

CHAPTER 12

IN AUSTRALIA 1943-45

THE beginning of the period 1943-45 proved later to be a turning point in the Allied fortunes in the Pacific War, though this was not apparent at the time. Part of the military population of Australia was directly concerned in operations, though not sundered by so great a distance from the mainland as in the earlier episodes of the Middle East. Occasional periods of leave lessened their isolation from home, and to a less extent, periods of rehabilitation and training, usually on the Atherton Tableland in North Queensland. Militia troops were more concerned in these experiences as time passed, especially after 19th February 1943, when the Australian Government passed a bill empowering the sending of the militia anywhere in the South-West Pacific Area. An order was promulgated also that any militia unit which included three-quarters of volunteers in its ranks could make application for acceptance as an A.I.F. unit.

To these classes of what may be called "fighting troops" must be added the large numbers used for purposes of defence. Many troops were retained for this purpose, in one instance at least, consisting of specialists such as the Armoured Force, which were substantially reduced during this period, as there seemed no likelihood of their being used overseas, excepting to a limited extent in the island campaigns. The centre of gravity of defence was more obviously to the north of Australia, and a considerable body of troops was maintained in the Northern Territory, known as Northern Territory Force. This force had special problems and difficulties, some being medical in nature: these will be dealt with later.

Other factors were of increasing importance, chiefly those related to tropical disease, which was causing at least a 7 per cent wastage of troops actively engaged in hyperendemic areas. As the areas held in New Guinea and other islands increased in size and strategic importance, the task of the Australian Army became more and more centred there, and reduction of troops in other areas became necessary. The maintenance of twelve divisions in a population then not exceeding seven millions became too great a task without risking attenuation of the force. New Guinea needed three divisions, with three more in reserve, and the rest of a force comprising in all nine infantry divisions.

The strain of service requirements on the medical personnel both in and out of the Services was somewhat lifted by these adjustments. The effect of war on the life of civilians varied to some extent in different areas. The proximity of military formations had some influence on this, and it is curious that during war a degree of antagonism may be detected between the Services and civilians. It is perhaps akin to the well-known combination of admiration and hostility seen in families. The relations of doctors in practice and that section of the public needing medical attention occasionally showed strain too. Civilian doctors were reduced in number,

they carried more than their usual burdens and in addition, the extra burden of age, for the ageing medical man came back to help. The remaining practitioners were invariably engaged in part-time work connected with the war, and they had difficulty in obtaining necessary drugs and appliances for use in practice. Hospitals suffered similar disabilities, and their buildings often housed Australian or Allied medical service units. It was fortunate that adequate steps had been taken even before the outbreak of war to coordinate the work of the medical profession and its ancillaries. This work had gone on steadily during the first half of the war years, as has been recounted in the previous volume.

COORDINATION IN 1943-45

In 1943 Colonel Sir Alan Newton resigned from the position of Deputy Chairman of the Central Medical Coordination Committee and Lieut-Colonel W. G. D. Upjohn was appointed in his place. The retiring Deputy Chairman thenceforth was able to devote more time to the exceedingly pressing problems of medical equipment; he left behind him an efficiently running organisation, whose momentum and experience would be of high value in overcoming difficulties ahead. These were mainly concerned with the chief duty of the C.M.C.C., the maintenance of balance between civil and service medical requirements. At one end of the chain were the universities, charged with the education of medical practitioners under stringencies of reduced staff and facilities. At the other end were the vital needs of the armed forces, whose demands were not always predictable. Between were the over-worked civil practitioners, and the anxious, strained civilians, with an undue proportion of older people, already beset with growing difficulties in everyday living.

Some degree of control was exercised over the university medical courses. A quota system was controlled by the Commonwealth Government, intending applicants being required to intimate their intention before leaving school. No call was made on intending medical students until it was decided whether they would be included in a quota, the selection for which was made purely on academic qualifications. No preference was given to Australians over aliens. Students failing to gain inclusion in the quota automatically came under control of the manpower authorities. In 1944 the army agreed to discharge soldiers to commence or continue medical courses, if approved by the Director-General of Manpower and the Universities Commission. The B.M.A. Federal Council pointed out in 1945 that these conditions discriminated against soldiers who through ability had attained rank over that of corporal. The conditions were later made less restrictive.

In 1944 the medical manpower position was reviewed: the total number of civilian doctors was then, in June, 4,166; in 1943 it had been 4,032. The manpower director and the Universities Commission wished to know how many medical men would be released and how many called up over given periods in 1944 and 1945. The position did not warrant the release of one medical officer for every practitioner recruited. A statement was

issued by the Medical Directors of the Services setting out the reasons why medical officers could not then be spared from the Services; this statement was published in *The Medical Journal of Australia*. It pointed out that, in order to avoid wastage of doctors, the establishments for medical units and formations were not filled, and the army and the air force were considerably below strength. The wastage rate of medical officers in the Services, which was considerable, was hardly equalled by the intake. In spite of the lessened threat to the Australian mainland, the numbers of Australian forces committed in active operational areas was greater than ever, and the very nature of these areas involved a high sickness rate. In the navy, doctors serving at sea must perforce be distributed among ships of various types and no simple ratio of medical officers to men was practicable. Emergencies showed that even the medical staffs carried were barely adequate. Considering that the medical services of the armed forces looked after about one-eighth of the total population of Australia, and were of necessity so strategically placed that full attention to men under emergency conditions could always be available at short notice, the numbers so employed were far from excessive. In addition, preventive medicine, itself a great sparer of human wastage, absorbed a considerable number of doctors. Steps had been taken to detail medical officers in Australia to relieve civil practitioners in need of rest, and, in 1943, 162 medical officers, 125 on full-time duty, had been released from the army. In the air force similar steps were being taken. In issuing this statement the Service Medical Directors emphasised their awareness of the medical problems affecting civilians, and their active cooperation in measures which would help to solve them. Relief was given to civilian doctors in all parts of Australia from time to time by assigning a service medical officer to the duties of a private practice. The numbers available were not great, and the time of relief was usually short, but the results were good. The service medical officers made no financial gain; the usual fee for a *locum tenens* was paid into general funds, while the relieving doctor welcomed the opportunity of a brief period of professional value to all parties, and felt the benefit of making contacts of very different kind to those of service medicine.

