was fortunate that the construction and settling-in at Maadi Camp took place during the winter months, as about two thousand natives were employed in the area, and prior to the arrival of the First Echelon had been defaecating indiscriminately, with the result that the whole camp area was fouled. Four hygiene men were employed for two months in directing a gang of about a hundred natives to clear away the excreta, as well as cleaning rubbish out of extensive quarries in or near the camp. In summer, when flies were more prolific, this would have been a health menace of the first magnitude. As it was, the First Echelon was able to get acclimatised at the most favourable season, and by the time of the arrival in Egypt of Second and Third Echelon troops, camp amenities had been improved and conditions controlled.

The ADH BTE visited Maadi Camp in April 1940 at the time of an outbreak of diarrhoea and dysentery among the New Zealand troops. He reported that the condition of the latrines, and the disposal of rubbish and the contents of the latrine buckets was satisfactory, but pointed out that the preparation rooms, stores, and dining rooms were not flyproof, admitting at the same time that it was difficult to make them so owing to the poor construction of the huts. The protection of food from flies, especially at meal times, was never entirely satisfactory at Maadi Camp owing to the type of huts constructed, and the fact that most messrooms were located some yards across the desert from the cookhouses, where the food was served out to long queues of men. In this respect the design of buildings and the system of serving food in the main camps in New Zealand were much superior. In Maadi Camp the best safeguard of health was achieved by keeping down the fly population.

CLEANSING OF MESS UTENSILS

Cleansing of Mess Utensils

Facilities for the heating of water for the adequate cleansing of plates and cutlery were never really adequate at Maadi Camp. It was decided at a conference of officers in Wellington in December 1939 that these mess utensils would be kept in messrooms and sterilised. The DMS 2 NZEF found upon his arrival in Egypt that two divisions in the Cairo area (Indian and Cavalry) had found it essential to boil such utensils, and similar arrangements were made accordingly for the First Echelon troops. This procedure fell into disuse later, possibly because of the labour involved and possibly because, from the point of view of quartermasters, messing gear was more easily accounted for when it was an individual issue. Plates and cutlery were taken to and fro across the desert from messroom to hut, where the utensils were usually exposed to dust; they were not sterilised before each meal, and for washing-up after meals there was never sufficient hot water or a sufficient number of tubs, so that the more hygiene-minded men hurried through their meals so as to be able to clean their plates and cutlery while the water was reasonably hot and clear. Probably no one really approved of the system, but there seems to have been little that could be done to improve it. In the officers' and NCOs' messes conditions were much better, in that all plates and cutlery were kept in the mess and were washed by mess orderlies. The lesson, of course, is that in the planning of messrooms and feeding arrangements the question of hygiene must always be the primary consideration, and that adequate liaison must be established with engineers and others at the planning stage before camp constructions were actually commenced. This was a question upon which the medical services had, for one reason and another, to make special representations in New Zealand in regard to camp construction in New Zealand. There was also a need for a hygiene officer to accompany any advance party of a force.

FOOD

Food

Every endeavour was made from the outset to ensure that only pure food reached the troops. Nothing in the way of uncooked vegetables and fruit that was not disinfected was to be eaten by the troops. Outside the camp they were enjoined not to eat uncooked green vegetables and onions, or any fruit which did not have a sound skin. In Cairo and other places they were advised to eat only at such approved places as forces clubs. Where fresh milk was used, boiling was insisted upon, but mostly tinned milk was used.

The ration for the New Zealand troops was the standard ration for British troops, with as a supplement certain increases made possible by the use of regimental funds for the purchase of fruit and vegetables. Variations from the British scale, which came into operation in June 1940 were: cheese reduced from 1 oz. to ½ oz.; herrings reduced from 4/7 oz. to nil; tea reduced from ¾ z. to ½ oz.; jam increased from 1 oz. to 2 oz.

WATER

Water

Maadi Camp was fortunate in its water supply in that it was drawn from the Maadi township supply, which was treated with alum, filtered through sand, and then chlorinated before being piped throughout the camp. A generous allowance of 20 gallons per man per day was available. The reservoir for the camp supply was covered in to avoid contamination. Outside the camp troops were instructed not to drink water from any source. Ample water was available for showers, at first cold only, but later hot as well.

Camp swimming baths were built and opened in April 1940, and adequate chlorination of the water in the baths became a responsibility of the hygiene section.

NATIVE LABOURERS

Native Labourers

A camp laundry was established. It was staffed by native labour, and strict hygiene supervision was necessary to ensure that a reasonable standard of cleanliness was maintained. Labourers with infectious disease were rejected and the clothing of the native workers was disinfected regularly as a precaution against lice. (It also became the practice for all native labourers employed in the camp to be compulsorily showered at the camp entrance regularly, and to have their clothing disinfested.)

The attention of the hygiene personnel had to be directed to the staffs of the NAAFIs and their standards of cleanliness in the handling of foodstuffs and the washing of plates and glasses. The observance of sanitary requirements by all native artisans and labourers—those employed by the engineer unit, the camp barbers, the swill contractors, the camp tailors, bootmakers, etc.—had to be continually checked. Outside the camp the inspection and improvement of conditions of sanitation in the nearby native villages of Bassatin, Tura, etc., was a necessary corollary of hygiene control within the camp, and the camp environs had to be subjected to mosquito control in the malaria season.

WAR SURGERY AND MEDICINE

GENERAL

General

The system of sanitation established in Maadi Camp in 1940 remained practically unchanged throughout the war.

Details of sanitation arrangements at Maadi Camp have been set out fairly fully, but the same treatment cannot be accorded all the places to which the Division or bodies of New Zealand troops moved. It was in Maadi Camp that the bulk of soldiers of 2 NZEF learnt the principles of hygiene, and where they learnt to apply them. It was there that most of them became acclimatised to life in the Middle East and North Africa, and where they became ‘salted’, suffering attacks of enteritis and other mild diseases which conferred upon them a degree of immunity to infections almost inseparable from life in Egypt and other foreign countries. It should be noted that preventive inoculations for typhoid, paratyphoid, tetanus, and smallpox, which were begun in New Zealand and on the troopships, were continued in Egypt and they conferred a high degree of immunity from these diseases.

HYGIENE ORGANISATION

Hygiene Organisation

The organisation for the control of hygiene grew as 2 NZEF grew in size and became more scattered. Early in 1940 there was the one hygiene section (4 Field Hygiene Section), with its OC directly responsible to DMS 2 NZEF. Towards the end of 1940, when separate headquarters establishments were set up for HQ 2 NZEF and HQ 2 NZ Division, and the Division was not at Base, it was necessary to have a Base Hygiene Section in Maadi Camp in addition to 4 Field Hygiene Section, which thereafter accompanied the Division. When lines of communication became long and an Advanced Base was established, an Advanced Base Hygiene Section had to be formed, as in southern Italy.

The functions of a Field Hygiene Section were officially described as:

Supervisory: The supervision of: Water supplies, including their purification and distribution; food supplies, cooking and slaughtering places; ablution places, including disposal of sullage water; all conservancy and refuse disposal; general sanitation of all camps, etc.; the disposal of carcases; all laundry and bathing arrangements; all anti-fly measures; and, on occasion, all anti-mosquito measures.

Executive: The disinfection of clothing, bedding, equipment and accommodation to the extent of which the unit is capable. The initiation of sanitary measures and the provision of sanitary appliances until such time as unit sanitary personnel are able to function. The provision and maintenance of standard patterns of appliances for the instruction and guidance of regimental sanitary personnel. The carrying out of sanitary schemes which are beyond the power of regimental sanitary detachments. The establishment of disinfestation stations when such are considered necessary.

From the end of 1942, when it took over a captured Italian mobile shower 4 Field Hygiene Section ran a shower unit which was the only one available in the Desert. The equipment was also operated by the shower section of the unit in the forward areas in Italy.

Increasing duties of the Field Hygiene Section, and the desirability of concentrating hygiene activities in the one unit, led to its establishment being amended in 1944 to that of a Field Hygiene Company. It absorbed the two malaria control units, one of which was to function as a typhus control section in the non-malaria season.

Early in 1945 the OC 4 Field Hygiene Company, Major Kennedy, was appointed DADH on the staff of Divisional Headquarters. In Syria and Tunisia when the malaria season opened, an extra medical officer was appointed Malaria Officer, but in Italy the OC 4 Field Hygiene Section held this additional appointment. (In the post-war establishment for a division there is now provision for a DADH.)

The Malaria Control Units were responsible for the anti-mosquito and anti-larval measures in areas outside the camp lines occupied by units, i.e., drainage, spraying of buildings in villages with flysol (and, later, DDT) spraying dangerous undrainable water with malariol, cuprous cyanide, or paris green, and canalising or flushing streams.

The Divisional Malaria Officer, as adviser to the ADMS, maintained close liaison with the Malaria Field Laboratory for technical advice, and with Ordnance for equipment. He kept in touch with RMOs, whose anti-malaria arrangements he inspected and on which he gave advice.

Hygiene within units was the responsibility of the Commanding Officer of the unit, but the active agents were the RMO and the unit sanitary and water personnel. The RMO was really a hygiene officer at unit level. He was adviser to the OC on the health of the unit, and it was his responsibility to:

1. Actively promote the health and wellbeing of the unit.
2. Ensure that sufficient stocks of water-sterilising material and disinfectants were available.
3. Maintain a sanitation diary and keep records of unit sick.
4. Keep the inoculation state of the unit up-to-date.
5. See that the water-supply was fit for drinking.
6. See that unit sanitary personnel were properly trained and carried out their duties satisfactorily.
7. Concern himself with the food of the unit—preparation, cooking and

consumption of rations, their calorie and vitamin values.

8. Assist in organising vigorous measures against venereal disease.

9. Medically inspect the members of the unit once a month, and specially inspect men engaged in cooking.

10. Carry out anti-malaria measures—training of unit in personal precautions, and organising unit anti-malaria squad.

The unit sanitary detachment was responsible for the disposal of waste water and refuse, disinfection, supervision of ablution places, conservancy, refuse disposal, and also acted as sanitary police.

The duties of the water detachment were the daily supervision of the water supply and its purification for drinking purposes, and the care of all apparatus and stores connected with water supply.

HYGIENE TRAINING AND EDUCATION

Hygiene Training and Education

None of the original men posted to 4 Field Hygiene Section when it first assembled in Burnham in 1939 had had any experience in hygiene work. What the unit knew by the time of its arrival in Egypt was taught by its first OC, Captain Wyn Irwin, a medical officer with the Diploma of Public Health. Some of the later postings to the unit were men with experience as sanitary inspectors, and some were tradesmen for workshop duties, but many had to be given courses of instruction to enable them to carry out their duties efficiently.

An important help in hygiene training was provided by the Middle East School of Hygiene, a British unit at Sarafand, Palestine. Full use was made of this school (and the later one at Benevento, Italy) by 2 NZEF, and large numbers of medical officers, hygiene NCOs, and unit officers and NCOs went to the various courses. The subjects taught covered hygiene in all its aspects—field sanitation, malaria and water control. The schools played a major part in improvising, standardising, and popularising useful apparatus made from four-gallon petrol tins and 44 gallon oil-drums—such appliances as incinerators, grease traps, cookers, fly traps, disinfestors, shower baths, food containers and refuse receptacles.

Some instruction of personnel from units was undertaken by the Base Hygiene Section in Maadi Camp. In the Division 4 Field Hygiene Section conducted one and two-day courses regularly from the end of 1942 onwards in field sanitation and water control for unit officers and NCOs. In Italy a divisional malaria school was opened.

The development of demonstration grounds was a very important part of hygiene education. The Base Hygiene Section prepared a very good model ground in Maadi Camp showing models of all types of sanitary apparatus. A small but effective model ground was carried by 4 Field Hygiene Section and set up at its headquarters when the Division was in a concentration area. Towards the end of the war in Italy Eighth Army developed a health education exhibit which was put on display.

Use was made in 2 NZEF of available posters and films, which, however, were not very numerous and not always very appealing. There was a distinct need for the film to be taken more seriously as a means of general education in health.

In 2 NZEF Orders, repeated in unit orders, detailed instructions were issued from time to time on the action to be taken to control infectious diseases such as typhus, typhoid, malaria, and dysentery, as well as on cleanliness in regard to food and general sanitation. Very full use was made of divisional orders for the promulgation monthly of venereal disease and malaria rates in units in an effort to get particular units to improve their record when it compared unfavourably with that of other units.

MAN MANAGEMENT

Man Management

Important to the health of 2 NZEF, as indeed of any force, was the morale and welfare of troops. Fundamental to morale and welfare are freedom from disease, good varied food, satisfactory clothing and accommodation, while sport and recreation facilities are also very important. Most officers, from the GOC downwards, were mindful of all these aspects.

Units judiciously used regimental funds to supplement the basic ration with local extras in the way of food and vegetables. The troops had summer and winter outfits of clothing, drill open-necked shirt, shorts and slacks, and battle dress. Head dress varied from peaked hat to forage cap to beret, with the topee in use occasionally at the beginning of the war until it was found unnecessary. Extra socks, blankets, leather jerkins, etc., were available when conditions were cold and wet, as in Italy.

Care was taken in the siting of camps—as far from native villages as possible, not in malarious areas if they could be avoided, etc. Tents and huts were provided on a liberal scale, though shortage of labour and material resulted in the minimum space standard in huts being reduced to 45 square feet per man, while the number in tents had to be increased above that allowed in peacetime. The situation in regard to venereal disease was carefully watched. On field service the men used their bivouac tents or slept on trucks. In Italy in the winter it was necessary to house all troops in buildings and make arrangements for heating.

Sport received plenty of attention in 2 NZEF. Swimming baths were constructed for Maadi Camp and many units benefited from proximity to the Mediterranean from time to time. Chlorination of the baths was a responsibility of Base Hygiene Section. Football needed no stimulation. Informal games were played whenever opportunity permitted, and unit competitions in the Division were organised. Cricket and hockey could not be so easily organised, but these sports were played regularly by base units and at least occasionally by other units. Athletic meetings were arranged from time to time.

Many amenities were provided through the National Patriotic Fund— YMCA recreation huts and canteens, mobile film units, forces clubs, libraries, and parcels, etc. Concert parties were encouraged, and the Kiwi Concert Party became famous. The NZEF Times was published weekly, giving items of New Zealand news and special features. Mail and parcels were delivered as soon as possible after their receipt.

Regular leave was granted to base units every six months, apart from day leave, and to divisional units when operations and leave accommodation permitted. Some leave camps were arranged, and troops were also accommodated at the forces clubs which were established in many of the larger cities in Egypt and Italy.

At the Convalescent Depot patients from hospital were fitted for full duty again by special programmes of rehabilitation. Where men were down-graded they came up for review periodically, and efforts were made to fit them usefully into base and L of C jobs. An employment officer was appointed in Maadi Camp to help deal with the problem of the accumulation of graded men there and the provision of work suited to the individual.

The developments and adaptations in hygiene and sanitation in 2 NZEF in its different locations after its basis had been established in Maadi Camp in 1940 can probably best be discussed generally under the specific headings that affected the health of troops.

CONSERVANCY

Conservancy

It was the policy in the Middle East Forces to use deep-pit latrines wherever possible. In nearly all British permanent and semipermanent camps this system superseded the bucket removal system. The deep-trench latrine was used by the Division in Greece, the Suez Canal area, Baggush, Syria, and Italy. Principles of their construction were an adequate depth, with a minimum of eight feet, and the provision of a fly-proof superstructure, while constant inspection was necessary to remedy any wear-and-tear and carelessness in their use. In the forward areas, especially in the Western Desert where the subsoil was of rock, making the construction of deep pits impossible, the problem of innocuous disposal was solved by the introduction of the incinerator latrine. For this petrol tins were used as receptacles and the contents were incinerated daily by ignition of a small quantity of petrol and some oil. From Tripoli, early in 1943 onwards, the Hygiene Section made latrine seats for issue to units, and then in Italy developed and produced a collapsible, portable latrine.

Urinals were in the main of the soakage pit type with a trough or funnel superstructure.

REFUSE DISPOSAL

Refuse Disposal

The burial of refuse from unit lines was sometimes inefficiently done, and this contributed to the breeding of flies, which became troublesome in the static phases as in the Alamein Line. Eventually incineration was accepted as the simplest and most practical method of rendering refuse innocuous. The simple oil-drum incinerator, easily improvised in the field, was used, or pits were filled with refuse and burnt out with petrol. The food tin—the dominant feature of desert rations—became a menace as it was rarely emptied completely and became an annoying and difficult refuse problem. Emphatic instructions were issued and persistent education to improve unit methods was carried out, and units gradually became more careful in emptying tins completely, burning them out, and disposing of them systematically.

The enforced dispersal of men and vehicles at first led to so-called vehicle cooking, each group of men in a vehicle fending for its own food. Apart from its evils of improperly prepared meals, dispersed vehicle camping also scattered refuse and waste products in an uncontrolled fashion over camping areas in the desert. It was therefore decided in 1942 to return to company cooking, and this eased the problem of refuse disposal in forward areas considerably and contributed much to lessening the fly menace.

At times the refuse was buried and in Italy controlled tips on the Bradford tip system were instituted not only for the troops but for the disposal of household and animal refuse from towns occupied by the troops. In such a tip the daily refuse was dumped to a depth of about five feet and then covered with a foot of clean soil. Italian local labour was used, and help in the construction of the tips was often provided by the engineers with bulldozers.

WASTE-WATER DISPOSAL

Waste-water Disposal

Apart from the use of evaporation pans at Maadi Camp, the usual means for the disposal of waste water from cookhouses and showers was by soakage pits.

FLY CONTROL

Fly Control

It was proved that camps with properly supervised refuse, waste-water and latrine disposal could be kept as free from flies as any area controlled by a civil local authority with full sanitary services. Therefore in the campaign to eliminate the fly, emphasis was placed on these essentials, with fair success in all New Zealand camps. The main problem in connection with flies, and one which threatened the fitness of the Eighth Army, arose with the holding of the Alamein Line in the period July to September 1942. Hygiene supervision of camps and lines of communication generally had been disrupted, and there were crowded together into the area between El Alamein and Amiriya vast numbers of small units as well as hordes of bedouin and native refugees. Literally appalling conditions of fly infestation developed. A concentrated drive had to be made, refugees were cleared back from the camping areas, and a special Fly Control Unit was organised to clear the whole area in and about the Alamein Line of fly-breeding materials such as dead bodies, litter, refuse, etc. Additional fly traps and insecticide were sent forward from Base. The special measures were successful and by the end of September the problem had abated considerably. The enemy experienced the same conditions in his lines, but his neglect of sanitary measures led to a high incidence of dysentery and diarrhoea which materially sapped the manpower and vigour of his forces. New Zealanders occupying ground captured from the enemy suffered an epidemic of infective hepatitis.

One technical point of importance that Middle East experience revealed was the necessity for placing fly traps away from cookhouses, messes, and latrines so that they formed a definite counter- attraction for flies away from these premises. Later the advent of DDT in 1944 provided a very effective means of fly control.

A new hygiene problem in Italy concerned the disposal of dead animals. In most cases they were buried as soon as possible. In the Rimini area gun posts, sited in farmyards for cover, were bothered by the decaying carcasses of animals either buried in the ruins or shot by the retreating enemy. For dealing with these bodies a truck was equipped with stirrup pumps and a supply of tar oil, which was sprayed lightly on the exposed parts of the carcasses and soon dried hard, getting rid of any smell. The animals were left to be buried by Italian civilians when the area was clear of the enemy. In the advance from the Senio River in 1945 German corpses had also to be disposed of.

BATHING FACILITIES

Bathing Facilities

As personal cleanliness is so important in promoting general bodily health, as well as in preventing skin disease, persistent pressure was applied by medical authorities for the provision of adequate bathing facilities in all areas. In base camps at Maadi and in Italy hot and cold showers were erected, but in the forward units, especially in the desert, little provision could be made. When near the coast all troops indulged freely in sea-bathing.

At Bardia in the advance from El Alamein, 4 Field Hygiene Section came into possession of an Italian mobile shower unit, and this was used to great advantage in the Division in subsequent campaigns. It could handle over 1000 men a day. It proved such a boon that there is a case for such units being part of the standard equipment of any force. In Tunisia, as soon as a unit was withdrawn from the line, the shower unit set up alongside a well and was providing hot showers within an hour. Likewise, a disinfestor was available when it was needed. When the Mobile Laundry and Bath Unit was formed extra showering facilities were provided. In Italy a number of units developed their own hot-water supply for showers by pumping water through the cooling system of unit water carts. When the mobile shower equipment wore out in Italy it was replaced by equipment made by 4 Field Hygiene Section to a plan of its own.

LAUNDRY FACILITIES

Laundry Facilities

Laundry facilities were generally available in base camps, but with the Division the washing of clothes on a large scale was not easily arranged, though the mobile laundry unit did good service. Laundry was often done by the individual when the water ration allowed, the drying of clothes presenting no difficulty in the dry atmosphere of the Middle East.

WATER SUPPLIES

Water Supplies

The supply of water did not constitute a problem except in the Western Desert. In many base areas local civilian supplies met military needs, provided economies were made. It involved little for the medical authorities other than orthodox supervision and testing and arrangements for chlorination, etc.

In the desert warfare water points were established wherever possible. Units such as battalions were supplied from these points by the standard army water truck which was part of their vehicle establishment. For desert operations a pipeline was pushed out westward from Alexandria by the engineers. As the distance westward increased, sweet water in adequate quantities became more difficult to provide. In spite of the size of the system, the quantity of water could not be raised above approximately one and a half gallons per man per day for all purposes. Additional means were sought for increasing the supply, and local wells and other sources were investigated and, if at all acceptable, exploited to the maximum. Ancient Roman subterranean aqueducts at places like Mersa Matruh and other coastal sites were tapped and made to contribute. For these isolated supplies from wells much hygiene supervision was demanded. Purification was almost invariably by superchlorination, using army water-sterilising powder (bleaching powder) followed by de-tasting with sodium thiosulphate. The excessive salinity of some desert wells was reduced wherever possible by mixing such waters with sweeter supplies from other wells, or with water transported from the pipeline. A problem for the hygiene officers was that of the water sources damaged and sometimes polluted by the retreating enemy, as when the Eighth Army advanced from Alamein. The methods of pollution were common to all the desert campaigns—introduction of diesel oil, dead bodies, and filth of any kind. Hygiene personnel assisted the engineers in the repair of pumps, clearance of wells, and neutralisation of contamination. The long advance carried units considerable distances ahead of water points. This led to the daily ration being reduced to half a gallon for certain periods, and in its 'left hooks' the New Zealand Division had to make special arrangements to ensure an adequate water supply. The majority of units equipped themselves with many captured two-gallon containers—the ‘jerrican’—a stout metal receptacle with a good screw cap. After thorough cleansing, these containers proved invaluable for carrying unit and individual water requirements. Similar cans were later provided by the British Army.

These containers continued to be used in Italy, where the actual obtaining of water did not constitute a serious problem as in the desert. In Italy the Auto-Minor mobile water-purifying equipment was introduced and two of these units were handled by the engineers, with the Hygiene Section supervising chlorination. Individual water-sterilising outfits were very important and were used by infantry sections. Irrespective of the state of the water, it always had to be chlorinated. Careful supervision resulted in no serious outbreak of water-borne disease occurring in the Middle East Forces or in 2 NZEF.

FOOD

Food

The food problem in the Middle East and Italy was rather more a supply problem than a medical one. The basic rations had nearly all to be imported and distributed, and in the early months of 1942, following Japan's southward drive, a crisis threatened and urgent measures had to be adopted in the Middle East to expand existing sources and create new local ones. Fortunately, fresh vegetables and fruit, and sometimes eggs and meat, were more or less readily available to supplement dry rations at all times except in active campaigns in the desert. On such occasions the prolonged use of battle rations was often unavoidable, especially when troops became isolated or when lines of communication were seriously interfered with. Medical anxiety arose when troops were retained for some time on a battle ration designed for one week only. The need for mobility, freedom for fighting, the least bulk and weight in transport for non-perishable readily-prepared foods on the one hand, clashed with the need to provide high calorific, palatable, sustaining and refreshing meals.

By 1942 the problem was more generally appreciated. The 'battle ration' used, for example, by the Eighth Army in its attack at El Alamein had a caloric value of 3100 and, besides the basic items of biscuits and pressed meat, included cheese, jam, tinned milk, vegetables, and fish, and the ingredients for tea. The extremely efficient follow-up of supplies behind the advance, however, saved the troops from any long spells on the 'battle ration'. The limit of ten days laid down was never exceeded. Operational rations in the Middle East showed the value of such items as dried fruits, ground nuts, boiled sweets, chocolate, and tinned fish. These items are palatable for troops living strenuous, exciting lives for a few days; they are of high caloric value, and easily carried. No cooking is required. Ingredients for a hot drink, tea in the case of British troops, should always be included in scales such as these. The mobile bakery was a valuable asset to the Division.

The milk used by all units was either tinned, powdered, or pasteurised. Pasteurising was done in Cairo for Maadi Camp, the plant being supervised by the

Base Hygiene Section.

In all routine ration scales, special care was taken to ensure adequate vitamin values. Food deficiency diseases did not occur.

Continuous training and propaganda were necessary to ensure that all units were provided with good cooks and proper company cooking arrangements, and that they developed a sense of cookhouse hygiene and sanitation. Care had to be taken to safeguard foodstuffs in transport to depots and thence to units. Fresh supplies suffer rapid deterioration in the field, and this was intensified in the conditions of heat, dust, and flies typical of a Middle East summer. The supply authorities built up a system of clean, efficient depots, and units, by education, were brought to a high standard in methods of collecting food from depots, transporting it forward, and storing it in unit areas. Food containers were improvised to carry and store fresh meat, vegetables, cereals, etc. The policy for divisional units in the line was to provide a cooked breakfast and a cooked evening meal. This was done by moving the company cookhouse as far forward as possible, and packing up by man-pack in individual haversacks a hot breakfast and a hot evening meal, usually before first light and after last light. The troops were thus assured of two good hot meals a day. This applied even to troops in Cassino. The Americans there had no cooked meals in the line. From time to time strong medical recommendations were made in regard to the preservation of vitamins in the storage and preparation of food supplies and to cleanliness in handling food.

LICE CONTROL

Lice Control

The standard of sanitation in New Zealand units was such that lice were rarely seen, but the delousing of prisoners was often a responsibility. The first delousing duties fell to the Field Hygiene Section in December 1940 in connection with the prisoner-of-war camp at Helwan. When the Division was in Syria, there were many Greek and other refugees coming across the Turkish border into Aleppo, and they were showered and their clothing disinfested. In Tunisia large numbers of prisoners were captured, and the disinfestor section of the Hygiene Section was called to work at high speed to clean many of these prisoners and their clothing as a preventive measure against a typhus epidemic. All vehicles carrying prisoners were sprayed out with formalin before returning to their units, to prevent the possible spread of lice.

Before going to Italy the troops received anti-typhus injections, but preventive measures against lice were not relaxed. In Naples there was an outbreak of typhus among civilians, but good control measures prevented its spread to troops, including New Zealanders who were in the area at the time. Later the laundry adopted the practice of adding DDT solution to rinse water to impregnate underwear.

Lice, and also scabies, became much more common among men of the Division in the latter half of 1945 when the troops were accommodated in buildings in and around the cities of Trieste and Florence, and when there was among them a high incidence of venereal disease.

MOSQUITO CONTROL

Mosquito Control

Throughout the period in the Middle East and Italy, 2 NZEF adopted comprehensive measures for anti-malaria control during the mosquito season. The burden of the anti-larva work fell on the hygiene companies. Anti-malaria control units were formed in 1942, and these were later incorporated in the Field Hygiene Company. Their efforts, backed by intensive education of the soldiers in the part they had to play in the way of personal precautions—in the wearing of clothing to cover arms and legs, using insect repellent, sleeping under netting and taking mepacrine—enabled the 2 NZEF, and especially 2 NZ Division, to establish a most creditable record in the low incidence of malaria.

CAPTURED TOWNS

Captured Towns

The occupation of towns by advancing troops called for an immediate check on the condition of their sanitation. For the New Zealand troops the first notable occasion was in Tripoli in January 1943, when the Division was in the vanguard of the Eighth Army. The Field Hygiene Section was called upon to check the water supply and sewerage system which had been damaged by bombing, to inspect restaurants, barbers' shops and billets, and arrange for the examination of prostitutes and the control of venereal disease.

Similar checks in civilian sanitation and the adoption of control measures became a regular feature of hygiene duties during the operations in Italy. Down-draught stoves were developed by the Hygiene Company to enable troops in buildings to keep warm during the Italian winter.

The diversified functions which the hygiene units were called upon to perform led to an increase in the number and standing of their personnel and in the amount of their equipment. As specialist units they promoted good sanitation, but in the long run a high standard of sanitation depends on the education and co-operation of the individual soldier.

Incidence of Disease

The conscientious application (for the most part) of all these measures to promote the health of 2 NZEF resulted in the incidence of disease in our Force in the Middle East comparing more than favourably with other formations in the same area, in spite of a lack of immunity to many diseases when the troops left New Zealand. This lack of immunity was most strikingly shown in relation to infective hepatitis, a virus disease to which New Zealanders were particularly susceptible, and which was responsible for the only two large epidemics, each of which affected over 2000 men. New Zealand troops were also more prone to dysentery than some other forces, and there were some of these cases all the year round, with a rise in incidence during the summer months.

At the temporary Mena camp in 1943 there was a short epidemic of typhoid fever affecting fewer than 200 men of the 10th Reinforcements. Its cause was traced to a carrier working in the camp kitchen, although there was also some question of the potency of the protective inoculations given in New Zealand. There were only sporadic cases of typhus, cerebro-spinal meningitis, and poliomyelitis. In proportion to other forces the number of malaria cases was commendably low. The number of deaths from these epidemic diseases was fewer than ten for each condition.

Venereal disease varied in incidence but was kept within reasonable proportions until the post-armistice phase in Italy, when the troops apparently were not prepared to exert the necessary measure of self-control, and the check on sources of infection could not be as thorough or as effective. (In connection with venereal disease, the Mobile VD Treatment Centre achieved a valuable saving of manpower by keeping men in the divisional area for treatment. In 1945 the large numbers of patients were able to be treated and cured in a few days or treated only as outpatients, whereas formerly they would have had to go to hospital.)

Apart from battle casualties, accidental injuries were a major cause of disablement. Many of the cases were probably unavoidable as transport casualties in a force that moved on wheels, though there were many, such as petrol burns, which could have been avoided by the observance of adequate precautions. Research in accident prevention in the Army would be well worth while.

RESULTS OF GOOD HEALTH

Results of Good Health

On the positive side it can be said that good health was one of the predominant factors enabling the Eighth Army to achieve its victory at El Alamein, as, on the other hand, the enemy's poorer health weakened his resistance. In 2 NZ Division high standards of hygiene conserved valuable manpower, and the physical efficiency and morale of the Division both interacted to help build up its famous record as a fighting force. High health standards must have saved many men from becoming invalids or suffering from some disability, with consequent benefit to the men themselves and the War Pensions Fund. The results in the health of 2 NZEF more than amply repaid the efforts of those responsible for the organisation of its health standards and services.

HYGIENE IN 2 NZEF IN SOUTH-WEST PACIFIC

The areas involved were first New Caledonia (20–22 degrees from the Equator), and later the New Hebrides, the Solomons, and up as far as the Green Islands group (4 degrees off the Equator). The areas were all tropical and ranged from coral atolls to larger islands of volcanic origin with distinct mountain areas.

In the Pacific area New Zealand troops were faced with many of the same hygiene problems as those already mentioned, some of them somewhat different owing to the humid tropical conditions of the islands. Gastro-intestinal tract infections and skin diseases, including septic sores, had to be especially guarded against, and a high standard of field sanitation was called for. Flies were very prevalent in the jungle, and the Japanese had a high incidence of dysentery and contaminated the areas in the Solomon Islands which they had been occupying. It was considered that all streams were contaminated and troops in the jungle required individual water-sterilising tablets or small filters. Chlorination was not effective against amoebic cysts, which required filtration for their removal. As the troops advanced from one island to another in the Solomons they took with them portable latrines, but free use was made of sea latrines. On active operations the individual soldier showed, in spite of training, a lack of appreciation of field hygiene, and in particular of disposal of faeces and the treatment of water for drinking.

CAMP SANITATION

Camp Sanitation

Camps were of two varieties: those where units settled for periods of one to ten months and those used for shorter staging periods. In the more permanent camps standard types of cookhouses were built with the usual stoves, grease traps, and rubbish disposal bins. Much local ingenuity was evident both in constructing patent stoves and ovens, grease traps, and collapsible safes suitable for moving from place to place. Rubbish cans—usually half 44-gallon drums with lids—were standard. For cleaning dishes other 44-gallon drums—cut into half along their length—were filled with water and boiled over a fire. Usually a tent or hut, with tables and forms devised of local wood, was used for a mess hall. In some cases metal airfield construction strips were used for this purpose.

In staging areas the cookhouses were of a more temporary type—cooking was usually done on the standard army cookers, and rubbish and waste disposed of by simple burial.

RUBBISH DISPOSAL

Rubbish Disposal

Where more permanent camps were established the disposal of rubbish was the responsibility of the Hygiene Section. This was probably the biggest task it had to deal with, involving as it did, on American rations, the disposal of large numbers of tins, all of which were potential fly and mosquito breeding places. These came from both New Zealand and American units. Usually the New Zealand hygiene unit was the only hygiene unit in the area. The problems involved were only partly covered by the standard Army Manual of Hygiene and, in view of modern warfare with its intensive use of machinery, traditional methods were modified to a large degree. Where ample soil was available, as in New Caledonia, standard tip dumps were made under supervision of field hygiene personnel. These were built over the side of a hill and the dump built up gradually and all refuse covered daily with soil.