In inaccessible areas occasional visits were made by medical officers by air to patients unable to travel. At Alice Springs a service hospital, the 109th A.G.H., carried out all varieties of medical and surgical work, including obstetric care, using the civilian midwifery block. During 1943, fifteen such cases were attended in three months. Help was also given in the central areas in the flying doctor practice, and arrangements were made for army medical officers to examine aliens working under the Allied Works Council in Central Australia. Evacuees were also given medical care by service personnel and when malarial suspects passed through from the occupied islands to the north they were given necessary observation.

These activities dislocated civil administration to some extent in respect of medical services, but agreement was reached that the army would assume responsibility for treatment of civil cases in the whole Northern Territory while military occupation continued there. Some difficulties

arose. For example, at Brunette Downs there were complaints, as the civilians wanted an improved service. The administrator wanted a regular patrol of doctors through certain areas, but only a restricted service was possible in view of the scattered population and the great distances.

Civilians could also obtain special types of treatment, such as facio-maxillary and plastic surgery, if approval was given by the Adjutant-General and the D.D.M.S. of the Northern Territory Force. No full-time medical officer charged or received a fee, but indemnity against the claim was signed by the patient. It was agreed that reversion to ordinary civil control would be made as soon as this was practicable. Manpower shortages prevented the Commonwealth Department of Health from taking it over until the end of the war.

Even in urban populations there were regional shortages of doctors. In the Illawarra district in N.S.W. for a time during 1943 the ratio of doctors to patients fell to 1 in 5,000 and in Bankstown to 1 in 8,000. (By comparison the ratio rose early in 1947 to 1 in 1,000.)

At June 1943 the number of army medical officers on the Order of Battle was 2,082; that on the active list was 1,464. By effecting savings in various ways 33 per cent was thus saved on the Order of Battle. In October the same year the war establishment of medical officers was 1,932, and only 1,565 were on full-time duty, 43 of these being about to be released. When the end of the academic year came the position was expected to be further relieved.

It was evident that many questions were being asked about the number of doctors in the Services. These questions came not only from the public: explanations were required by the Department of the Army in October 1943. General Burston on this occasion pointed out that a comparison of percentages of medical officers in the armed Services at war and in a civil community served no useful purpose. The ratio of the former to the latter was inevitably higher. It is true, of course, that numbers of medical officers complained of times when they had little to do. Usually, however, men of resource could find useful tasks, even though these did not fall within their usual duties. At times, when for example units were waiting movements, delays were unavoidable.

An important step was taken in 1943 which helped the ideal of equalisation of effort and sacrifice. Medical officers over forty years of age were circularised in order to ascertain who were willing to return to civil practice. No promise was implicit in this circular, but when permission was given by the forces, the way was made easier for the coordination committees to replace the senior men by recent graduates. During the previous two years most of these young men had been taken into the Services, and as a very large number of the medical men remaining in civil practice were over fifty years of age, and many considerably over it, the strain was increasingly felt. On the other hand, there were medical men in the Services over forty who were not qualified as specialists, nor fitted for promotion in the Services to carry out work of special type. As some form of priority had to be considered in carrying out this plan,

those medical officers who had served in a theatre of active operations would be considered first, otherwise those with longest service were given preference.

As time went on this plan worked very well. Criticisms were occasionally heard, some from members of other arms of the service, who were inclined to forget the claims of health in the civilians at home, and others from doctors themselves, who were occasionally inclined to take umbrage at a suggestion which was meant to benefit the community. The Services' Medical Directors prepared a statement showing the Defence Committee the manpower position of the medical officers and nurses with regard to releases and intakes during the period 1st June 1944 to 30th June 1945. The posted strength of medical officers in September 1944 was 1,410, as against 1,565 a year earlier, and during the stated period 241 doctors were released and only 116 enlisted. This was made possible by the lessened number of units employed in an operational role in 1943.

However, the period 1944-45 was expected to see a greater number of troops engaged in operations in tropical areas than at any time during the preceding war years. Even allowing for an expected reduction in casualties from malaria, this might be offset by inroads by other diseases, and reductions in units on the Order of Battle could not safely be entertained. At home, the care of repatriation patients had been accepted, and an elaborate mechanism was growing up for this national duty, and first-rate hospitals were being built; and the care of civilians and natives in certain areas was also likely to increase medical work. Therefore the following figures were presented by the D.G.M.S. of the Army:

	Medical Officers	A.A.N.S.
War Establishment as at 30th September 1944 . . .	1,620	3,333
Posted strength as at 30th September 1944 . . .	1,410	2,631

These considerable deficiencies, 210 medical officers and 702 nurses, and the expected numbers of 800 medical officers and 1,200 nurses overseas, with a probable heavy wastage rate, left only the depleted units on the mainland as a source of reinforcements. Burston warned that these strengths must be maintained, particularly those of nurses if the work was to be carried out properly. In August 1943, the committee approved of the principle of granting exemption from portion of the training required of nurses for registration, by women who had undergone that training provided by military hospitals.

During 1943 a severe outbreak of typhoid fever occurred on the outskirts of Melbourne and nurses from the army and air forces were made available for this work in the civilian community.

In July 1944 the Director of Manpower made enquiries concerning the easing of the position with nurses for civilian work. In reply the D.G.M.S. of the Army stated that during the past twelve months there had been 2,706 members of the A.A.N.S.; 294 had been discharged and 24 called up. During the same period 2,500 were added to the pool of trainees. He pointed out further, that in disciplined services considerable saving could be effected, as the nurses could be moved about to meet varying needs.

Similar concern was also felt about pharmacists at the close of 1944, and a survey was ordered to discover qualified pharmacists in the A.M.F. who were employed in other capacities, and who could be more usefully employed in civil life.

The C.M.C.C. was very active during this period 1943-45 in expediting the return of officers to civilian activities. In 1944, however, it was noticeable that a saving in medical officers was accomplished chiefly by reduction of war establishments by means which have been previously described. Posted strengths of medical officers were not kept up at a perfectly even rate, however, as enlistments were mainly of young graduates who had a year's experience in hospitals. The method adopted in 1944 was as follows. Most graduates were available during the March-July period, this being the time of graduation, and even with staggering of the intake of these officers over a period of three months, the result was that at July 1944 almost every young medical officer available was already enlisted, and no more would come forward till March 1945. Therefore wastages would reduce the posted strength of medical officers, for not more than twenty accessions were expected before March 1945, and losses from casualties and age would probably be fifty.

However, the course of events was favourable in 1945. The success of preventive medical measures in Borneo lessened the possible wastage by illness there, and the comparatively small resistance encountered, and the successes in other island fronts enabled the Australian forces to discharge their commitments without undue strain on the medical services. The accelerated pressure on Japan finally brought hostilities to a close in August 1945 and the position was entirely altered.

In July 1945 the need for lifting wartime controls became a subject of practical importance, and the C.M.C.C., following an enquiry from the Prime Minister to the Minister of Health, appointed a sub-committee to consider the methods by which the coordination controls could best be removed. The report submitted traversed the work that had been done, and considered the possible repercussions from relaxation of controls. The committee advised that no immediate relaxation of controls was possible. The needs of the Services were considerable, and large numbers of medical officers were required in routine service work and in the base hospitals. The possibility of evoking the powers of direction of the Emergency Medical Practitioners Service had also to be considered, and it was not thought wise to relinquish these at an early stage. Controls of dentists, pharmacists, and nurses under manpower authorities were also involved, and the Universities Commission still had responsibilities to medical students. After demobilisation the rights of ex-servicemen had to be preserved, and therefore some limitation of students, so far as this was possible, was desirable. Further consideration of demobilisation and its medical aspects must be left till that subject is considered. The relaxation of controls was effected gradually, so as to avoid the confusion of too speedy a release, always with the ideal in view that undue control should be abandoned as soon as it was wise and possible. By the end of 1945 the

Medical Advisory Committee, which had given counsel to the manpower authority on scientific matters, was disbanded. The Central Medical Coordination Committee came to an end on 8th April 1946.

Some of the work done during the war by the Coordination Committees and other organisations concerned in these national activities may be here recapitulated. The chief tasks to be performed were (a) the provision and distribution of medical personnel to the armed forces of the Commonwealth and the civil population and (b) the provision of hospital accommodation, equipment and staff to meet any emergency arising out of the war. In carrying out these tasks the balance was fairly held between the parties concerned. Both armed Services and civil community had their champions on all the committees; this was a good thing. Careful consideration was given to the withdrawal of doctors from the civil community, but as no surplus of doctors existed before the war, and as from one-quarter to one-third of all fit doctors were needed in the Services, no more than an equitable adjustment could be achieved. As pointed out above, medical officers taken from the civil pool decreased in number as time went on, dropping from 2,007 at 21st November 1943 to 1,885 at 31st May 1945.

The acceleration of graduation of medical students was a useful measure, though imposing strain on the teaching schools. The graduates for the years 1934-39 numbered 1,098 and those for 1940-45, 1,740. It was actually possible to release more doctors from the Services in the last two years than were enlisted. This resulted in an increase in the number of doctors available for civil practice: 4,085 at 30th June 1943, 4,353 at 30th June 1944, and 4,550 at 31st March 1945. Fortunately the Emergency Medical Practitioners scheme was not called on to do more than have an adequate organisation ready and waiting for any crisis, and only in a few instances was it necessary to direct members of this service to practise in localities other than their normal place. The measure of extending legal registration beyond its usual restricted State bounds was valuable in conferring greater elasticity on these arrangements, and was essential to ensure medical attention to civilians from service medical officers where no civil doctor was available.

The Standing Committee of Service Directors, established in 1940, gave invaluable service. It was an advisory and consultative body; all its reports were forwarded to the Minister for Defence Coordination through that department's secretary. It was in fact the adviser of the Minister on the coordination of the administration and organisation of the medical services of the armed forces, and on the maintenance of a limited and consistent policy, so that actions of these services should be based on a common ground. The committee further had the duty of investigating and reporting on questions of medical policy affecting more than one service, or requiring concerted action which had been referred to the committee by the Department of Defence Coordination or by any of the service departments. An important duty of the committee was that of bringing to the notice of the Minister of Defence Coordination any significant matter affecting the medical services. The chairman of the com-

mittee was the Director-General of Medical Services of the Army, and other original members were the Director of Naval Services and the Director-General of the Air Force. The executive officer of the Central Medical Coordination Committee and the Deputy Chairman of the Medical Equipment Control Committee were coopted to the committee. Prompt diffusion of the Minister's decisions was secured by communications from the Secretary of the Defence Department, not only to the committee, but also to the Departments of the Navy, the Army and the Air. In its monthly meetings a very wide range of subjects was covered. As Burston, in describing its work, has said,¹

Its activities covered any and every interest of the medical departments of the Services: personnel, hospital provision and maintenance, medical equipment, transport by air, land and sea of sick and wounded, hygiene, malaria control and the control of venereal diseases; in fact, anything to do with the health and physical welfare of members of the Services, prisoners of war and civilian communities coming under military authority or control.

Sometimes the problems discussed concerned allied medical services, then medical officers of these services were coopted. The committee also obtained authority from the C.M.C.C. to detail medical officers to act as *locum tenentes* for doctors in civil practice who were unable through illness or other important cause to carry on practice. The same service was extended to hospital medical officers. In anticipation of the cessation of hostilities, the Medical Service Directors' Committee had devised and developed the medical arrangements for demobilisation, with the assistance of the Principal Medical Officers of the Repatriation Commission. The experience hitherto gained in coordination of medical work bore fruit amply in this final important contribution of the medical services; it was truly an inter-service organisation which was smooth and efficient in design and operation.