In the coral areas such as Vella Lavella it was not possible to use this method. Here a bulldozer was put to use and a hole cut out of the coral, 50 yards long and 10 to 12 feet deep. Trucks could be run into it and the rubbish placed at one end. The rubbish was burned and later covered with coral by the bulldozer. Due to difficulty in keeping this constantly covered, it was necessary to insist on all tins being crushed to prevent insect-breeding in retained water. In other islands, such as the Green Islands and in the Treasuries, the machinery was not available to dig pits, and in both cases shutes over the cliff into the sea where there was sufficient depth were used. These entailed little work once built, but still required policing to prevent fouling of the area.

LATRINES

Latrines

These were a unit responsibility. Standard patterns were suitable and good. Fly-proof boxing and lids were insisted upon, with usually a built-in fly trap to catch any flies in the holes. Where wire gauze was available troops often netted the whole latrine into a hut. Unless properly done this served to keep the flies in rather than exclude them. In some cases, especially New Caledonia, these latrine holes served as gross breeding places for flies, and treating with diesel oil to immobilise the larvae and flaming with petrol to burn the wings of adult flies was done regularly each day.

Digging holes both in rock and sand was a problem often solved by building the latrine above ground level or using a 44-gallon drum.

FLIES

Flies

As in all tropical areas, flies were a constant problem, but one which was controllable. Constant attention to camp sites, removing breeding areas such as decaying vegetation and old coconut shells, and normal camp hygiene could control them. In permanent areas the use of fly traps about cookhouses was found to be useful. It was necessary constantly to stop both natives and troops from throwing aside coconuts after having used them for drinking, as they formed ideal sites for mosquito and fly breeding.

WASHING

Washing

Personal washing and washing of clothes was often a problem. Where a fresh-water stream existed there was no trouble, and in New Caledonia in the permanent camps water was freely accessible. However, in the coral atolls fresh water was at a premium and often sea-water only was available. American issues of salt-water soap helped, but the high salinity made the position very unsatisfactory. Most men utilised tents and coconut palms as catchment areas to conserve rain-water for washing.

WATER SUPPLIES

Water Supplies

Water supplies varied from area to area. In New Caledonia streams were numerous and water tanks with chlorination plants were established by the New Zealand Engineers. These were satisfactory and were continually supervised by field hygiene personnel.

In some of the forward areas, e.g., Vella Lavella, there were streams, but in many of the atolls no fresh water was available. In the Green Islands all fresh water, apart from that collected from rain showers, was obtained from American-operated sea-water distillation plants. In the Treasury Group surface wells were utilised which gave drinkable but scarcely palatable brackish water. This was treated through filtration and chlorination units.

Water was a problem in forward areas. Where an advance was made each man carried a limited supply in his water bottle which was scheduled to last for a certain time. Strict water discipline was required, but was often not observed. Many conserved their water and drank coconut milk instead, with resultant diarrhoea. Several units were equipped with Pack Set (Italian or German) field water filters. These were efficient, although the amount of water they could handle was limited. Others carried chlorination tablets, but here the taste factor often stopped their use. More permanent installations arrived later.

FIELD SANITATION

Field Sanitation

Where units were on the move from island to island or to new sites, some sanitary personnel from the field hygiene unit were included when possible in the advanced group of troops. Their primary object was to establish latrines on the beach-heads for immediate use and to arrange a rubbish dumping area where rubbish could be accumulated and later dealt with. Two types of field latrines were advocated: either a simple hole to be filled in after use, or a hole with a covering of a simple hinged lid over a foot square piece of board with a latrine hole in the centre. A hole thus covered could be used for some time.

Sanitary policing of any newly occupied area or beach-head was immensely important as gross fouling could occur in the first hour, and the resultant damage to health was out of all proportion to the time the area had been occupied.

CLOTHING

Clothing

As regards clothing, shorts were of no use in the jungle and shirts required long sleeves, while as far as possible tight-fitting belts had to be avoided. The drying of clothes proved difficult at times. From the point of view of skin troubles of the feet, good leather boots and woollen socks proved the best, but free use of foot powder and talc powder was essential.

TROPICAL MACROCYTIC ANAEMIA

Tropical Macrocytic Anaemia

There was a fairly widespread anaemia among New Zealand troops in New Caledonia, particularly 4 General Hospital staff, in the early part of 1943. It was more marked among female staff. The same anaemia occurred to a less extent among United States personnel. An investigation was made by Colonel Sayers, assisted by the medical officers of 4 General Hospital. Apart from undue tiredness there was a striking absence of symptoms, and no evidence of other deficiency disease. Sore tongues, peripheral neuritis, and scorbutic symptoms were absent. The anaemia was found to be macrocytic in type. It appeared to be of nutritional origin and was probably due to a deficiency of some element in the Vitamin B complex.

In assessing the dietetic factors, the following points should be emphasized:

(a) The New Zealand troops were confronted with a diet (US Expeditionary Force Menu No. 1) to which they were entirely unaccustomed.

(b) Owing to strong food dislikes the troops did not consume very important elements of the diet. This included valuable biological protein and a large proportion of the Vitamin B complex.

(c) The cooks were inexperienced and ill-trained, especially in the preparation of canned and dehydrated foods.

(d) Owing to the constant bad weather, the almost constant presence of pest mosquitoes, and the unattractiveness of the diet to their own particular palates, the personnel studied, especially the female hospital staff, missed many meals, preferring to remain in their tents under mosquito nets. There was a considerable all-round loss of body weight.

(e) If the complete diet as laid down in Tropical Menu No. 1 had been supplied and consumed it is most unlikely that any anaemia would have developed. The complete diet was not supplied, and the food as prepared was not eaten in sufficient quantity, and no fresh food of any sort was available.

The following measures were taken. New cooks were appointed to the hospital and instructed in the preparation of dehydrated foods. A full-time messing officer was appointed. Marmite and Bemax were placed on all mess tables at all meals. Fresh fruit, vegetables, and meat were provided.

As regards treatment, patients with the anaemia responded immediately to the administration of liver extract and Vitamin B concentrates, but iron therapy, Ferri et Ammon Cit. 90 grammes a day, did not appear to influence the course of the anaemia. The anaemia soon disappeared, and a year later there was no evidence of its recurrence in New Zealand or other troops in New Caledonia.

MALARIA CONTROL

Malaria Control

New Caledonia was non-malarious, but the Solomon Islands were highly malarious and intensive malaria control was necessary to keep the troops fit and able to take their part in active operations. Benefiting to some extent from the experience of the United States troops, who early suffered heavy malaria casualties, the New Zealand medical services planned a comprehensive campaign and supervised its execution. A strong malaria control unit, including an engineer and two entomologists, was formed, and the Division was trained in anti-malaria measures.

The result was that only 120 cases of malaria occurred while the Division was in the Solomon Islands, and, including those cases who developed malaria in New Caledonia and New Zealand after the cessation of suppressive atebrin, fewer than 5 per cent of the troops who entered the malarious area actually developed malaria.

RESULTS

Results

As in the Middle East Force, the medical services in the Pacific Force were alert to all threats to health and active in instituting preventive measures or in educating the individual soldier to protect himself. The incidence of sickness was low, and, benefiting to some extent from the earlier costly experiences of the Americans in the Solomons, the Force achieved a remarkably good record in its minimal number of malaria cases.

CHAPTER 23 — HEALTH OF MAORIS IN 2 NZEF

CHAPTER 23
Health of Maoris in 2 NZEF

IN certain features of the health of Maoris under active service conditions definite comparisons can be made with the European section of 2 NZEF serving under the same conditions.

The susceptibility of the Maori to tuberculosis is well known and this was the cause of rejection of a large number of recruits for the Maori Battalion. A report by the battalion's first RMO, Major W. B. Fisher, on the period 24 January to 1 May 1940, when the battalion was in camp at Palmerston North showgrounds, states that a total of 725 men had X-ray examination of the chest, of whom 120 were medically boarded down to Grades II, III, and IV and discharged. Of 140 men marched in as replacements, 60 were discharged as medically unfit.

The same report also states that a routine inspection of the men's feet on admission to camp revealed that 80 per cent had tinea and a large number had corns and callouses. It was noticed that most Maoris had flat feet and were very wide across the heads of the metatarsals, with a definite tendency to bunion formation of the big toe as well as a similar condition of the little toe, with the result that corns readily formed at these sites. No special care had been taken in the issuing of boots, and the recruits accepted the pairs they received, seeming to think they could make their feet fit the boots just as easily as make the boots fit their feet.

It was also noted that the incidence of venereal disease was high, especially in the North Auckland district and certain parts of the East Coast. A total of 80 cases of venereal disease were dealt with at Palmerston North, and of these, 60 were sent to the hospital at Trentham Camp.

Overseas, these particular conditions continued to be a cause of medical unfitness. Tuberculosis was not manifest among the Maoris in the incidence obtaining among the race in New Zealand, but it was the cause of a higher proportion of Maoris being invalided back to New Zealand than of Europeans.

Dr Macdonald Wilson of the War Pensions Department made a survey in 1949 of tuberculosis among Maoris in the services. He pointed out that for the first time in history a large group of Maoris was selected under the same conditions as European New Zealanders and went overseas and served under the same conditions. Official statistics show that the incidence of pulmonary tuberculosis in New Zealand is five times as high amongst the Maoris as in the Europeans. In the 3543 Maoris in the Army overseas, 48 cases of pulmonary tuberculosis were recorded from 1939 to 1949, equivalent to 13.5 cases per 1000, compared with an incidence of 7.4 per 1000 in the whole force of which they were part.

The periods in which the cases were diagnosed were: During service, 20 cases (41.7 per cent); at discharge, 16 cases (33.3 per cent); after return to civil life, 12 cases (25 per cent). Most of the original men of the Maori Battalion, unlike the rest of the Second Echelon, were chest X-rayed in 1940 and about 16 per cent were rejected for abnormal chest conditions. Radiology eliminates only those cases already showing parenchymal reaction to infection and does not eliminate those which have reached only mucosal infection. Thus with such a high percentage of cases amongst the Maoris picked up by X-ray examination it is only correct to assume that a higher percentage than normal of potential cases of tuberculosis already infected was accepted as fit for service. Seven of the 48 active cases were not X-rayed and 11 with X-ray evidence of past or inactive disease were considered fit for overseas service. One man rejected on X-ray re-enlisted and obtained a substitute for his routine X-ray, and no action was taken in another case recommended by the radiologist for boarding.

Included in the 48 cases were 10 cases of pleurisy with effusion. Of these, 8 were apparently cured or quiescent in 1949. Of the 48 cases the results of treatment in 1949 were: Apparently cured, 10; quiescent, 19; still active (domiciliary treatment), 7; in hospital, 5; died, 7. Four of the 10 cured cases followed pleurisy and 6 were cases picked up by X-ray but not requiring treatment. The quiescent cases were all working.

The annual incidence in New Zealand of new civilian cases per thousand population in 1948 was Maori 3.6 and European 0.77, and the average annual incidence per thousand in returned service personnel from 1945 to 1949 was Maori 1.73 and European 0.95. The figures of returned service personnel would be more complete, and in addition the personnel are in the age groups most susceptible to tuberculosis. By comparison with the annual civilian Maori rate of 23.5 per 1000, the rate of 13.5 per 1000 for a decade in Maoris who served overseas shows a remarkable reduction.

Dr Wilson sums up as follows:

Therefore the fact that a group of Maoris with this background in civil life, who were, like the Europeans, incompletely screened prior to going overseas, lived in a strange climate and underwent all the herding together and privations of campaigns, developed over the years a total of only 48 cases of pulmonary tuberculosis, definitely suggests the Maori is not unduly susceptible to tuberculosis—probably no more so than the average European if he lived under similar conditions to the European. With this has to be borne in mind the fact that the incidence of tuberculosis among Europeans in New Zealand is one of the lowest in the world.

In 2 NZEF there was always a higher incidence of venereal disease among Maoris than among Europeans. The happy-go-lucky nature of the race and lack of control, together with differences of social background, must be held accountable in part at least.

Difficulties with the feet also constituted problems, but many of the conditions were probably pre-enlistment disabilities, which were not assisted by the lack of right-fitting boots. The flat feet in themselves produced little functional disability, as flat feet are common to most native races.

On the other hand, Maoris overseas displayed an immunity, or decreased susceptibility, to certain diseases. The infective hepatitis incidence at certain stages was higher in 2 NZEF than in most other Allied forces in the same area, and yet the Maori incidence was consistently much below that for the Europeans. Detailed figures from the epidemics in the Western Desert in 1942 and Italy in 1944 amply support this point.

The skin condition of desert sores has also been stated to have been less troublesome in the Maori Battalion than in other units, but the evidence is less conclusive.

Turning to the psychological side, we find that the morale of the Maori Battalion was so high that there was a consequent reduction in anxiety neurosis and the allied disease of dyspepsia. Experience in the War Pensions Branch has shown that few Maoris are disabled for anything other than an organic disability, and that this is usually a gunshot wound. No unit probably suffered more in loss of personnel by battle casualty from gunshot wounds than the Maori Battalion. There was never any neurosis problem among the Maoris, who have not developed it post-war as have the Europeans. Since it is often stated that the Maori looks for every type of pension or grant he can get from the Government, it is significant that he has never developed the pension complex through 'neurasthenia'.

CHAPTER 24
Occupational Therapy

The use of organised occupational therapy was almost entirely confined to mental hospital practice until the First World War, when its value came to be recognised in the treatment and rehabilitation of patients. Occupational therapy then came to be firmly established as a valuable form of therapy for sick and injured patients. For sick or nervous cases it involves treatment by mental or physical occupation, under the encouragement and direction of a trained observer, to hasten recovery and improve the mental state. It aims to divert the mind from anxieties and morbid fears, to improve effort and attention, and to awaken interest. For the wounded it aims at the restoration of impaired function of muscles, nerves, and joints to fit a patient to resume his normal activities. It endeavours to provide a progressive programme of mental, physical, and social activity according to the needs and capabilities of each patient. By achievement confidence is restored and recovery and rehabilitation hastened.

Diversional or prophylactic occupational therapy aims at diverting attention from a physical or nervous disability and directing interest towards some prescribed activity. Remedial therapy has these attributes also, but in addition is directed towards the restoration of a special function.

The type and range of part-time occupation useful in a base military hospital is considerable. Although no occupational therapists were posted to the staff of hospitals of 2 NZEF as such, each hospital soon developed an important department with talented rather than trained staff working under interested medical officers.

The first occupational therapy department was established at 2 General Hospital at Helwan in November 1940, and was promoted by Colonel F. M. Spencer and Major J. E. Caughey, both enthusiasts who made a notable contribution to 2 NZEF in this connection. The staff establishment did not allow for the posting of occupational therapists, but a call was made for voluntary workers from the civilian population, and this met with a ready response from American, Swiss, and English women, mostly from Maadi. There were up to twelve of them at different times, and one of them lent much equipment free of charge. Only a few had previous training, but all gave much time and devoted attention to the work in the hospital. They also aided the occupational therapy department financially. There was an initial grant of £10 from Red Cross funds, but thereafter the department became almost entirely self-supporting.

The work soon produced results. A large building at Helwan hospital was made available for a 'workshop' for walking patients, while many others were provided with diversional therapy at their beds.

By 1942 each hospital had an established occupational therapy department, operating under an NCO. With the arrival of the NZ WAAC (Medical Division) at the beginning of 1942 it was possible to expand the staffs of these departments by employing the nurses, some of whom displayed a particular aptitude for the work. On the hospital ships, too, this valuable work was developed. Materials were made available by the British Red Cross Society, and by the New Zealand Red Cross Society through its Commissioner in 2 NZEF. The Convalescent Depot made much use of occupational therapy of the more active type.

Occupational therapy thus came into its own. Having no official place at the beginning of the war, it came to be regarded as indispensable for the treatment and recovery of patients long before the end of the war, and some remarkable work was accomplished. The work expanded to such an extent that at 2 General Hospital in Italy at one stage there were four on the staff with an average of 280 patients a month, of whom 60 per cent were bed patients.

A review by Lieutenant-Colonel Caughey of the ambulatory patients who passed through the occupational therapy department at 2 General Hospital over two three-monthly periods indicated the class of patients who received therapy. During the period May to August 1941, 233 patients received treatment—14 psychotic, 50 psychoneurotic, 14 men with cerebral contusions, 45 orthopaedic cases, 110 general medical and surgical cases. Between October 1942 and January 1943, 174 patients attended for treatment—4 psychotic, 60 psychoneurotic, 54 orthopaedic, and 56 general medical and surgical cases.

In both series the largest group treated was made up of psychoneurotic patients, which included those with anxiety neurosis and hysteria. For these the treatment was both diversional and remedial. Some worked in the general occupational therapy room, but as far as possible they were set to work at carpentry or some outdoor occupation such as landscape gardening. From this group were drawn patients to assist in various departments of the hospital—engineer's shop, carpenter's shop, electrician's department, laboratory, linen store, pack store, clothing store, hospital library, canteen, etc. It was found that progress was usually good. The cases of anxiety neurosis and hysteria were set to work on various tasks as soon as they arrived in hospital, and, as far as possible, a programme was arranged for a full day's activity. Each morning a physical training class was held in the gymnasium under the direction of a patient.

For the psychotic group, occupation was invaluable as a form of therapy, the type of occupation being determined according to the mental state of the patient—in the excitable patient, a sedative type of occupation was most suited. If the restlessness was great, some plain painting was suitable work, or, for the less excitable type, tapestry or leather work was chosen. For those who were depressed, weaving or tapestry with bright elaborate designs helped to fix the attention and to bring about a change in the emotional tone. Concentration on close colourful work helped to divert the mind from depressive thoughts and anxieties. For the schizophrenic who was preoccupied with delusions and hallucinations, some occupation requiring close attention and concentration helped keep the mind in touch with reality.

With many cases of head injury with persistent cerebral contusion there occurred a superadded nervous factor which developed during the period of convalescence. To avoid this, it became the accepted practice to use occupational therapy as a prophylactic measure. Bed work was commenced soon after the initial shock had passed. Weaving or other simple activity was suitable, and this was continued until the patient was allowed up, when some light outdoor occupation could be commenced. With these cases in the early stages close detailed work, such as tapestry, or noisy work, such as carpentry, often induced headache and was best avoided until the tendency disappeared. Work which entailed postural changes, such as stooping, was best avoided on account of the sense of dizziness which so often followed.

Apart from acute illness with fever, toxaemia and marked debility, there were few contra-indications to diversional activities of some kind for a patient confined to bed. For those soldiers confined to bed for prolonged periods it was found that weaving, tapestry, and leatherwork were the most suitable occupations. Small hand looms were quite conveniently operated in bed and were valuable both as diversional and remedial activity.

Orthopaedic patients confined to bed for long periods in plaster required diversional activities, and in many cases remedial work was invaluable. Hand and wrist cases were helped by some activity such as weaving, tapestry, or painting. Lower-limb cases could be helped by a treadle fretsaw.

General medical and surgical cases required diversional activities while in bed, and active work to help them through the long periods of convalescence. Those with arthritis could have valuable remedial work for joints crippled by swelling and restricted movements. Occupation could prove invaluable for chronic dyspepsia, cardiac cases, and those with chronic pulmonary disease.

The general effect of well-organised occupational therapy within a hospital ward was impressive. Patients who had been dissatisfied and discontented became less irritable and contented, but to attain this it was essential that medical officers, sisters, nurses, and orderlies should play their part by co-operating with the occupational therapist in taking an active interest in the various activities of the patients.

Occupational therapy as a planned attempt, under skilled direction, to restore or improve in health, usefulness, and happiness those who were suffering from an injury, or who were recovering from sickness, more than proved its worth.

Reference

J. E. Caughey New Zealand Medical Journal, October 1943.

[SECTION]

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REFERENCE

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CHAPTER 25

The Work of a General Hospital Laboratory

THE work which may be undertaken by the laboratory of a General Hospital can be classified as follows:

1. From Hospital In patients: This is similar to the work done in any public hospital in New Zealand, for all laboratory facilities must be available to the sick soldier. In addition there will be extra bacteriological and transfusion work from battle casualties and work related to the tropical or other diseases endemic and epidemic to the area. Details are given below.
2. From Hospital Outpatients: A base hospital often made its specialists available in outpatient clinics to the units encamped in the neighbourhood and some work from this source fell to the laboratory.
3. From the 'Area': This would include water and milk analyses from camps in the area; investigation of outbreaks of food poisoning; material from RAPs and station sick quarters; the doing of serological tests from VD treatment centres, etc.
4. Transfusion Work: It was found better to have the servicing of apparatus, preparation of solutions and maintenance of the blood bank under care of the laboratory; in some hospitals the Pathologist bled the donors and supervised actual transfusions.
5. Research Work: An enormous amount of material from the sick, from battle casualties, and from epidemics was received by laboratories: there is considerable opportunity for research which may produce valuable results—but adequate staff is essential.

Analysis of Work Done at 1 NZ General Hospital Laboratory During Thirty-one Months at Helwan

This analysis is based on the monthly reports furnished to the Deputy Director of Pathology, Middle East, and is set out in full month by month in the following table. The graph shows the fluctuation of work, relating it to the monthly admissions.

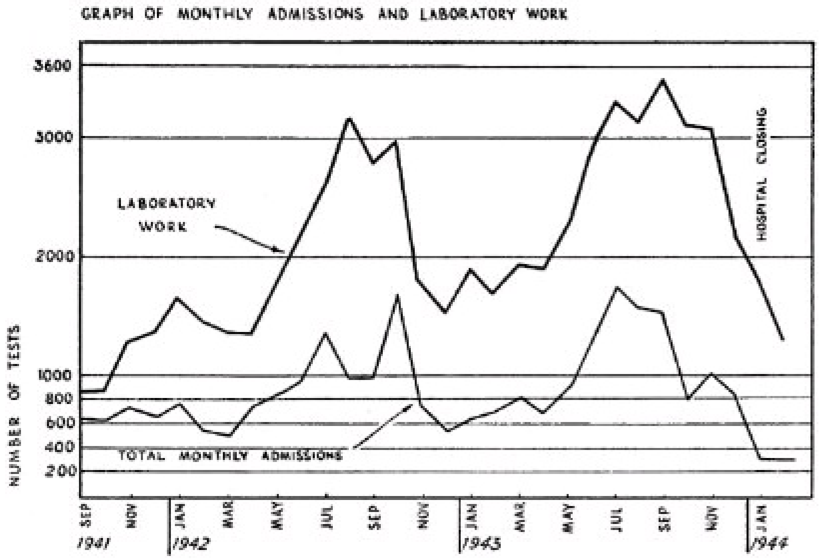
Following is the total of specimens examined in thirty-one months under the various headings in the monthly reports:

	Specimens Examined
Enteric group fevers	3613
Dysentery	9113

Helminthiasis	396
Malaria	5906
Other protozoology	7
Relapsing fever	128
Undulant fever	42
Typhus fever	25
Throat swabs	2927
Sputa	2329
Pus, skin scales, etc.	814
Wound infections	678
Venereal disease	10353
Biochemistry	1865
Vaccines made	139
Blood counts	11169
Puncture fluids	739
Urines	5919
Food, milk, water	355
Histological sections	569
Post-mortems	139
Blood-grouping	725
	—
Grand total	57,950

Consideration of the above figures shows:

1. That the average number of specimens examined per month fell little short of 2000. The average figure for Christchurch Hospital over a two-year period (1948–50) was approximately 3000. The staff at 1 NZ General Hospital was 5 technicians, most of whom were partly trained; the staff at Christchurch Hospital during the above period was 17, trained or in training.
2. That about one-third of the work done arose from tropical diseases.
3. Work arising from battle casualties made only a small contribution (about 6 per cent) to the total (wound infections, part of blood counts and blood grouping).
4. A relatively small amount of biochemical work. Nevertheless, a wide range of chemical work was undertaken to provide all the tests normally available in a public hospital. This branch of the work is certain to show a large increase in any future war, and will require the services of a properly trained biochemist.
5. A high figure for tests under venereal disease: this was largely due to the laboratory undertaking serological tests for VD Treatment Centres in a large area.



GRAPH OF MONTHLY ADMISSIONS AND LABORATORY WORK

Epidemic and Endemic Diseases

Enteric Fever: Cases of enteric fevers occurred occasionally, but there was one outbreak in the latter half of 1943 which involved much laboratory work—in one month 762 specimens (blood cultures, urines, and faeces) were derived from this source alone, 'clearance' specimens contributing largely to the total.

Dysentery: Bacillary and amoebic dysentery were endemic—peak months were November 1941, October 1942, and September 1943, when 358, 732, and 662 specimens of faeces were respectively examined. Careful search for amoebae in every case of dysentery throws much work on the laboratory staff.

Malaria: This too was endemic, but showed peak months which unfortunately almost coincided with the peak dysentery months—September 1942, 428; August 1943, 567 specimens examined.

Infective Hepatitis: Many cases were admitted during the Middle East epidemics—few were fatal. The laboratory work involved consisted of blood counts, icterus indices, and urine and faeces for bile pigments. While much of this work was not essential it was felt important to take advantage of the epidemics to make some laboratory studies. Much more might have been done with adequate staff.

Diphtheria: Occasional cases occurred throughout the period. At the end of 1942 there was both an increase in faucial diphtheria and in diphtheritic infection of wounds. At one stage the nursing staff were Schick tested and the susceptible members immunised.

The Central Pathology Laboratory

The RAMC Laboratory was attached to 15 Scottish Hospital in Cairo, and was under the supervision of the DDP ME and his staff. It was used as a reference laboratory on many subjects. In particular it carried out Wassermann tests checking our positive Kahn tests, investigated anaerobic bacteria, phage-typed strains of typhoid bacilli.

The DDP ME paid regular and most helpful visits to the laboratories under his command and held an annual conference of pathologists at which current problems were discussed, recent advances in technique described, and papers on research projects presented.

Through the DDP it was arranged for the reference to any one pathologist of all the material arising from certain diseases so that sufficient material for research could be assembled.

Analysis of Post-mortem Examinations Made at 1 General Hospital, Helwan, October 1941 to March 1944

admissions—		
Surgical (incl over 2000 battle casualties)		10,500 approx
Medical		15,000 approx
Total (includes other than New Zealanders)		25,500
deaths	91	
Post-mortems carried out—		
On hospital deaths	90	
'Brought in dead'	43	
	—	
	133	

CAUSES OF DEATH IN HOSPITAL—	
Battle casualties	21 *
Pneumococcal infections	11
Following accidents	10

Following burns	6
Staphylococcal infections	6
Tuberculosis	4
Infective hepatitis	4
Typhoid fever	4
Typhus fever	3
Diphtheria	3
Malaria	1
Miscellaneous	18
	—
	91

CAUSES OF DEATH OF SOLDIERS 'BROUGHT IN DEAD'—

Murder	1
Suicide	8
Accident (vehicle and falls)	21
GSW (accidental)	3
Drowning	1
Natural causes	9
	—
	43

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(9) Transfusion Orderly, if blood transfusion work and intravenous solution preparation is undertaken by the laboratory.

This suggested staff of 8 (plus transfusion orderly = 9) for dealing with approximately 2000 specimens per month may be contrasted with the Christchurch Hospital staff of 17 (plus 3 transfusion staff=20) for dealing with approximately 3000 specimens per month.

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For the future it might be suggested that the Senior Technician-in-charge should be a qualified and experienced 'Hospital Bacteriologist' and should be given commissioned rank. There should also be in every General Hospital laboratory a technician with considerable experience in biochemistry.

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Training of technicians was therefore carried out in all the General Hospital laboratories and proved very satisfactory. It must, however, be emphasized that a trainee is for a considerable time of no use—in fact, an encumbrance—in a laboratory, and that a nucleus of several trained (qualified) technicians is essential for the provision of a first-class laboratory service.

General Hospital Laboratory Equipment.

The laboratories of the General Hospitals in 2 NZEF were in the main furnished with standard RAMC equipment. This was well thought out and of good quality. It was designed to operate anywhere, and as kerosene was the fuel for incubators, sterilisers, etc., it was independent of electric light and gas, though when available these were, of course, used for heating and lighting. With the standard equipment, and using its boxes as benches and cupboards, it was possible to operate an efficient laboratory in a hospital tent, as, for example, 1 NZ General Hospital laboratory at Farsala in Greece. Criticism may be made of the rather cumbrous design of some of the larger laboratory pieces—e.g., the incubators, which could be better designed for transport. Other suggestions for improvement are:-

(1) Provision of at least four microscopes for a hospital of 600 beds.

(2) Provision of some sort of microscope lamp (? high-pressure mantle type, kerosene burning) for use when electricity is not available.

(3) Provision of a better centrifuge (electric or hand).

(4) Provision of better haematological apparatus-Haemoglobinometer, better quality counting chambers and pipettes.

(5) Provision of a colorimeter (the MRC Grey Wedge Photometer could well be used) for biochemistry—this would enable the more usual standard biochemical methods to be used.

On a future occasion it might well be ascertained in advance what sort of laboratory equipment a General Hospital might expect at its destination overseas.

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* Battle casualties included: Chest wounds, 6; abdominal wounds, 2; brain and cord wounds, 4; septic wounds, 5; haemorrhage, 2.

WAR SURGERY AND MEDICINE

[SECTION]

THE work which may be undertaken by the laboratory of a General Hospital can be classified as follows:

1. From Hospital In patients: This is similar to the work done in any public hospital in New Zealand, for all laboratory facilities must be available to the sick soldier. In addition there will be extra bacteriological and transfusion work from battle casualties and work related to the tropical or other diseases endemic and epidemic to the area. Details are given below.
2. From Hospital Outpatients: A base hospital often made its specialists available in outpatient clinics to the units encamped in the neighbourhood and some work from this source fell to the laboratory.
3. From the ‘Area’: This would include water and milk analyses from camps in the area; investigation of outbreaks of food poisoning; material from RAPs and station sick quarters; the doing of serological tests from VD treatment centres, etc.
4. Transfusion Work: It was found better to have the servicing of apparatus, preparation of solutions and maintenance of the blood bank under care of the laboratory; in some hospitals the Pathologist bled the donors and supervised actual transfusions.
5. Research Work: An enormous amount of material from the sick, from battle casualties, and from epidemics was received by laboratories: there is considerable opportunity for research which may produce valuable results—but adequate staff is essential.

ANALYSIS OF WORK DONE AT 1 NZ GENERAL HOSPITAL LABORATORY DURING THIRTY-ONE MONTHS AT HELWAN

Analysis of Work Done at 1 NZ General Hospital Laboratory During Thirty-one Months at Helwan

This analysis is based on the monthly reports furnished to the Deputy Director of Pathology, Middle East, and is set out in full month by month in the following table. The graph shows the fluctuation of work, relating it to the monthly admissions.

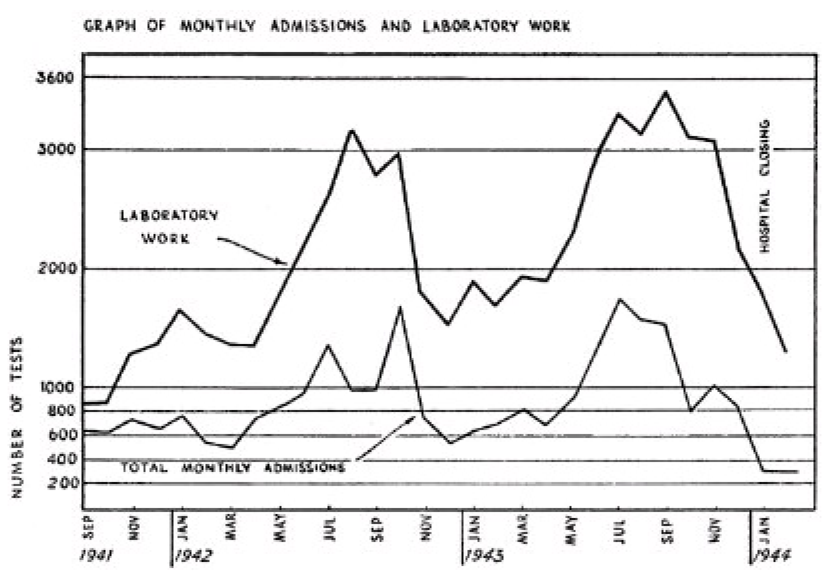
Following is the total of specimens examined in thirty-one months under the various headings in the monthly reports:

	Specimens Examined
Enteric group fevers	3613
Dysentery	9113
Helminthiasis	396
Malaria	5906
Other protozoology	7
Relapsing fever	128
Undulant fever	42
Typhus fever	25
Throat swabs	2927
Sputa	2329
Pus, skin scales, etc.	814
Wound infections	678
Venereal disease	10353
Biochemistry	1865
Vaccines made	139
Blood counts	11169
Puncture fluids	739
Urines	5919
Food, milk, water	355
Histological sections	569
Post-mortems	139

Blood-grouping	725
	—
Grand total	57,950

Consideration of the above figures shows:

1. That the average number of specimens examined per month fell little short of 2000. The average figure for Christchurch Hospital over a two-year period (1948–50) was approximately 3000. The staff at 1 NZ General Hospital was 5 technicians, most of whom were partly trained; the staff at Christchurch Hospital during the above period was 17, trained or in training.
2. That about one-third of the work done arose from tropical diseases.
3. Work arising from battle casualties made only a small contribution (about 6 per cent) to the total (wound infections, part of blood counts and blood grouping).
4. A relatively small amount of biochemical work. Nevertheless, a wide range of chemical work was undertaken to provide all the tests normally available in a public hospital. This branch of the work is certain to show a large increase in any future war, and will require the services of a properly trained biochemist.
5. A high figure for tests under venereal disease: this was largely due to the laboratory undertaking serological tests for VD Treatment Centres in a large area.