FINAL COMMENTS ON MEDICAL COORDINATION

The history of the organisations called into being for the realisation of the great aim of medical coordination shows that the aims and powers of the central committee were somewhat whittled down from the original suggestions. However, the process of adjustment produced a very satisfactory organisation which delegated duties and powers in an efficient and orderly fashion, and fulfilled the purposes for which it had been created. It lacked one necessary power, independent executive action. Had the medical profession not been so cooperative control would have been more difficult. Though conscripted early, as pointed out before, and by its own desire, the medical profession has the satisfaction of knowing that its members voluntarily allowed themselves to be conscripted a year before the Government proclamation enacted the conditions they desired for their better service.

Further applications of coordination of medical services in time of war might be made with advantage. These can hardly be dealt with here, but

¹ *The Medical Journal of Australia*, 9th July 1949.

certain deficiencies in an otherwise broad and comprehensive plan may be mentioned. The lack of executive power has been referred to above. Inter-service coordination of establishment to requirements was sometimes not so complete as it should have been. Particularly was this so in hospital resources, and a closer combination of these in base areas and perhaps lines of communication areas might have been advantageous. The common use of consultants and specialists in service hospitals would seem to be advisable in the cause of economy. Other aspects might be mentioned such as complete cooperation between services in satisfying the medical requirements for enlistment, and in securing equal justice for medical officers of all services in demobilisation.

These are but indications of subjects which might be discussed with advantage. After the distinguished service rendered by this organisation it is a matter for regret that when the work of the committee terminated in 1946 it was not at once replaced by a body to examine the possibilities for the future.

EQUIPMENT CONTROL IN 1943-45

PROPRIETARY MEDICINES

Before dealing with the general work of the Medical Equipment Control Committee during the later years of the war, reference may be made to a semi-political subject which has been touched on earlier, and which gave rise to much discussion, that of proprietary medicines. Actually the matter first arose in 1942, but it was not settled till well into 1943. Proprietary medicinal preparations are those sold under a trade mark; there are two types, the ethical and the unethical. The composition of ethical proprietaries is known; they appear in official pharmacopoeias under official names, but are marketed under trade names. They are advertised only to the medical profession. Unethical proprietaries are known more commonly as patent medicines; their composition is not divulged, and they are widely advertised to the public, and thereby gain and maintain a market. Ethical preparations include most of the drugs which we owe to modern pharmacological research, and they have had a great influence in advancing scientific medicine. Their makers usually sell only their own products. In recommending to the Division of Import Procurement the importation of these preparations, the M.E.C.C. was securing a supply of such drugs as sulphathiazole, pentothal sodium, pentnucleotide, anahaemin, sodium amytal, nembutal, decicain, pitocin and many others which were essential for adequate treatment of important conditions. Substitutes were obtained for some of these by importation of alternatives or by manufacture.

The committee was not interested in non-ethical medicines except those which contained important drugs and over which control could be exercised. Early in 1942 the Department of War Organisation of Industry undertook a survey of the field of proprietary medicines, with a view of limiting production and saving manpower.

A member of the department was coopted to the M.E.C.C. at this time, but it was evident that the points of view differed. "Rationalisation"

of this industry was desired by the department, but the committee held that methods successful with such lines as textiles would not be appropriate for drugs. An approach to the drug firms by the chairman produced a list of preparations which they suggested might be no longer manufactured, but little saving was expected thereby, since the drugs listed were in little demand. The chairman drew up a report on all aspects of the subject, covering the methods by which saving might be effected. A special sub-committee held several meetings; these and negotiations with the department did not reveal a solution of the problem, so a submission was made to the Minister for Health and Social Services, whose department was interested in patent medicines. Finally after much discussion and advice from the Director-General of Health, the Production Executive of the Government, to which the question was referred, gave a ruling restricting production of medicines considered by the Department of Health useless for their advertised purposes, and limiting the use of salesmen and advertising. Though a committee representing all the interested departments and the M.E.C.C. was commissioned to make further enquiries, this decision placed control in the hands of the Department of Health. Considerable dissatisfaction was felt by the wholesale drug firms, but regulations giving effect to this ruling after approval of parties concerned were drawn up and gazetted on 20th October 1942.

Mutual Agreement Reached

Meanwhile a sub-committee (Dr J. H. L. Cumpston, Sir Alan Newton, Lieut-Colonel C. W. Ross and Dr B. L. Stanton) began consideration of the formulae of proprietary medicines. The Director-General of Health had obtained specimens of most of these preparations with their formulae from their manufacturers or distributors. Some difficulties became apparent. It was doubtful if restrictive conditions covering all forms of packaging and advertising should apply to drugs; the quantities of essential drugs were found to be very small in many extensively advertised preparations, and their production required very limited manpower. On 5th March, however, the regulations were tabled in the House of Representatives, challenged and disallowed, owing, it was suggested, to intensive "lobbying". It was now evident that no extensive rationalisation could be accomplished by the Department of War Organisation of Industry. Previously more than one adviser had pointed out that attempts to control these products had not been satisfactory or successful in other countries. A mutual agreement was now made. The department undertook to divert salesmen to more essential work, and to limit unnecessary transport of non-essential medicines. The M.E.C.C. agreed to restrict proprietaries on sale at canteens, which was done by limiting purchases, and to continue its strict policy of limiting use of essential drugs. When price control was introduced in 1943, the question of subsidy was raised in some instances, but it appeared that increased costs of proprietaries could usually be borne by the manufacturers, and little recourse was made to subsidies during the duration of the war.

METHODS OF CONTROL

During 1943, after four years of work, the Medical Equipment Control Committee still pursued the same general plan which had proved successful. The main features of this were, as before, encouragement of importation, fostering local manufacture, control and coordination of consumer demand, rationing of supplies, control of exports, avoidance of waste, recording the stock position, consolidation of demands by the Services, and application of general and wartime restrictions to the industries concerned in medical equipment. To this list must be added a number of routine activities concerned with the application of special material or skilled labour to specific tasks, or advising in matters of difficulty of supply or production and many other daily problems solved by the chairman or the chief executive.

Where questions arose concerning action in matters which involved scientific decisions, the committee referred these to the appropriate Scientific Advisory Panel, and thence to the Scientific Advisory Liaison Bureau. Information was then sought by the bureau from laboratories and universities able to give practical help, and the advisory panel was thus able to make a well based recommendation to the committee.

Importation, as previously told, had become more complex in some ways, since the introduction of lend-lease, and in 1943 a mission was despatched from Australia to the United Kingdom and America under the direction of the Division of Import Procurement. It consisted of Mr B. Egan, representing the division, and Lieut-Colonel Ross representing the equipment directorate of the Army Medical Department. At the same time Lieut-Colonel J. A. Doull was sent to Australia and New Zealand from the lend-lease administration in the United States of America to report on medical equipment. Doull reported very favourably on the Australian organisation, and recommended that the local views concerning the essential nature of certain supplies be accepted. The mission did work in the United States which greatly helped in the provision of medical material essential for the war effort in Australia. The results of these personal missions were evident in the prompt arrival of goods from the United States, and in the agreement of the British Ministry of Supply to export to Australia large additional amounts of necessary items. A further practical result was that the requisitions for 1944 could be somewhat reduced. Lend-lease administration was also simplified by the co-ordination of the overall requirements for the British Empire, the allotting of supplies to Britain and the Dominions being arranged by the missions in Washington. Naturally difficulties and delays in obtaining rail and shipping space were encountered, but there was now good prospect of shortening the delivery times. It will be seen that from now onwards an important function of the M.E.C.C. would be the compilation of advance estimates of medical requirements, having regard to its availability through the trade, by importation or manufacture, or from the United Kingdom. Emergency supplies were occasionally obtained from the United States under license through government cash purchase. By this time

practically all drugs and similar material were under control, and the term "essential" was interpreted very strictly. For example, in many instances only one drug of a group having similar action was included in the list.

MANUFACTURE OF DRUGS AND INSTRUMENTS

Manufacture of drugs was expanding. One noteworthy effort was the production of sulphaguanidine. In 1943 the importance of this drug as a specific for dysentery had been established by its dramatic use in the first Papuan campaign, and the local output of sulphanilamide was diverted to make sulphaguanidine, and it was possible to satisfy all service needs and in addition to allow fifty pounds per week to meet civil needs.

Research by Professor A. K. MacBeth also made possible the commercial production of sulphamerazine. This drug had given promising experimental results in malaria in the United States and was, in addition, a potent and useful member of the sulphonamide family. For security reasons it was called "A.S.", and a pilot plant was soon producing twenty-five pounds a week. Full production was expected in a few weeks after the end of the year 1943, when a special factory was completed. It was planned to take the place of other sulphonamides in Australia and in the armed forces, quite apart from other possible advances. The difficulties in such large-scale productions were smoothed by the cooperation of all departments and persons concerned. Occasionally problems were solved in unexpected ways: thus Colonel J. E. Down, the Dental Equipment Officer of the committee, dealt with minute flaws in some enamel vessels by inserting gold dental fillings.

Vitamin products were examined also for local manufacture. Only vitamins *A* and *C* (ascorbic acid) could be made in Australia, but adequate supplies of vitamin *A* were produced from livers of snapper and sharks, and vitamin *C* was made by the Colonial Sugar Refining Company. Wheat germ containing vitamin *B* was produced in good quantity. Important work was carried out on some antiseptics. Dr. A. Albert's work on the acridines enabled him to evolve methods for producing proflavine, of which there was an exportable surplus, and new members of the series, such as 5-amino acridine. Mercurial diuretics and antiseptics were also made, and in addition, dextrose and phenolphthalein. The introduction of dimethyl phthalate as an insect repellent made its manufacture necessary: this was accomplished through the efforts of Ross, with assistance of the Surgical Instruments Panel and the Department of Munitions.

Certain vegetable drugs were now being produced in useful quantities. During 1943, both hyoscine and atropine were produced in quantities sufficient for an exportable surplus. Further planned research on this and other drugs was proceeding. Homatropine was now also made from *duboisia*, and morphine from Australian-grown opium poppies. The C.S.I.R.² arranged for planting enough poppies for a large yield of

² C.S.I.R.O. (Commonwealth Scientific and Industrial Research Organisation) was at this time known by its original name, C.S.I.R. (Council for Scientific and Industrial Research).

morphine sulphate during the next year. A method of extracting morphia direct from poppy hay was devised by a commercial firm which, with government assistance, was prepared to manufacture it without profit. Ergot was being produced in Victoria under subsidy, and all local requirements for *digitalis* could now be met from locally grown foxglove.

Manufacture of surgical instruments was proceeding satisfactorily. The manpower authorities helped by securing skilled workmen, and by allowing firms to declare "a protected undertaking" and to train young operatives. The Department of Munitions supplied machine tools and metals, and standardisation of instruments lightened the task. By 1943, 200,000 drop-forgings had been successfully produced by the Newport workshops of the Victorian Railways. The making of hypodermic syringes was simplified by the production of suitable glass tubing, and the discovery of a skilled craftsman with European experience in the work. Unfortunately fire destroyed the factory, but this setback was overcome, and, by the end of 1943, production, which had risen to 850 syringes a week, seemed likely to attain the same figure again. Enough stocks of rubber were now held to meet requirements for two years. Adhesive strapping was still controlled, as both rubber and cloth backing were scarce. A gelatine company produced a special glue, which, when painted over cotton bandages, was effective for certain purposes.