GRAPH OF MONTHLY ADMISSIONS AND LABORATORY WORK

EPIDEMIC AND ENDEMIC DISEASES

Epidemic and Endemic Diseases

Enteric Fever: Cases of enteric fevers occurred occasionally, but there was one outbreak in the latter half of 1943 which involved much laboratory work—in one month 762 specimens (blood cultures, urines, and faeces) were derived from this source alone, 'clearance' specimens contributing largely to the total.

Dysentery: Bacillary and amoebic dysentery were endemic—peak months were November 1941, October 1942, and September 1943, when 358, 732, and 662 specimens of faeces were respectively examined. Careful search for amoebae in every case of dysentery throws much work on the laboratory staff.

Malaria: This too was endemic, but showed peak months which unfortunately almost coincided with the peak dysentery months—September 1942, 428; August 1943, 567 specimens examined.

Infective Hepatitis: Many cases were admitted during the Middle East epidemics—few were fatal. The laboratory work involved consisted of blood counts, icterus indices, and urine and faeces for bile pigments. While much of this work was not essential it was felt important to take advantage of the epidemics to make some laboratory studies. Much more might have been done with adequate staff.

Diphtheria: Occasional cases occurred throughout the period. At the end of 1942 there was both an increase in faucial diphtheria and in diphtheritic infection of wounds. At one stage the nursing staff were Schick tested and the susceptible members immunised.

THE CENTRAL PATHOLOGY LABORATORY

The Central Pathology Laboratory

The RAMC Laboratory was attached to 15 Scottish Hospital in Cairo, and was under the supervision of the DDP ME and his staff. It was used as a reference laboratory on many subjects. In particular it carried out Wassermann tests checking our positive Kahn tests, investigated anaerobic bacteria, phage-typed strains of typhoid bacilli.

The DDP ME paid regular and most helpful visits to the laboratories under his command and held an annual conference of pathologists at which current problems were discussed, recent advances in technique described, and papers on research projects presented.

Through the DDP it was arranged for the reference to any one pathologist of all the material arising from certain diseases so that sufficient material for research could be assembled.

ANALYSIS OF POST-MORTEM EXAMINATIONS MADE AT 1 GENERAL HOSPITAL, HELWAN, OCTOBER 1941 TO MARCH 1944

Analysis of Post-mortem Examinations Made at 1 General Hospital, Helwan, October 1941 to March 1944

admissions—		
Surgical (incl over 2000 battle casualties)		10,500 approx
Medical		15,000 approx
Total (includes other than New Zealanders)		25,500
deaths	91	
Post-mortems carried out—		
On hospital deaths	90	
'Brought in dead'	43	
	—	
	133	

CAUSES OF DEATH IN HOSPITAL—	
Battle casualties	21 *
Pneumococcal infections	11
Following accidents	10
Following burns	6
Staphylococcal infections	6
Tuberculosis	4
Infective hepatitis	4
Typhoid fever	4
Typhus fever	3
Diphtheria	3
Malaria	1
Miscellaneous	18
	—
	91

CAUSES OF DEATH OF SOLDIERS 'BROUGHT IN DEAD'—	
Murder	1
Suicide	8

Accident (vehicle and falls)	21
GSW (accidental)	3
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CHAPTER 26 — INCIDENCE OF DISEASE IN 2 NZEF

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IT has been possible to assemble sufficient statistics to give the picture of the incidence of disease in 2 NZEF.

Admissions to medical units from July 1941 to December 1945 (Table I), which covers most of the period after 2 NZEF was built up to strength, shows that much of the sickness was caused by the same diseases as affected troops in New Zealand. The commonest causes of admission to the camp and public hospitals from camps in New Zealand from 1943 to 1945 were, in order, influenza and common cold; diseases of bones, joints and muscles; diseases of teeth and gums (dental treatment of recruits was carried out in camps after their mobilisation); tonsillitis; skin diseases; PUO; venereal disease; scabies; ear and nose diseases; diseases of the nervous system. Most of these conditions were among the twenty most common causes of sickness in 2 NZEF. To them were added infective hepatitis, dysentery, malaria, and sandfly fever, which diseases were endemic to the Middle East, and to which New Zealanders possessed little or no immunity. Devastating diseases of previous wars such as typhoid and typhus fevers caused relatively few cases of sickness, due in part at least to artificially induced immunity, typhoid inoculations being given to troops from the beginning of the war, and typhus inoculations from late 1943.

In actual man-days it is likely that the skin diseases, infective hepatitis, and dysentery and diarrhoea caused the greatest wastage, with malaria, pneumonia and venereal disease next in order. Infective hepatitis kept the most seriously ill patients in hospital and convalescent depot for some six weeks, and pneumonia and some of the skin diseases caused almost as long hospitalisation.

The findings agree substantially with those of the British Army, which has more complete statistics. In the British Army in the Middle East Force in 1943 the greatest wastage was caused by malaria, infective hepatitis, tonsillitis and pharyngitis, bacillary dysentery, and psychiatric disorders in that order. In the British Army in Italy in 1944 the order was malaria, infective hepatitis, venereal disease, cellulitis and IAT, dysentery and diarrhoea.

Sufficient figures are available to compare 2 NZEF and 2 AIF in the Middle East as regards incidence of dysentery, malaria, and venereal disease (Table II). In 1940 the 2 NZEF dysentery rate was over double that of 2 AIF, but in 1941 and 1942 there was not much difference. The malaria rate was similar in 1940, but the AIF had a much higher rate in 1941, and the NZEF had a higher rate in 1942. This corresponds with the years the respective forces were in Syria. For venereal disease 2 NZEF had the higher rate in 1940, but the rate improved considerably in 1941 and 1942, whereas the AIF rate increased to be double that of 2 NZEF.

The morbidity figures for 2 NZEF from 1943 to 1945 (Table III), remembering that most of 2 NZEF was in Italy in 1944 and 1945, show some contrasts as between Egypt and Italy. Dysentery, malaria, sandfly fever, and otitis media were more common in 1943 than in the later two years. In 1944 there were rises in the incidence of infective hepatitis (from an epidemic similar to that of 1942), pneumonia, diarrhoea, areolar disease, nervous disease, and venereal disease. Pneumonia doubtless increased as a result of the wet winter conditions, nervous disease possibly from the strenuous battle conditions at the Sangro, Cassino, and Florence, and venereal disease as a result of more readily available sources of infection.

The number of evacuations of sick and wounded from 2 NZ Division alone, and also the discharges to divisional units from Field Ambulances, during the campaign in Italy are shown in Table IV. The number evacuated from their units in one year almost equalled the numerical strength of the Division, though those able to be discharged to their units from Field Ambulances and the mobile venereal disease treatment centre did not leave the divisional area. Cases shown as NYD Fever would have been diagnosed at CCS or General Hospital, but the breakdown of this group is not known.

The fresh cases admitted to medical units each day averaged about 2 per 1000 strength (Table Va). The percentage of the Force in medical units at any one time varied from 3 to 13, depending on the number of battle casualties and the occurrence of epidemics such as infective hepatitis. Sickness cases in medical units averaged 4–5 per cent, but during the periods when the Division was actively engaged the addition of battle casualties raised patients in medical units to an average of over 8 per cent of the Force (Table Vb).

Sufficient hospital beds had to be available for normal sickness and seasonal epidemics, as well as for battle casualties and the accidentally injured. Table Vc shows the occupied bed states for base medical units in 2 NZEF over the year May 1942 to April 1943. The period July—December 1942 was a period of strain due to numerous battle casualties from the Alamein Line and an infective hepatitis epidemic. The monthly average of 2189 beds occupied in hospitals and 782 at convalescent depots is thus probably higher than the average over a longer period, but there was at times almost as much strain when one of the hospitals was shifting to a new location. An estimate in May 1945 by the DMS 2 NZEF gave the average number held in all base medical units at one time as 2100. Of these, it was estimated that 1500 would be sick, 300 accidental injuries, and 300 battle casualties. The average monthly addition to the invalids awaiting evacuation to New Zealand by hospital ship was judged to be 120, of whom 90 would be sick and 30 battle casualties.

Table VI, invalids evacuated to New Zealand, 1940–45, indicates the conditions for which soldiers were incapacitated for further service overseas. Nervous diseases and the group of bone, joint, and muscle diseases were the causes of most invaliding, while respiratory, digestive, and skin diseases contributed sizeable totals. It should be noted that most of these conditions were not peculiar to the particular theatre of service, but could have applied to any force, even in New Zealand itself. The New Zealand force in the Pacific had the same experience. For instance, tropical diseases as such were not the cause of very much invaliding to New Zealand, but conditions overseas, such as the heat and dust in the deserts of North Africa, caused conditions to 'flare up' whereas they might have remained quiescent in New Zealand in the troops concerned.

(From 1 NZEF in France major causes of invaliding to New Zealand apart from war wounds (Table VII) were nervous diseases, tuberculosis, respiratory disease, diseases of the circulatory system, impairment of the organs of locomotion, diseases of the eye, ears and nose, diseases of the digestive system, and effects of gas. Evacuations for skin disease were notably few.)

Mortality

As regards deaths from disease the record of 2 NZEF was a good one, aided by spectacular advances in medicine. There were only 190 deaths in 2 NZEF from 1939 to 1945, as against 1579 in 1 NZEF from 1914 to 1918 (Table VIII). It has to be noted that 1 NZEF had an average strength nearly half as great again (in round figures 40,000 as against 30,000), but its period was 4 years 2 months against nearly six years. The most notable reductions were in deaths from pneumonia, influenza, tuberculosis, typhoid, dysentery, and malaria. Most of the deaths in 2 NZEF could have occurred normally in a civilian population, except a handful of deaths from dysentery (8), typhus (6), infective hepatitis (6), and malaria (2). The death rate is almost exactly equal to that for deaths from natural causes for the RNZAF in New Zealand—100 deaths for a force of average strength of approximately 16,500—and very similar to the rate for the army in New Zealand. The average age of the forces in New Zealand was probably somewhat older.

In the group of 8000 who were prisoners of war, most of them for nearly four years, there were 105 deaths from disease (Table IX). Doubtless there would have been more deaths but for the good work of Allied medical officers in captivity and the steady arrival of Red Cross parcels.

Down-gradings

Other wastage occurred with troops who had to be downgraded, although many did useful work as graded men. The causes for down-grading at 31 December 1944 (Table X) show that functional nervous disorders, pes planus, and hallux valgus predominated (a large proportion of the foot disabilities was mainly psychoneurotic in origin). Battle wounds and accidental injuries caused a number of down-gradings, but many of these were only temporary. Debility and various diseases of bones, joints, and muscles came in the next large group. Each month a number of men who had further deteriorated in condition were boarded for return to New Zealand. Their places in the ranks of graded men were usually more than filled by new down-gradings, so that the number of graded men was a steadily mounting total. Thus the number in 1944 is larger than it was in the earlier years of the war, although the causes of down-grading varied little.

2 NZEF (IP)

In the Pacific Force (2 NZEF IP) the causes of admissions to medical units were very similar to those present in the Middle East. Table XIA for the year June 1943 to July 1944 shows skin diseases as easily the most frequent cause, followed by septic sores, malaria, dengue, tonsillitis, dysentery, diarrhoea, PUO, influenza, and nervous diseases. There were very few cases of infective hepatitis, pneumonia, and venereal disease. As in the Middle East, the malaria figures were kept low by a carefully planned campaign by the medical services. Deaths from disease numbered only sixteen.

Invalidings to New Zealand arose principally as a result of neurosis, skin disease, asthma, and diseases of the joints (Table XIB). In down-gradings for base duties these conditions were also prominent, as were diseases of the ear, and pes planus and pes cavus.

Accidental Injuries

In 2 NZEF, MEF and CMF, deaths from accidental injuries (314) totalled more than deaths from disease (190).

The Statistical Report on the Health of the (British) Army states that deaths from injuries in the Middle East Force in 1943 were only two-fifths of the deaths from disease. The explanation of the difference in proportion is probably that accidental injuries were higher in the New Zealand Force because of the high degree of mobility of 2 NZ Division, and the deaths from disease in 2 NZEF may also have been at a lower rate than for the British Army as a whole.

In 2 NZEF (IP) there were 16 deaths from disease, but 34 from accidental injuries, including 4 from burns.

War Disablement Pensions

War disablement pensions granted up to 31 March 1950 are shown in Table XII. The statistics apply to all three services. The number of servicemen demobilised from overseas service up to 31 March 1951 was 145,054, and from home service 66,734, and the pensions granted at least temporarily to these groups were 43,087 and 10,551 respectively. It will be noted that service within New Zealand alone gave rise to nearly one-fifth of the pensions. The generous outlook as regards pension administration means that some pensions have been paid for pre-enlistment disabilities not detected at the enlistment of recruits, and to some extent explains why nervous disabilities constitute the most numerous group.

Some claims for pensions were coming in seven years after the end of the war, but their numbers were more than offset by the steady reduction in the number of temporary pensions paid. At 31 March 1950 the temporary pensions for Second World War service were 13,011, and the permanent pensions 10,065. Over 76 per cent of all the pensions were assessed at less than 40 per cent disability. Unfortunately, details of the disabilities of these groups are not available. It is of interest to note that 13,585 permanent pensions and 230 temporary pensions were being paid at 31 March 1950 for ex-servicemen of the First World War, and that 49 per cent of these were assessed at less than 40 per cent disability.

Table I
2 NZEF, MEF AND CMF
Morbidity: Admissions to Medical Units for Disease July 1941 to December 1945

Disease	No. of Cases, July 1941 to December 1945	Percentage of all Sick Admissions
Dysentery	5846	7.29
Diarrhoea	3926	4.90
Infective hepatitis	7051	8.79
PUO	2848	3.55
Malaria	2065	2.57
Pneumonia	2594	3.22
Bronchitis	1417	1.77
Influenza	1305	1.65
Common cold	1036	1.29
Sandfly fever	1053	1.31
Anxiety neurosis	1696	2.11
Nervous and physical exhaustion	1013	1.26
Otitis media and externa	1959	2.44
Sinusitis	1330	1.66
Tonsillitis—catarrhal	1519	1.89
follicular	1756	2.19

Venereal disease	4477	5.58
Skin diseases	4774	5.95
IAT	5903	7.36
Scabies	1450	1.81
Fibrositis	1188	1.48
	——	——
	56206	70.07
Total sick admissions	80215	

Wastage is related to duration of stay, and figures for the British Army MEF in 1943, for Hospital and Convalescent Depot combined, were (in days): Dysentery, 17; infective hepatitis, 40; PUO, 11.8; malaria, 24.4; pneumonia, 42.2; bronchitis, 24.6; common cold, 10.2; sandfly fever, 10.6; psychiatric disorders, 36; otitis media and externa, 24.5; tonsillitis, 14.3; venereal disease, 19.2; dermatitis, 32; boils and carbuncles, 24.3; scabies, 10.5; rheumatic conditions, 24.3.

Average: 24.7 days.

Table II

Infectious Diseases, 2 NZEF and 2 AIF Compared

	1940				1941				1942		
—-	Admissions		Rate/1000		Admissions		Rate/1000		Admissions		Rat
	Aust	NZ	Aust	NZ	Aust	NZ	Aust	NZ	Aust	NZ	
Dysentery	298	399	21	45	2561	1136	34	40	1330	935	
Malaria	131	73	9	8	2312	323	30	11	932	728	
Venereal disease	502	448	36	50	3704	745	48	26	1964	654	
Average strengths for	Aust		NZ		Aust		NZ		Aust		NZ
year	14258		8875		76440		28308		41594		

Table III

2 NZEF, MEF AND CMF

Morbidity: Admissions to Medical Units, 1943-45

	1943	1944	1945
Injuries—battle casualties	2681	4209	1384
accidental	3440	3738	2668
self-inflicted	5	2	2

Hepatitis and catarrhal jaundice	545	2990	647
Dysentery	1673	875	628
Malaria	452	292	197
Pneumonia	516	750	363
Pleurisy	142	123	91
Influenza	285	333	143
Typhoid fever	145	34	9
Paratyphoid fever	5	2	
Smallpox	2	3	
Typhus	10		
Poliomyelitis	8	3	6
Tuberculosis	23	15	9
Cerebrospinal meningitis	2	14	6
Mumps	6	11	13
Measles	23	11	6
Diphtheria	66	73	167
Chickenpox	19	11	21
Sandfly fever	358	144	27
Diarrhoea	973	1297	691
Anxiety neurosis	471	658	176
Mental cases	188	275	146
Nervous and physical exhaustion	329	558	114
Nervous	314	344	278
Eye	231	347	223
Otitis media	553	380	230
Otitis externa	139	210	118
Ear, other	56	89	65
Nose	540	508	306
Respiratory	167	211	176
Asthma and bronchitis	437	557	223
Circulation	210	194	130
Blood and blood-forming	103	100	78
Glands	93	119	102
Breast	3	16	4
Teeth and gums	125	209	241
Digestive	2768	3155	2707
Nutrition and metabolism	16	12	6

Bones, joints, muscles, etc.	961	1201	558
Areolar	1314	1862	1363
Skin	1174	1328	1236
Erysipelas	8	5	
Infection and infestation	2133	3353	3484
Generative—venereal	373	1361	3075
non-venereal	447	415	952
Urinary	302	271	213
Other causes	792	836	961
	25626	33504	24243
Average strength of 2 NZEF	31554	32538	26557

In the Statistical Report on the Health of the British Army, issued by War Office, it is reported that in Italy in 1944 the mean duration of stay in hospital and convalescent depot was slightly less than 3½ weeks for disease, 4 weeks for accidental injuries, and nearly 7 weeks for battle casualties. A much higher proportion of the last-mentioned went to convalescent depot than of either of the other two classes.