Dental, radiological and laboratory equipment was increased in amount, but there were still shortages, particularly in imported items. Essential dental requirements were still greatly in demand, largely owing to the higher standards of dental fitness demanded by the Services than that common in the civil community. Numbers of X-ray items were still imported, such as tubes and rectifying valves. Microscopes were very scarce, but a supply was obtained through lend-lease. Optical material was very scarce, including spectacle lenses, but the optical industry, developed in conjunction with munitions requirements, was expanding and production of lens blanks was expected soon. It should be mentioned that anticipation of demand played an important part in production of special material. For example, the synthesis of sulphaguanidine began in 1941, long before the acute need arose in New Guinea, and similarly, ascorbic acid, in demand for supplementing the diet of troops was made in 1940. The timely purchase of two tons of agar from Japan, the sole pre-war source of supply, just before the extension of war to the East, was also a fortunate move. For future bacteriological needs local production of agar was fostered by the M.E.C.C. and the C.S.I.R.

PENICILLIN PRODUCTION IN AUSTRALIA

A significant step was taken when the decision was made to produce penicillin in Australia. The Chairman of the M.E.C.C. took the first steps, and discussed production with the D.G.M.S. and his staff. Very limited amounts were being produced in England and America, but representations were made to General Blamey, following which the Minister for

the Army authorised the despatch of two army officers to America to study technical methods. After consultation with Major-General Burston and Professor E. Ashby, Chief Scientific Liaison Officer, Sir Alan Newton approached the Institute for Medical and Veterinary Research in Adelaide, where some research had been carried out on moulds analogous to *Penicillium*. The original plan was that it should be undertaken in Adelaide, but Dr Cumpston, Director-General of Health, was strongly in favour of production being carried out in the Commonwealth Serum Laboratories in Melbourne. This was agreed and production was expected after the expiry of a year.

In October 1943 Captain P. L. Bazeley and Lieutenant H. H. Kretchmar went to the United States of America, where full cooperation was given by the firms and laboratories there engaged in production. The great difficulties of manufacture had been largely overcome by that time, and several alternative processes were in use, producing an increasing yield of penicillin. After six weeks of intensive investigation these officers selected the most valuable features of the current methods, and through the help of the Australian Military Mission in Washington obtained top priority from the United States Government for the necessary equipment.

The delegation arrived back in Australia early in December 1943 and, with the energetic help of the Director of the Commonwealth Serum Laboratories, began work at once on the installation. Measures for obtaining glassware had already been taken, and temporary buildings were erected and equipment designed and manufactured. The scientific and technical staffs were soon trained in the intricacies of production of a pure and potent penicillin, and large amounts were actually being produced within six weeks. All departments and industrial firms concerned responded to the need for speed, with the gratifying result that Australia was the first country to make enough penicillin to satisfy all service requirements, and to provide for the needs of the civil community. Local supplies were available to the army in March 1944, and in May the same year to civilians. The credit was chiefly due to the team led by Bazeley, which studied production methods in the United States of America, and to the staff of the Commonwealth Serum Laboratories. The earliest preparations used were the sodium salt, and the "crude" and "refined" varieties of the calcium salt. A good deal of extemporisation was necessary, and, though the facilities at the Laboratories were quite adequate, the project was housed in modest basement quarters. The product was most satisfactory and gave excellent clinical results.

At the end of July 1944 arrangements were made for Sir Howard Florey to visit Australia. Blamey made a strong recommendation to the Prime Minister that Florey be invited to come and this was done. Florey gave lectures in all large centres and visited units in the field. This visit was most stimulating and helpful, and did much to further knowledge of antibiotic therapy in the Services and the civil medical profession.

The production of vitamin A oils from sharks' livers has been mentioned: it attained importance in the last years of the war, as Australia

could then meet all local demands and in addition, export large quantities for the enrichment of margarine in Burma. The establishment of numbers of factories for the manufacture of medical supplies created a demand for machinery used in commercial processes. Machines for tableting, mixing and filling containers and ampoules for pharmaceutical processes had to be supplied.

The total expansion of production in the trades concerned in medical equipment was estimated to exceed by 60 per cent that which occurred in the year before the war. In addition to these larger projects, many small articles were successfully made in "one-man factories". From the large ventures of mass production and the wide sweep of lend-lease and other importation, to the growing of drug producing plants and the small-scale output of workshops and laboratories, the machine ran smoothly in the later war years.

A little more may be said about exports. New Zealand was a special case. In a less favourable position than Australia, and without having taken early action to build up reserves, this Dominion looked to Australia for some assistance. After an appeal by the New Zealand Director-General of Health in July 1942, the Chairman of the M.E.C.C. agreed to do everything possible to help, provided an official assurance was given that supplies were urgently needed, and that the position in Australia warranted action. The committee regarded all British possessions in the Pacific as dependent upon Australia for essential medical supplies, and such supplies were allocated to these people without restriction, except when the material desired was rationed to Australian civilians. The committee took no direct part in exportation through official channels, but was always consulted before tenders were issued. Similarly, medical equipment was only transferred to the forces of the Allied nations with the committee's concurrence. Much valuable biological material, such as sera and vaccines was exported from the Commonwealth Serum Laboratories to other countries, and contributed greatly to the Allied war effort in the Pacific, but this needed no control by the committee, as the aims of the two bodies were so completely in harmony.

Though the post-war activities of the equipment control committee do not fall within the time range of this history, a word may be said about the work done in disposal of stores after the war. Newton resigned as chairman on 30th October 1945. Ross succeeded him, and continued the work of the committee till 30th September 1946, when he was followed in office by Lieut-Colonel K. B. Brown. The committee's activities came to an end on 31st December 1946. Many problems remained after the war. The days of shortages had not gone. Some drastic action was necessary at times to control supplies of essential therapeutic agents, such as insulin and penicillin. Huge accumulations of equipment and supplies now became surplus stock, which needed disposal, if possible on favourable terms, without embarrassing local trade or production. This colossal task was carried out successfully, and before the end of September 1946 £1,500,000 was recovered by surplus disposals.

This set the seal on the work of the Medical Equipment Control Committee. A worthy offspring of the Central Medical Coordination Committee, it made a contribution to the Australian war effort equally remarkable for its scope and efficiency as for its economy of personnel. Heavy strain fell upon the executive officers, particularly on Newton, whose ability and personality carried the work through many difficulties and anxieties.

DRUG-PRODUCING PLANTS

During the years 1943-45 further work was carried out by the C.S.I.R. on drug-producing plants; the earlier stages of these investigations have been described in Volume II, Chapters 3 and 20.

Cinchona. Seed of cinchona had been planted in New Guinea, and in 1943 the surviving trees were pruned and assayed. Professor F. H. Shaw found that the yield of the plant was 1 per cent, but that of the root and stem was 1.5 per cent. Some selected seed was obtained from an American, Lieut-Colonel Fischer, who brought some with him when he escaped from Luzon in the Philippines. The C.S.I.R. raised seedlings in Australia, to obviate losses in New Guinea, and obtained good germination. In January 1944 these were transferred to New Guinea and looked after by an expert from the Netherlands East Indies. Some plants did not survive, but though a conference of experts recommended the further cultivation of trees in New Guinea and Papua, and in Australia, in particular the Atherton Tableland, by 1945 no other definite action had been taken. Much work was done on methods of raising, planting and extracting the cinchona, *C. robusta* and *ledgeriana* being found the best, and the possibility of producing *totaquina* was explored, but by the end of the war no definite contribution to wartime needs had been made.

Ergot of Rye. Mention has been made previously of preliminary work by C.S.I.R. on the production of ergot of rye, and cultures of *Claviceps purpurea* had been inoculated in a rye crop of 200 acres in N.S.W. in 1940. The quality of the yield was good, with an alkaloid content of 0.3 to 0.4 per cent, well over the minimum British Pharmacopoeia standard of 0.2 per cent. A great deal of technical information was gleaned, and in spite of weather problems and the need for development of harvesting methods other than hand picking, ergot from this source was sold. In 1944 the Department of Supply suggested guarantee of a price, but the M.E.C.C. now found the clinical position changed. Spain and Portugal, chief sources of pre-war supply, had re-entered the field, and ergot was falling into disuse, as modern hormone therapy had largely supplanted it. Therefore no further Australian effort was warranted.

Pyrethrum. Past attempts to grow pyrethrum had been successful, but little interest was shown by growers, as the costs of harvesting were too high. In 1939 further trials were made, and two years later seed was distributed to farmers for planting. Supplies were short in 1942 and the Division of Plant Industry of C.S.I.R. was asked about growing pyrethrum and harvesting it with the help of the Women's Land Army Organisation. A trial at Armidale was unsuccessful, and as immediate action was needed

to produce a crop in 1944, the Adjutant-General ordered seed from Kenya. Further trials produced very meagre results, and Dr B. T. Dickson and Dr C. Barnard of the C.S.I.R. were consulted. Tests of Kenya seed showed only 1 per cent germination, and experimental plots were disappointing in 1943. The pyrethrin content of flowers was low, but 2,000 pounds was harvested at the end of 1944. Useful work was carried out on methods of increasing pyrethrin content, but in 1945 further planting was given up because of the availability of D.D.T. and stocks of pyrethrum from Kenya.

Opium. In September 1939, medical, scientific and industrial representatives conferred on essential drugs, chief of which was opium. The Plant Industry Division of the C.S.I.R. was asked to investigate the position concerning cultivation of *Papaver somniferum* and other plants, and collected samples for analysis in university departments in Sydney and Melbourne. Opium came chiefly from the Balkans, but India started production again and began to supply the Allies. Australian supplies were very short and until the position eased, only three months' stock was held in Australia. To fulfil demands by cultivation it was necessary for 450 acres of poppies to be grown each year. One serious difficulty lay in the prohibitive cost in Australia of incising and draining latex from the capsules; some less primitive method was needed. During 1940 and 1941 seeds of *P. somniferum* from India, England and France were grown, and efforts were made to extract alkaloids from poppy juice, not from opium. Felton, Grimwade and Duerdins Ltd made a pilot plant for extraction by an improved method from the poppies grown on Mr W. R. Grimwade's farm and at the C.S.I.R.'s experimental areas. Reasonable yields were obtained, but methods of assay of raw poppy were receiving close attention by Mr H. Finnemore of Sydney University, as there was some reason to doubt the accuracy of some assays. Trial showed reasonable yields. In the year 1941-42 an area of about 75 acres was sown, much below the desired figure of 500 acres, which was disappointing, since morphine stocks had been reduced by one-half during the year. Unfortunately too, there were inordinate delays in obtaining approval for these trials, which were also set back by destruction of some of the crop by frost. However, by 1942-43 the Equipment Control Committee had a stock of one and a half to two years' supply of morphine and the position was less pressing; still, growers were encouraged, and 97 acres were planted. Attempts were made to extract from the straw, but these were not a success, quite apart from the drawback that the straw carried much less morphine than the capsules. Plans were made for a factory for the extraction of morphine, and assay showed that no loss of morphine occurred in material awaiting processing, which at the end of the year totalled 31,380 pounds. The next year poppies were grown in internment camps at Hay and Loveday, but crops were decreased by bad weather and pests, and the delayed factory, now not to be ready till the end of 1943, was only expected to produce 2,260 ounces of morphine. In 1944 a yield of 3,000 ounces was in sight, and the factory was producing

twenty ounces per ton of the whole plant. Two disappointments were encountered; most of the 1943-44 crop was found to be worthless, and the colorometric method of analysis hitherto used was found untrustworthy by Finnemore. Further dry weather caused poor yields in 1944-45, and in 1945 these arrangements for producing morphine were discontinued as uneconomic, although work went on after the end of the war under the same supervision.

These rather frustrate attempts show how many pitfalls await the optimist in this field. Probably only the scientific advisers and the commercial producers realised how much experimental background work is necessary, in order to overcome the difficulties in agriculture, extraction and analysis before a finished product is available.