In the table above most of the cases in 1943 were from the Middle East and most of those for 1944 and 1945 from Italy.

Table IV
2 NZ Division
Cases Admitted to Medical Units, Italy

	18 Nov 1943 to 17 Nov 1944	18 Nov 1944 to 30 Sep 1945
Dysentery	272	53
Diarrhoea	750	234
Infective hepatitis	1924	494
Malaria	60	47
NYD fever	2039	949
Respiratory	439	175
Pneumonia	32	38
ENT	892	797
Scabies	228	847
Pediculosis	186	356

VD	1028	1428	
Physical exhaustion	603	160	
Accidental injuries	1933	1507	
Other diseases	86	50	(estimated)
	——	——	
	10472	7135	
Discharged to unit from Field Ambulances	3740	2500	(estimated)
	——	——	
	14212	9635	
Battle casualties	4833	2441	(war ended May 1945)
	——	——	
	19045	12076	
	——	——	
Average strength of Division	20,500	18,000	(approx)

The number of first attendances at RAPs (incl BCs) averaged 4405 for the months December 1944 to September 1945. With BCs excluded the average was 4205 per month.

Table VA
2 NZEF, MEF AND CMF
Average Daily Sickness Rate (Fresh Cases) per 1000 per Month

	1941		1942		1943		1944		1945	
	Offrs	ORs	Offrs	ORs	Offrs	ORs	Offrs	ORs	Offrs	ORs
Jan			1.35	1.35	1.1	1.3	1.28	1.29	1.89	2.2
Feb			1.56	1.53	1.1	1.3	2.1	2.08.	1.73	2.05
Mar			0.75	0.92	1.5	1.49	2.2	2.2	1.69	2.13
Apr			0.98	1.53	1.96	2.35	1.4	1.35	2.07	3.25
May			1.37	1.39	1.5	1.49	2.2	2.2	1.69	2.13
Jun			1.5	2.2	1.9	1.95	1.46	1.73	1.87	2.79
Jul					1.87	2.43	2.2	2.04	1.79	2.24
Aug	2.4	2.03			1.84	2.09	1.96	2.17	2.05	2.41
Sep	1.9	1.6	2.2	2.2	1.46	1.95	2.33	2.55		
Oct	2.0	2.2	3.62	3.57	0.84	1.12	2.74	3.16		
Nov	1.9	2.0	2.2	2.3	1.09	1.19	2.84	2.84		
Dec	1.4	1.4	1.9	1.76	1.85	1.85	1.94	2.94		

Table VB

Percentage of 2 NZEF, MEF and CMF in Medical Units at End of Each Month

	1942 Sick & BC	1942 Sick	1943 Sick & BC	1943 Sick	1944 Sick & BC	1944 Sick	1945 Sick & BC	1945 Sick	
Jan			5.62	4.4	5.89	4.55	7.36	5.91	
					9.60	5.82	3.28	3.28	Egypt
Feb			5.52	4.86	7.77	6.13	5.77	4.67	
					7.17	4.01	2.7	2.7	Egypt
Mar			6.61	4.74	9.05	5.74	5.78	5.0	
					4.67	3.21	4.2	4.2	Egypt
Apr			7.97	4.98	7.71	5.46	9.18	4.77	
					4.7	2.97	5.1	5.1	
May	5.45		5.88	4.02	7.49	5.79	4.69	3.43	
					3.93	3.73	5.3	5.3	Egypt
Jun	6.57	6.32	5.25	4.43	5.96	5.08	4.38	3.58	
					3.26	3.16	4.48	4.48	Egypt
Jul	12.03	7.83	5.26	5.03	8.25	5.98	3.04	2.97	
					3.08	3.08			Egypt
Aug		13.48	8.49	4.47	4.39	7.69	5.64	3.56	3.52
					3.79	3.79			Egypt
Sep	12.3	9.1	4.59	4.54	10.62	7.84	4.67	4.64	
					3.8	3.8			Egypt
Oct	13.02	11.2	3.97	3.93	9.96	7.84	4.44	4.43	
					4.94	4.94			Egypt
Nov	13.41	8.96	3.29	3.14	9.81	8.38	3.79	3.77	
					4.3	4.3			Egypt
Dec	9.32	6.84	6.00	3.74	9.75	6.98	5.03	4.97	
					5.4	5.4			Egypt

In 1944 and 1945 the first figures for each month refer to Italy only.

The only two large epidemics (those of infective hepatitis) are reflected in the high figures for autumn 1942 and autumn 1944.

Table Vc 2 NZEF MEF Bed States Base Medical Units

	All Hospitals	Convalescent Depot and Rest Homes
1 May 1942	1386	256

1 Jun	1357	479
1 Jul	2674	822
1 Aug	2434	1500
1 Sep	2784	1283
1 Oct	2637	974
1 Nov	2904	1179
1 Dec	2773	1051
1 Jan 1943	2067	688
1 Feb	1964	524
1 Mar	1655	359
1 Apr	1635	280
Average over twelve months	2189.2	782.9

An estimate in May 1945 gave the average number held in all base medical units at any one time as 2100. Of these, it was estimated that 1500 would be sick, 300 accidental injuries, and 300 battle casualties. The average monthly addition of invalids for evacuation to New Zealand by hospital ship was judged to be 120, of whom 90 would be sick and 30 battle casualties.

Table VI
2 NZEF 1940–45
Invalids Evacuated to New Zealand
Sickness And Accidental Injuries
(See also Table VI A)—

Respiratory disease	747
Infectious disease	366
Nervous disease	1927
Digestive disease	412
Ear disease	274
Eye disease	255
Nose disease	74
Circulatory	217
Blood and glands	65
Metabolic	35
Malignant	25
Debility	172
Skin	321

Genito-urinary	208
Hernia	36
Bones, joints, and muscles	908
	6042
Accidental injuries	767

Average strength of 2 NZEF, 30,000 (approx.).

Table VI A
Invalids (Sick) Evacuated to New Zealand from 2 NZEF, MEF and CMF, 1940–45

INFECTIOUS DISEASE—	
Infective hepatitis	124
Dysentery	86
Rheumatic fever	51
Poliomyelitis	30
Typhoid fever	17
Malaria	16
Venereal disease	12
Other	30
	366
RESPIRATORY DISEASE—	
Asthma	239
Bronchitis	173
Pleurisy	117
Tuberculosis	127
Pneumonia	27
Other	64
	747
NERVOUS—	
Anxiety neurosis	692
Nervous exhaustion	163
Schizophrenia	84
Psychopathic personality	72
Depression	94

Other	822
	1927
DIGESTIVE—	
Duodenal ulcer	163
Dyspepsia	83
Gastric and peptic ulcer	51
Other	115
	412
EAR DISEASE—	
Otitis media	190
Other	84
	274
EYE DISEASE	255
NASAL DISEASE	74
CIRCULATORY DISEASE	217
BLOOD AND GLANDS	65
METABOLIC	35
MALIGNANT DISEASE	25
DEBILITY	172
SKIN DISEASE—	
Eczema	171
Dermatitis	72
Other	78
	321
GENITO-URINARY	208
HERNIA	36
BONES, JOINTS, AND MUSCLES—	
Arthritis	196
Osteo-arthritis	112
Fibrositis	106
Pes planus and cavus	70
Sciatica	37
Other	387

	908
Total	6042

Table VII

1 NZEF: Evacuations to New Zealand and Discharges in United Kingdom, May 1916 to December 1918

SICKNESS AND ACCIDENTAL INJURIES—	
Tubercle of the lung	960
Other tuberculous disease	125
Venereal	81
Carriers	12
Other general diseases	1753
Mental	175
Nervous system and shell shock	1370
Eye, ear, and nose	1012
Circulatory system	1713
CPDI (pulmonary, indeterminate)	283
Other respiratory diseases	1293
Digestive system	719
Urogenital system and suprarenals	448
Organs of locomotion	1874
Skin	26
Effects of gas	567
Other general injuries and trench foot	80
Local injuries	1092
Tubercle of lung and amputation of leg	3
CPDI and amputation of leg	1
	13587

Table VIII

Deaths from Disease

	2 NZEF, MEF and CMF, 1940–45	1 NZEF, 1914–12 Nov 1918 (Carbery)
Meningitis—		
Pneumococcal	14	

Follg otitis media	5	
Meningococcal	2	109
Other	8	6
Heart—		
Heart failure	7	51
Myocarditis	6	
Other	5	
Pneumonia, lobar	14	578
Appendicitis and peritonitis	15	40
Generalised infection—		
Septicaemia	8	7
Other	4	15
Haemorrhage—		
Cerebral	8	5
Other	2	6
Acute abdominal conditions	8	14
Dysentery—		
Bacillary	7	81
Amoebic	1	
Poliomyelitis	8	
Typhoid fever	8	126
Neoplasms	8	17
Infective hepatitis	6	10
Nephritis	6	30
Typhus fever	6	
Anaemia	6	4
Diphtheria	4	9
Tuberculosis	4	149
Duodenal ulcer	3	2
PUO	2	5
Malaria	2	61
Influenza	152	
Others	13	102
	190	1579

Table IX

2 NZEF Prisoners of War.

Deaths from Sickness

Pneumonia	12
Dysentery	12
Meningitis	8
Heart	6
Neoplasms	5
Tuberculosis, pulmonary	4
Diphtheria	4
Toxaemia	4
Nephritis	3
Peritonitis	3
Enterocolitis	3
Malaria	2
Cachexy	2
Other	25
Unknown	12
	105

Table X

2 NZEF, MEF AND CMF

Graded Personnel at 31 December 1944

	Grade			
	B	C	D	To
Officers—CMF	7	37	7	51
MEF	2	13	16	31
Other ranks—CMF	105	787	301	1193
MEF	76	451	287	814
	190	1288	611	2089

Analysis by Disabilities

Nervous diseases, functional	751
Injuries—	
Battle casualties	236
Accidental	147
Pes planus, hallux valgus, etc.	178

Debility	90
Arthritis, etc.	64
Deafness	60
Eye	59
Hernia	56
Knee disorders	53
Other diseases bone and muscle	49
Fibrositis	43
Skin	40
Otitis media and externa	39
Mental dullness	32
Respiratory	27
Nervous diseases, organic	25
Gastro-intestinal disorders	23
Cardio-vascular	15
Rheumatism	14
Asthma	13
Congenital defects	10
Varicose veins	9
Tumours and cysts	9
Sinusitis	8
Hepatitis	7
Other	32
	2089

Table XI A
2 NZEF IP
Admissions to Medical Units, June 1943–July, 1944

DISEASE—	
Skin disease	1930
Malaria	398
Dengue	372
Septic sore	547
Infected tonsils	331
Dysentery	281

Diarrhoea	213
PUO	241
Influenza	238
Nervous	233
Peptic conditions	210
Gasstro-enteritis	207
Appendicitis	186
Ankylostomiasis	166
Mental	160
Eye	108
Sinusitis	97
Asthma	90
Otitis media	79
Infective hepatitis	85
Gonorrhoea	44
Pneumonia	19
TB pulmonary	8
Diphtheria	5
	6248
INJURIES—	
Wonded	189
Accidental injuries	1291
Burns	206
Hernia	81
	1767

Table XI B

2 NZEF IP

Medical Boradings to 31 May 1944

Disability	For Return to NZ	For Base Duties
Skin disease	115	250
Mental—neurosis	167	208
Mental—general	63	59
Accidental injuries	88	176
Battle casualties	32	15
Joints—diseases of	69	131

Digestive system	42	71
Asthma	85	48
Ear	27	120
Eye	12	56
Arthritis	44	68
Fibrositis	18	51
Physical exhaustion	23	50
Respiratory	32	21
Nose	17	35
Throat		8
Genito-urinary	30	30
Pes planus and cavus	13	103
Surgical history	14	29
Headaches	15	48
Varicose veins	4	23
Hernia	4	18
Malaria	3	
Circulatory system	34	48
Miscellaneous	50	138
	1001	1804

Some 60 officers are not included in the total of those graded for base duties. Some of those graded for base duties were probably reboarded later for return to New Zealand.

Table XII

War Disablement Pensions Granted to Ex-servicemen of Second World War up to 31 March 1950

Class of Disability or Disease	Overseas	Area of Service Japan	New Zealand	Total
Infections and infestations	1869	9	112	1990
Nervous system	9589	10	1646	11245
Ear, eye, and nose	6418	15	1317	7750
Circulatory and blood system	1925	1	985	2911
Metabolism and endocrine system	380	1	172	553
Lungs	3203	47	1077	4327

Diseases of bones, joints, muscles	5003	4	1807	6814
Digestive system	3825	7	1128	4960
Generative system	316		119	435
Gunshot wounds and accidental injuries to bones, joints, and soft tissues	5997	23	1183	7203 *
Skin	2329	10	519	2858
Tumours and neoplastic growths	149		48	197
Malformations	300		131	431
Amputations	471		18	489
Urinary tract	525	2	135	662
Debility	442		109	551
	42741	129	10506	53376

The total disablement pensions in force at 31 March 1950 for servicemen of the Second World War was 23,076, of whom 10,065 were classified as permanent and 13,011 as temporary.

The percentage of disability of these cases was:

Percentage of Disability	Permanent	Temporary	Total
100	510	946	1456
90–99	53	14	67
80–89	218	92	310
70–79	322	231	553
60–69	260	255	515
50–59	650	578	1228
40–49	606	595	1201
30–39	1135	1198	2333
20–29	3249	3739	6988
10–19	3033	5360	8393
Under 10	29	3	32
	10065	13011	23076

It has not been possible to obtain an analysis of the disabilities for which pensions were still being granted at this date.

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Editor-in-Chief	Sir Howard K. Kippenberger, kbe, cb, dso, ed
Medical Editor	T. D. M. Stout, cbe, dso, ed
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Sub-Editor	W. A. Glue
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Archives Officer	R. L. Kay
Draughtsman	L. D. McCormick

the author: Colonel Stout was educated at Wellington College and at Guys Hospital, London. He served overseas for the whole period of the 1914–18 War, first in the Samoan Advance Force and then in Egypt, Salonika, France, and England. He was attached to 1 NZ Stationary Hospital and was seconded with a New Zealand surgical team to British casualty clearing stations during the battles of the Somme and Vimy. He was later Surgical Divisional Officer at 1 NZ General Hospital at Brockenhurst and acted as Consultant Surgeon 1 NZEF at the later stages of the war. He was awarded the DSO and OBE and mentioned in despatches. After the war he was attached as Surgical Consultant to the Trentham Military Hospital and later acted as surgical examiner for the Pensions Department throughout the inter-war period.

Proceeding overseas with the Second Echelon in May 1940, he served with 2 NZEF in England, Egypt, Greece, North Africa and Italy, first as Surgical Divisional Officer 1 NZ General Hospital and, from May 1941 till October 1945, as Consultant Surgeon 2 NZEF. He was awarded the CBE and mentioned in despatches.

In civil life Colonel Stout held the position of Senior Surgeon to the Wellington Hospital from 1920 till 1945, since when he has been an honorary Consultant Surgeon to the hospital. For many years he was a University lecturer in surgery and also an examiner in surgery to the University of New Zealand. He has played an active part in the British Medical Association and has held the position of President and Chairman of Council of the New Zealand Branch. He was also for many years on the New Zealand Committee of the Royal Australasian College of Surgeons. He has been associated with the University of New Zealand as a Member of Senate and also as a member and chairman of the Victoria College Council and as a member of the

Massey College Council.

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* Does not include all gunshot wounds, e.g., those of abdomen are included in digestive system.

WAR SURGERY AND MEDICINE

[SECTION]

IT has been possible to assemble sufficient statistics to give the picture of the incidence of disease in 2 NZEF.

Admissions to medical units from July 1941 to December 1945 (Table I), which covers most of the period after 2 NZEF was built up to strength, shows that much of the sickness was caused by the same diseases as affected troops in New Zealand. The commonest causes of admission to the camp and public hospitals from camps in New Zealand from 1943 to 1945 were, in order, influenza and common cold; diseases of bones, joints and muscles; diseases of teeth and gums (dental treatment of recruits was carried out in camps after their mobilisation); tonsillitis; skin diseases; PUO; venereal disease; scabies; ear and nose diseases; diseases of the nervous system. Most of these conditions were among the twenty most common causes of sickness in 2 NZEF. To them were added infective hepatitis, dysentery, malaria, and sandfly fever, which diseases were endemic to the Middle East, and to which New Zealanders possessed little or no immunity. Devastating diseases of previous wars such as typhoid and typhus fevers caused relatively few cases of sickness, due in part at least to artificially induced immunity, typhoid inoculations being given to troops from the beginning of the war, and typhus inoculations from late 1943.

In actual man-days it is likely that the skin diseases, infective hepatitis, and dysentery and diarrhoea caused the greatest wastage, with malaria, pneumonia and venereal disease next in order. Infective hepatitis kept the most seriously ill patients in hospital and convalescent depot for some six weeks, and pneumonia and some of the skin diseases caused almost as long hospitalisation.

The findings agree substantially with those of the British Army, which has more complete statistics. In the British Army in the Middle East Force in 1943 the greatest wastage was caused by malaria, infective hepatitis, tonsillitis and pharyngitis, bacillary dysentery, and psychiatric disorders in that order. In the British Army in Italy in 1944 the order was malaria, infective hepatitis, venereal disease, cellulitis and IAT, dysentery and diarrhoea.

Sufficient figures are available to compare 2 NZEF and 2 AIF in the Middle East as regards incidence of dysentery, malaria, and venereal disease (Table II). In 1940 the 2 NZEF dysentery rate was over double that of 2 AIF, but in 1941 and 1942 there was not much difference. The malaria rate was similar in 1940, but the AIF had a much higher rate in 1941, and the NZEF had a higher rate in 1942. This corresponds with the years the respective forces were in Syria. For venereal disease 2 NZEF had the higher rate in 1940, but the rate improved considerably in 1941 and 1942, whereas the AIF rate increased to be double that of 2 NZEF.

The morbidity figures for 2 NZEF from 1943 to 1945 (Table III), remembering that most of 2 NZEF was in Italy in 1944 and 1945, show some contrasts as between Egypt and Italy. Dysentery, malaria, sandfly fever, and otitis media were more common in 1943 than in the later two years. In 1944 there were rises in the incidence of infective hepatitis (from an epidemic similar to that of 1942), pneumonia, diarrhoea, areolar disease, nervous disease, and venereal disease. Pneumonia doubtless increased as a result of the wet winter conditions, nervous disease possibly from the strenuous battle conditions at the Sangro, Cassino, and Florence, and venereal disease as a result of more readily available sources of infection.

The number of evacuations of sick and wounded from 2 NZ Division alone, and also the discharges to divisional units from Field Ambulances, during the campaign in Italy are shown in Table IV. The number evacuated from their units in one year almost equalled the numerical strength of the Division, though those able to be discharged to their units from Field Ambulances and the mobile venereal disease treatment centre did not leave the divisional area. Cases shown as NYD Fever would have been diagnosed at CCS or General Hospital, but the breakdown of this group is not known.

The fresh cases admitted to medical units each day averaged about 2 per 1000 strength (Table Va). The percentage of the Force in medical units at any one time varied from 3 to 13, depending on the number of battle casualties and the occurrence of epidemics such as infective hepatitis. Sickness cases in medical units averaged 4–5 per cent, but during the periods when the Division was actively engaged the addition of battle casualties raised patients in medical units to an average of over 8 per cent of the Force (Table Vb).

Sufficient hospital beds had to be available for normal sickness and seasonal epidemics, as well as for battle casualties and the accidentally injured. Table Vc shows the occupied bed states for base medical units in 2 NZEF over the year May 1942 to April 1943. The period July—December 1942 was a period of strain due to numerous battle casualties from the Alamein Line and an infective hepatitis epidemic. The monthly average of 2189 beds occupied in hospitals and 782 at convalescent depots is thus probably higher than the average over a longer period, but there was at times almost as much strain when one of the hospitals was shifting to a new location. An estimate in May 1945 by the DMS 2 NZEF gave the average number held in all base medical units at one time as 2100. Of these, it was estimated that 1500 would be sick, 300 accidental injuries, and 300 battle casualties. The average monthly addition to the invalids awaiting evacuation to New Zealand by hospital ship was judged to be 120, of whom 90 would be sick and 30 battle casualties.

Table VI, invalids evacuated to New Zealand, 1940–45, indicates the conditions for which soldiers were incapacitated for further service overseas. Nervous diseases and the group of bone, joint, and muscle diseases were the causes of most invaliding, while respiratory, digestive, and skin diseases contributed sizeable totals. It should be noted that most of these conditions were not peculiar to the particular theatre of service, but could have applied to any force, even in New Zealand itself. The New Zealand force in the Pacific had the same experience. For instance, tropical diseases as such were not the cause of very much invaliding to New Zealand, but conditions overseas, such as the heat and dust in the deserts of North Africa, caused conditions to 'flare up' whereas they might have remained quiescent in New Zealand in the troops concerned.

(From 1 NZEF in France major causes of invaliding to New Zealand apart from war wounds (Table VII) were nervous diseases, tuberculosis, respiratory disease, diseases of the circulatory system, impairment of the organs of locomotion, diseases of the eye, ears and nose, diseases of the digestive system, and effects of gas. Evacuations for skin disease were notably few.)

MORTALITY

Mortality

As regards deaths from disease the record of 2 NZEF was a good one, aided by spectacular advances in medicine. There were only 190 deaths in 2 NZEF from 1939 to 1945, as against 1579 in 1 NZEF from 1914 to 1918 (Table VIII). It has to be noted that 1 NZEF had an average strength nearly half as great again (in round figures 40,000 as against 30,000), but its period was 4 years 2 months against nearly six years. The most notable reductions were in deaths from pneumonia, influenza, tuberculosis, typhoid, dysentery, and malaria. Most of the deaths in 2 NZEF could have occurred normally in a civilian population, except a handful of deaths from dysentery (8), typhus (6), infective hepatitis (6), and malaria (2). The death rate is almost exactly equal to that for deaths from natural causes for the RNZAF in New Zealand—100 deaths for a force of average strength of approximately 16,500—and very similar to the rate for the army in New Zealand. The average age of the forces in New Zealand was probably somewhat older.

In the group of 8000 who were prisoners of war, most of them for nearly four years, there were 105 deaths from disease (Table IX). Doubtless there would have been more deaths but for the good work of Allied medical officers in captivity and the steady arrival of Red Cross parcels.

DOWN-GRADINGS

Down-gradings

Other wastage occurred with troops who had to be downgraded, although many did useful work as graded men. The causes for down-grading at 31 December 1944 (Table X) show that functional nervous disorders, pes planus, and hallux valgus predominated (a large proportion of the foot disabilities was mainly psychoneurotic in origin). Battle wounds and accidental injuries caused a number of down-gradings, but many of these were only temporary. Debility and various diseases of bones, joints, and muscles came in the next large group. Each month a number of men who had further deteriorated in condition were boarded for return to New Zealand. Their places in the ranks of graded men were usually more than filled by new down-gradings, so that the number of graded men was a steadily mounting total. Thus the number in 1944 is larger than it was in the earlier years of the war, although the causes of down-grading varied little.

2 NZEF (IP)

2 NZEF (IP)

In the Pacific Force (2 NZEF IP) the causes of admissions to medical units were very similar to those present in the Middle East. Table XIA for the year June 1943 to July 1944 shows skin diseases as easily the most frequent cause, followed by septic sores, malaria, dengue, tonsillitis, dysentery, diarrhoea, PUO, influenza, and nervous diseases. There were very few cases of infective hepatitis, pneumonia, and venereal disease. As in the Middle East, the malaria figures were kept low by a carefully planned campaign by the medical services. Deaths from disease numbered only sixteen.

Invalidings to New Zealand arose principally as a result of neurosis, skin disease, asthma, and diseases of the joints (Table XIB). In down-gradings for base duties these conditions were also prominent, as were diseases of the ear, and pes planus and pes cavus.

ACCIDENTAL INJURIES

Accidental Injuries

In 2 NZEF, MEF and CMF, deaths from accidental injuries (314) totalled more than deaths from disease (190).

The Statistical Report on the Health of the (British) Army states that deaths from injuries in the Middle East Force in 1943 were only two-fifths of the deaths from disease. The explanation of the difference in proportion is probably that accidental injuries were higher in the New Zealand Force because of the high degree of mobility of 2 NZ Division, and the deaths from disease in 2 NZEF may also have been at a lower rate than for the British Army as a whole.

In 2 NZEF (IP) there were 16 deaths from disease, but 34 from accidental injuries, including 4 from burns.

WAR DISABLEMENT PENSIONS

War Disablement Pensions

War disablement pensions granted up to 31 March 1950 are shown in Table XII. The statistics apply to all three services. The number of servicemen demobilised from overseas service up to 31 March 1951 was 145,054, and from home service 66,734, and the pensions granted at least temporarily to these groups were 43,087 and 10,551 respectively. It will be noted that service within New Zealand alone gave rise to nearly one-fifth of the pensions. The generous outlook as regards pension administration means that some pensions have been paid for pre-enlistment disabilities not detected at the enlistment of recruits, and to some extent explains why nervous disabilities constitute the most numerous group.

Some claims for pensions were coming in seven years after the end of the war, but their numbers were more than offset by the steady reduction in the number of temporary pensions paid. At 31 March 1950 the temporary pensions for Second World War service were 13,011, and the permanent pensions 10,065. Over 76 per cent of all the pensions were assessed at less than 40 per cent disability. Unfortunately, details of the disabilities of these groups are not available. It is of interest to note that 13,585 permanent pensions and 230 temporary pensions were being paid at 31 March 1950 for ex-servicemen of the First World War, and that 49 per cent of these were assessed at less than 40 per cent disability.

Table I
2 NZEF, MEF AND CMF
Morbidity: Admissions to Medical Units for Disease July 1941 to December 1945

Disease	No. of Cases, July 1941 to December 1945	Percentage of all Sick Admissions
Dysentery	5846	7.29
Diarrhoea	3926	4.90
Infective hepatitis	7051	8.79
PUO	2848	3.55
Malaria	2065	2.57
Pneumonia	2594	3.22

Bronchitis	1417	1.77
Influenza	1305	1.65
Common cold	1036	1.29
Sandfly fever	1053	1.31
Anxiety neurosis	1696	2.11
Nervous and physical exhaustion	1013	1.26
Otitis media and externa	1959	2.44
Sinusitis	1330	1.66
Tonsillitis—catarrhal	1519	1.89
follicular	1756	2.19
Venereal disease	4477	5.58
Skin diseases	4774	5.95
IAT	5903	7.36
Scabies	1450	1.81
Fibrositis	1188	1.48
	——	——
	56206	70.07
Total sick admissions	80215	

Wastage is related to duration of stay, and figures for the British Army MEF in 1943, for Hospital and Convalescent Depot combined, were (in days): Dysentery, 17; infective hepatitis, 40; PUO, 11.8; malaria, 24.4; pneumonia, 42.2; bronchitis, 24.6; common cold, 10.2; sandfly fever, 10.6; psychiatric disorders, 36; otitis media and externa, 24.5; tonsillitis, 14.3; venereal disease, 19.2; dermatitis, 32; boils and carbuncles, 24.3; scabies, 10.5; rheumatic conditions, 24.3.

Average: 24.7 days.

Table II

Infectious Diseases, 2 NZEF and 2 AIF Compared

	1940				1941				1942		
—-	Admissions		Rate/1000		Admissions		Rate/1000		Admissions		Rat
	Aust	NZ	Aust	NZ	Aust	NZ	Aust	NZ	Aust	NZ	
Dysentery	298	399	21	45	2561	1136	34	40	1330	935	
Malaria	131	73	9	8	2312	323	30	11	932	728	
Venereal disease	502	448	36	50	3704	745	48	26	1964	654	
Average	Aust		NZ		Aust		NZ		Aust		NZ

strengths for year	14258	8875	76440	28308	41594

Table III

2 NZEF, MEF AND CMF

Morbidity: Admissions to Medical Units, 1943-45

	1943	1944	1945
Injuries—battle casualties	2681	4209	1384
accidental	3440	3738	2668
self-inflicted	5	2	2
Hepatitis and catarrhal jaundice	545	2990	647
Dysentery	1673	875	628
Malaria	452	292	197
Pneumonia	516	750	363
Pleurisy	142	123	91
Influenza	285	333	143
Typhoid fever	145	34	9
Paratyphoid fever	5	2	
Smallpox	2	3	
Typhus	10		
Poliomyelitis	8	3	6
Tuberculosis	23	15	9
Cerebrospinal meningitis	2	14	6
Mumps	6	11	13
Measles	23	11	6
Diphtheria	66	73	167
Chickenpox	19	11	21
Sandfly fever	358	144	27
Diarrhoea	973	1297	691
Anxiety neurosis	471	658	176
Mental cases	188	275	146
Nervous and physical exhaustion	329	558	114
Nervous	314	344	278
Eye	231	347	223
Otitis media	553	380	230
Otitis externa	139	210	118
Ear, other	56	89	65

Nose	540	508	306
Respiratory	167	211	176
Asthma and bronchitis	437	557	223
Circulation	210	194	130
Blood and blood-forming	103	100	78
Glands	93	119	102
Breast	3	16	4
Teeth and gums	125	209	241
Digestive	2768	3155	2707
Nutrition and metabolism	16	12	6
Bones, joints, muscles, etc.	961	1201	558
Areolar	1314	1862	1363
Skin	1174	1328	1236
Erysipelas	8	5	
Infection and infestation	2133	3353	3484
Generative—venereal	373	1361	3075
non-venereal	447	415	952
Urinary	302	271	213
Other causes	792	836	961
	25626	33504	24243
Average strength of 2 NZEF	31554	32538	26557

In the Statistical Report on the Health of the British Army, issued by War Office, it is reported that in Italy in 1944 the mean duration of stay in hospital and convalescent depot was slightly less than 3½ weeks for disease, 4 weeks for accidental injuries, and nearly 7 weeks for battle casualties. A much higher proportion of the last-mentioned went to convalescent depot than of either of the other two classes.

In the table above most of the cases in 1943 were from the Middle East and most of those for 1944 and 1945 from Italy.

Table IV
2 NZ Division
Cases Admitted to Medical Units, Italy

	18 Nov 1943 to 17 Nov 1944	18 Nov 1944 to 30 Sep 1945

Dysentery	272	53	
Diarrhoea	750	234	
Infective hepatitis	1924	494	
Malaria	60	47	
NYD fever	2039	949	
Respiratory	439	175	
Pneumonia	32	38	
ENT	892	797	
Scabies	228	847	
Pediculosis	186	356	
VD	1028	1428	
Physical exhaustion	603	160	
Accidental injuries	1933	1507	
Other diseases	86	50	(estimated)
	——	——	
	10472	7135	
Discharged to unit from Field Ambulances	3740	2500	(estimated)
	——	——	
	14212	9635	
Battle casualties	4833	2441	(war ended May 1945)
	——	——	
	19045	12076	
	——	——	
Average strength of Division	20,500	18,000	(approx)

The number of first attendances at RAPs (incl BCs) averaged 4405 for the months December 1944 to September 1945. With BCs excluded the average was 4205 per month.

Table VA
2 NZEF, MEF AND CMF
Average Daily Sickness Rate (Fresh Cases) per 1000 per Month

	1941		1942		1943		1944		1945	
	Offrs	ORs	Offrs	ORs	Offrs	ORs	Offrs	ORs	Offrs	ORs
Jan			1.35	1.35	1.1	1.3	1.28	1.29	1.89	2.2
Feb			1.56	1.53	1.1	1.3	2.1	2.08.	1.73	2.05

Mar			0.75	0.92	1.5	1.49	2.2	2.2	1.69	2.13
Apr			0.98	1.53	1.96	2.35	1.4	1.35	2.07	3.25
May			1.37	1.39	1.5	1.49	2.2	2.2	1.69	2.13
Jun			1.5	2.2	1.9	1.95	1.46	1.73	1.87	2.79
Jul					1.87	2.43	2.2	2.04	1.79	2.24
Aug	2.4	2.03			1.84	2.09	1.96	2.17	2.05	2.41
Sep	1.9	1.6	2.2	2.2	1.46	1.95	2.33	2.55		
Oct	2.0	2.2	3.62	3.57	0.84	1.12	2.74	3.16		
Nov	1.9	2.0	2.2	2.3	1.09	1.19	2.84	2.84		
Dec	1.4	1.4	1.9	1.76	1.85	1.85	1.94	2.94		

Table VB

Percentage of 2 NZEF, MEF and CMF in Medical Units at End of Each Month

	1942		1943		1944		1945		
	Sick & BC	Sick	Sick & BC	Sick	Sick & BC	Sick	Sick & BC	Sick	
Jan			5.62	4.4	5.89	4.55	7.36	5.91	
					9.60	5.82	3.28	3.28	Egypt
Feb			5.52	4.86	7.77	6.13	5.77	4.67	
					7.17	4.01	2.7	2.7	Egypt
Mar			6.61	4.74	9.05	5.74	5.78	5.0	
					4.67	3.21	4.2	4.2	Egypt
Apr			7.97	4.98	7.71	5.46	9.18	4.77	
					4.7	2.97	5.1	5.1	
May	5.45		5.88	4.02	7.49	5.79	4.69	3.43	
					3.93	3.73	5.3	5.3	Egypt
Jun	6.57	6.32	5.25	4.43	5.96	5.08	4.38	3.58	
					3.26	3.16	4.48	4.48	Egypt
Jul	12.03	7.83	5.26	5.03	8.25	5.98	3.04	2.97	
					3.08	3.08			Egypt
Aug		13.48	8.49	4.47	4.39	7.69	5.64	3.56	3.52
					3.79	3.79			Egypt
Sep	12.3	9.1	4.59	4.54	10.62	7.84	4.67	4.64	
					3.8	3.8			Egypt
Oct	13.02	11.2	3.97	3.93	9.96	7.84	4.44	4.43	
					4.94	4.94			Egypt
Nov	13.41	8.96	3.29	3.14	9.81	8.38	3.79	3.77	

				4.3	4.3			Egypt
Dec	9.32	6.84	6.00	3.74	9.75	6.98	5.03	4.97
				5.4	5.4			Egypt

In 1944 and 1945 the first figures for each month refer to Italy only.

The only two large epidemics (those of infective hepatitis) are reflected in the high figures for autumn 1942 and autumn 1944.

Table Vc 2 NZEF MEF Bed States Base Medical Units

	All Hospitals	Convalescent Depot and Rest Homes
1 May 1942	1386	256
1 Jun	1357	479
1 Jul	2674	822
1 Aug	2434	1500
1 Sep	2784	1283
1 Oct	2637	974
1 Nov	2904	1179
1 Dec	2773	1051
1 Jan 1943	2067	688
1 Feb	1964	524
1 Mar	1655	359
1 Apr	1635	280
Average over twelve months	2189.2	782.9

An estimate in May 1945 gave the average number held in all base medical units at any one time as 2100. Of these, it was estimated that 1500 would be sick, 300 accidental injuries, and 300 battle casualties. The average monthly addition of invalids for evacuation to New Zealand by hospital ship was judged to be 120, of whom 90 would be sick and 30 battle casualties.

Table VI
2 NZEF 1940–45
Invalids Evacuated to New Zealand
Sickness And Accidental Injuries
(See also Table VI A)—

Respiratory disease	747
Infectious disease	366

Nervous disease	1927
Digestive disease	412
Ear disease	274
Eye disease	255
Nose disease	74
Circulatory	217
Blood and glands	65
Metabolic	35
Malignant	25
Debility	172
Skin	321
Genito-urinary	208
Hernia	36
Bones, joints, and muscles	908
	6042
Accidental injuries	767

Average strength of 2 NZEF, 30,000 (approx.).

Table VI A
Invalids (Sick) Evacuated to New Zealand from 2 NZEF, MEF and CMF, 1940–45

INFECTIOUS DISEASE—	
Infective hepatitis	124
Dysentery	86
Rheumatic fever	51
Poliomyelitis	30
Typhoid fever	17
Malaria	16
Venereal disease	12
Other	30
	366
RESPIRATORY DISEASE—	
Asthma	239
Bronchitis	173
Pleurisy	117

Tuberculosis	127
Pneumonia	27
Other	64
	747
NERVOUS—	
Anxiety neurosis	692
Nervous exhaustion	163
Schizophrenia	84
Psychopathic personality	72
Depression	94
Other	822
	1927
DIGESTIVE—	
Duodenal ulcer	163
Dyspepsia	83
Gastric and peptic ulcer	51
Other	115
	412
EAR DISEASE—	
Otitis media	190
Other	84
	274
EYE DISEASE	255
NASAL DISEASE	74
CIRCULATORY DISEASE	217
BLOOD AND GLANDS	65
METABOLIC	35
MALIGNANT DISEASE	25
DEBILITY	172
SKIN DISEASE—	
Eczema	171
Dermatitis	72
Other	78

	321
GENITO-URINARY	208
HERNIA	36
BONES, JOINTS, AND MUSCLES—	
Arthritis	196
Osteo-arthritis	112
Fibrositis	106
Pes planus and cavus	70
Sciatica	37
Other	387
	908
Total	6042

Table VII
1 NZEF: Evacuations to New Zealand and Discharges in United Kingdom, May 1916 to December 1918

SICKNESS AND ACCIDENTAL INJURIES—	
Tubercle of the lung	960
Other tuberculous disease	125
Venereal	81
Carriers	12
Other general diseases	1753
Mental	175
Nervous system and shell shock	1370
Eye, ear, and nose	1012
Circulatory system	1713
CPDI (pulmonary, indeterminate)	283
Other respiratory diseases	1293
Digestive system	719
Urogenital system and suprarenals	448
Organs of locomotion	1874
Skin	26
Effects of gas	567
Other general injuries and trench foot	80

Local injuries	1092
Tubercle of lung and amputation of leg	3
CPDI and amputation of leg	1
	13587

Table VIII
Deaths from Disease

	2 NZEF, MEF and CMF, 1940–45	1 NZEF, 1914–12 Nov 1918 (Carbery)
Meningitis—		
Pneumococcal	14	
Follg otitis media	5	
Meningococcal	2	109
Other	8	6
Heart—		
Heart failure	7	51
Myocarditis	6	
Other	5	
Pneumonia, lobar	14	578
Appendicitis and peritonitis	15	40
Generalised infection—		
Septicaemia	8	7
Other	4	15
Haemorrhage—		
Cerebral	8	5
Other	2	6
Acute abdominal conditions	8	14
Dysentery—		
Bacillary	7	81
Amoebic	1	
Poliomyelitis	8	
Typhoid fever	8	126
Neoplasms	8	17
Infective hepatitis	6	10
Nephritis	6	30
Typhus fever	6	

Anaemia	6	4
Diphtheria	4	9
Tuberculosis	4	149
Duodenal ulcer	3	2
PUO	2	5
Malaria	2	61
Influenza	152	
Others	13	102
	190	1579

Table IX
2 NZEF Prisoners of War.
Deaths from Sickness

Pneumonia	12
Dysentery	12
Meningitis	8
Heart	6
Neoplasms	5
Tuberculosis, pulmonary	4
Diphtheria	4
Toxaemia	4
Nephritis	3
Peritonitis	3
Enterocolitis	3
Malaria	2
Cachexy	2
Other	25
Unknown	12
	105

Table X
2 NZEF, MEF AND CMF
Graded Personnel at 31 December 1944

	Grade			
	B	C	D	To
Officers—CMF	7	37	7	51

MEF	2	13	16	31
Other ranks—CMF	105	787	301	1193
MEF	76	451	287	814
	190	1288	611	2089

Analysis by Disabilities

Nervous diseases, functional	751
Injuries—	
Battle casualties	236
Accidental	147
Pes planus, hallux valgus, etc.	178
Debility	90
Arthritis, etc.	64
Deafness	60
Eye	59
Hernia	56
Knee disorders	53
Other diseases bone and muscle	49
Fibrositis	43
Skin	40
Otitis media and externa	39
Mental dullness	32
Respiratory	27
Nervous diseases, organic	25
Gastro-intestinal disorders	23
Cardio-vascular	15
Rheumatism	14
Asthma	13
Congenital defects	10
Varicose veins	9
Tumours and cysts	9
Sinusitis	8
Hepatitis	7
Other	32
	2089

Table XI A

Table [illegible]

2 NZEF IP

Admissions to Medical Units, June 1943–July, 1944

DISEASE—	
Skin disease	1930
Malaria	398
Dengue	372
Septic sore	547
Infected tonsils	331
Dysentery	281
Diarrhoea	213
PUO	241
Influenza	238
Nervous	233
Peptic conditions	210
Gasstro-enteritis	207
Appendicitis	186
Ankylostomiasis	166
Mental	160
Eye	108
Sinusitis	97
Asthma	90
Otitis media	79
Infective hepatitis	85
Gonorrhoea	44
Pneumonia	19
TB pulmonary	8
Diphtheria	5
	6248
INJURIES—	
Wonded	189
Accidental injuries	1291
Burns	206
Hernia	81

Table XI B
2 NZEF IP
Medical Boradings to 31 May 1944

Disability	For Return to NZ	For Base Duties
Skin disease	115	250
Mental—neurosis	167	208
Mental—general	63	59
Accidental injuries	88	176
Battle casualties	32	15
Joints—diseases of	69	131
Digestive system	42	71
Asthma	85	48
Ear	27	120
Eye	12	56
Arthritis	44	68
Fibrositis	18	51
Physical exhaustion	23	50
Respiratory	32	21
Nose	17	35
Throat		8
Genito-urinary	30	30
Pes planus and cavus	13	103
Surgical history	14	29
Headaches	15	48
Varicose veins	4	23
Hernia	4	18
Malaria	3	
Circulatory system	34	48
Miscellaneous	50	138
	1001	1804

Some 60 officers are not included in the total of those graded for base duties. Some of those graded for base duties were probably reboarded later for return to New Zealand.

Table XII
War Disablement Pensions Granted to Ex-servicemen of Second World War up to 31

March 1950

Class of Disability or Disease	Overseas	Area of Service Japan	New Zealand	Total
Infections and infestations	1869	9	112	1990
Nervous system	9589	10	1646	11245
Ear, eye, and nose	6418	15	1317	7750
Circulatory and blood system	1925	1	985	2911
Metabolism and endocrine system	380	1	172	553
Lungs	3203	47	1077	4327
Diseases of bones, joints, muscles	5003	4	1807	6814
Digestive system	3825	7	1128	4960
Generative system	316		119	435
Gunshot wounds and accidental injuries to bones, joints, and soft tissues	5997	23	1183	7203 *
Skin	2329	10	519	2858
Tumours and neoplastic growths	149		48	197
Malformations	300		131	431
Amputations	471		18	489
Urinary tract	525	2	135	662
Debility	442		109	551
	42741	129	10506	53376

The total disablement pensions in force at 31 March 1950 for servicemen of the Second World War was 23,076, of whom 10,065 were classified as permanent and 13,011 as temporary.

The percentage of disability of these cases was:

Percentage of Disability	Permanent	Temporary	Total
100	510	946	1456
90–99	53	14	67
80–89	218	92	310
70–79	322	231	553
60–69	260	255	515
50–59	650	578	1228
40–49	606	595	1201

30–39	1135	1198	2333
20–29	3249	3739	6988
10–19	3033	5360	8393
Under 10	29	3	32
	10065	13011	23076

It has not been possible to obtain an analysis of the disabilities for which pensions were still being granted at this date.

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Editor-in-Chief	Sir Howard K. Kippenberger, kbe, cb, dso, ed
Medical Editor	T. D. M. Stout, cbe, dso, ed
Associate Editor	M. C. Fairbrother, dso, obe, ed
Sub-Editor	W. A. Glue
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Draughtsman	L. D. McCormick

the author: Colonel Stout was educated at Wellington College and at Guys Hospital, London. He served overseas for the whole period of the 1914–18 War, first in the Samoan Advance Force and then in Egypt, Salonika, France, and England. He was attached to 1 NZ Stationary Hospital and was seconded with a New Zealand surgical team to British casualty clearing stations during the battles of the Somme and Vimy. He was later Surgical Divisional Officer at 1 NZ General Hospital at Brockenhurst and acted as Consultant Surgeon 1 NZEF at the later stages of the war. He was awarded the DSO and OBE and mentioned in despatches. After the war he was attached as Surgical Consultant to the Trentham Military Hospital and later acted as surgical examiner for the Pensions Department throughout the inter-war period.

Proceeding overseas with the Second Echelon in May 1940, he served with 2 NZEF in England, Egypt, Greece, North Africa and Italy, first as Surgical Divisional Officer 1 NZ General Hospital and, from May 1941 till October 1945, as Consultant Surgeon 2 NZEF. He was awarded the CBE and mentioned in despatches.

In civil life Colonel Stout held the position of Senior Surgeon to the Wellington Hospital from 1920 till 1945, since when he has been an honorary Consultant Surgeon to the hospital. For many years he was a University lecturer in surgery and also an examiner in surgery to the University of New Zealand. He has played an active part in the British Medical Association and has held the position of President and Chairman of Council of the New Zealand Branch. He was also for many years on the New Zealand Committee of the Royal Australasian College of Surgeons. He has been associated with the University of New Zealand as a Member of Senate and also as a member and chairman of the Victoria College Council and as a member of the Massey College Council.

GLOSSARY

Glossary

AA & QMG A/Q	Assistant Adjutant and Quartermaster-General
AAMC	Australian Army Medical Corps
A & D	Admission and Discharge
ADH	Assistant Director of Hygiene
ADMS	Assistant Director of Medical Services
ADS	Advanced Dressing Station
A (Farauti)	Anopheles (mosquito)
AI	Accidental Injury
AIF	Australian Imperial Force
AL 63	Anti-louse powder with derris and naphthalene
AMCU	Anti-malaria Control Unit
AMD	Army Medical Department
AMGOT	Allied Military Government of Occupied Territory
APT	Artificial Pneumothorax
ASC	Army Service Corps
ATS	Anti-tetanus Serum
BC	Battle Casualty
BCC	Bacillus Coli Communis
BCOF	British Commonwealth Occupation Force
BID	Brought in Dead
BIPP	Bismuth Iodine Paraffin Paste
BNA	British North Africa
BP	Blood Pressure
BT	Benign Tertian (malaria)
BTE	British Troops in Egypt
CCS	Casualty Clearing Station
CMF	Central Mediterranean Force
CNS	Central Nervous System
CO	Commanding Officer
DADH	Deputy Assistant Director of Hygiene
DADMS	Deputy Assistant Director of Medical Services

DAH	Disordered Action of the Heart
DAPM	Deputy Assistant Provost Marshal
DDMS	Deputy Director of Medical Services
DDP	Deputy Director of Pathology
DDT	Dichlor-Diphenyl-Trichlorethane
DGMS	Director-General of Medical Services
DI	Dangerously I11
DMS	Director of Medical Services
ENT	Ear, Nose, and Throat
EPIP	European Privates, Indian Pattern (tent)
FB	Foreign Body
FDS	Field Dressing Station
FGCM	Field General Court Martial
FSU	Field Surgical Unit
FTU	Field Transfusion Unit
GHQ	General Headquarters
GOC	General Officer Commanding
GSW	Gunshot Wound
HP	High Pressure
HQ	Headquarters
IAT	Inflammation Areolar Tissue
L of C	Line of Communication
MAC	Motor Ambulance Column (Convoy)
MDS	Main Dressing Station
MEF	Middle East Force
MO	Medical Officer
MRC	Medical Research Council
MSU	Mobile Surgical Unit
MT	Malignant Tertian (malaria)
NAAFI	Navy, Army, and Air Force Institutes
NAB	Nov-Arseno-Benzol
NCO	Non-commissioned Officer
NL	Nipple Line
NYD (N)	Not Yet Diagnosed (Nervous)
NZEF	New Zealand Expeditionary Force
NZEF (IP)	New Zealand Expeditionary Force (in Pacific)
NZGH	New Zealand General Hospital

NZMC	New Zealand Medical Corps
OC	Officer Commanding
OCTU	Officer Cadet Training Unit
ORA	Operation Room Assistant
ORs	Other Ranks
PA	Preventive Ablution
PR	Pulse Rate
PUO	Pyrexia of Unknown Origin
P(vivax, etc.)	Plasmodium (malaria parasite)
PW	Prisoner of War
QM	Quartermaster
RAMC	Royal Army Medical Corps
RAP	Regimental Aid Post
RIH	Right Inguinal Hernia
RMO	Regimental Medical Officer
RNZAF	Royal New Zealand Air Force
RNZN	Royal New Zealand Navy
SI	Seriously Ill
SMO	Senior Medical Officer
SMR	Submucous Resection
Stalag	Prison Camp, Other Ranks (in Germany)
SW	Shell Wound
TAB	Typhoid, Paratyphoid A and B (vaccine)
TB	Tuberculosis
VB	Voluntary Boarder
VD	Venereal Disease
VDTC	Venereal Disease Treatment Centre
WAAC	Women's Army Auxiliary Corps
WE	War Establishment
WO	Warrant Officer

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