FOOD AND CATERING

Questions relating to the feeding of the soldier are organisational problems which concern not only the Quartermaster-General's Department, but the other departments which have the responsibility of organising training and work in both peace and war. The medical services are concerned from the advisory point of view. The Director of Hygiene acted as the adviser of the Quartermaster-General in matters concerned with nutrition, and civilian caterers were also available for technical advice. In 1939 Lieut-Colonel C. H. Kellaway, Director of Hygiene, referred some problems in practical nutrition to Sir Stanton Hicks, Professor of Physiology and Pharmacology in the University of Adelaide, through the A.D.M.S. of the 4th Military District. Advice on subjects related to nutrition could be obtained from other sources in different commands; this varied in nature and influence, but in general the Australian Army procedure corresponded with that of the British Army.

Ration Scales. There were two peace rations, that of the Permanent Military Forces and that of the militia camps. The latter could be commuted to money value by permission of the Military Board, and expended locally to what seemed the best advantage, but Stanton Hicks in his experience regarded the result as very unsatisfactory in the feeding value of food so supplied. He was called up by his own desire with temporary rank of lieutenant, and, in addition to acting as an adviser in food and catering, began to press for the formation of an Australian Army Catering Corps.

When the Second A.I.F. came into being, the force was fed in the same unsatisfactory way as the militia in days of peace. The only personnel trained in the preparation and presentation of food were those produced by the army schools, under the aegis of the supply and transport service. Command training schools were not satisfactory, and did not remove from cooks the low degree of esteem which was, often unjustly, their portion. The system was reinforced by the engagement of civilian cooks at a raised rate of pay.

There were really several factors involved; the nutritional aspect, the correct utilisation of food without waste, and without loss of savour, in

itself a potent source of waste; the feeding habits of the people themselves from whom the volunteer forces were derived, and the need of technicians and technical advisers. It was to supply these needs that Hicks advocated the formation of a catering corps. Within this corps there would be, not units as such, except cooking schools, but specialist officers holding appointments, inspectors of catering at Army Headquarters, advisers at certain formation headquarters, instructors at cooking schools, and warrant officer caterers in major units.

A draft General Routine Order was circulated during 1943 from Hicks, who was then elevated to the rank of lieutenant-colonel and held the appointment of Chief Inspector of Army Catering and later that of Director of Army Catering. On 12th March 1943, G.R.O. 209 was promulgated approving the establishment of an Australian Army Catering Corps. This brief summary omits reference to the administrative difficulties and objections which had to be overcome, but it was then possible for the A.A.C.C. to come into being as an offshoot of the Supply Services of the Quartermaster-General's Branch. The Director of Catering circularised all officers of the corps and pointed out that the ideals of the organisation were those of prevention of waste of food, with all its strain on national reserves, and of physical efficiency of the fighting forces.

It was not so easy to carry out these ideals. When war was declared against Japan, the Australian Army was divided into two forces in most essentials of organisation. In its catering arrangements the A.I.F. in the Middle East was doing its best with its unchanged War Establishment to train men as cooks for its own requirements, while the fully mobilised A.M.F. in Australia had only half its establishment for cooks. Another important matter taken up by the Director of Army Catering was the adoption of improved methods of cooking. This led to the investigation and successful trial of the Wiles' steam cooker. The technical considerations here concern the volume on Science and Industry³ though the medical aspects are also very important. It is evident that a mobile cooker is in itself advantageous, but more important is the adoption of a method of cooking which does not cause spoiling or deterioration of the protective food factors, and which will preserve the flavour of food, thus minimising waste. The steam cooker was carefully tested at the School of Army Cookery at Geelong and proved to be efficient and economical.

Another matter which engaged attention was the preservation of accessory food factors in the dietary. Early in 1940 Hicks had introduced to the mainland ration the Tasmanian field pea, which, when partly germinated, was a source of ascorbic acid. Canned vegetables were found to be defective in this factor. A practical trial was carried out on a patrol force in the Kimberleys under Major G. D. Mitchell. The members obtained their ascorbic acid ration from this source without artificial supplement, and remained well and were free from skin lesions or other indisposition. A simple method of germination was evolved in which peas

* D. P. Mellor, *The Role of Science and Industry*.

were kept in a tin under water for twenty-four hours and then transferred to a muslin bag, the tin being scalded to prevent mould or bacterial contamination.

In medical units care was taken that catering corps personnel did not act as advisers on dietaries ordered by medical officers for patients, but the catering corps could act in an advisory capacity in matters of kitchen management.

As soon as the A.A.C.C. was formed, a liaison officer with the A.A.M.W.S. was appointed. This officer, Captain Alice Wunderly, attended to matters related to the feeding of women's services; as this involved the nursing service a useful contact was established with the feeding of ward patients. A diet supervisor was also introduced who was able to relieve the sister-in-charge of a ward of many feeding routines, but who acted under the direction of the sister. Further advances were made in the introduction of heated food trolleys in hospital wards and special stainless steel trays for receiving individual meals.

Major N. M. Gutteridge was appointed as medical liaison officer between the Medical Directorate and "Q" Branch, Nutrition. This ensured that the medical technical side was well served in questions of principle, and helped in raising the standard of knowledge of food and nutrition in all ranks.

During 1944 Hicks was temporarily released from his university and part-time army duties by consent of the Government, so that he might undertake a confidential mission to the United States of America in a civilian and scientific capacity. The Government felt that the experience of the Director of Army Catering would be of great assistance in discussing questions relating to food supplies to the Allied troops, particularly with regard to the full utilisation of food without waste. In the tropical zones this matter assumed great importance, since loss of essential food factors could reduce effectiveness of the fighting forces. Scientific catering had brought about economies with considerable success in the Australian forces, and it was hoped that Hicks could enlist the help of food scientists in the United States in the cause of food conservation. This mission could be best undertaken by a civilian scientist, as the subject concerned the scientific aspect of the national supplies of food for the whole community: it was carried out with success. Hicks' scientific colleagues in the United States of America were entirely in favour of uniting in an effort to minimise waste of food, particularly that transported to operational areas. In October the Australian Minister for the Army informed the Quartermaster-General that this mission had been very successful, and asked for full cooperation with the American authorities. The Australian Legation in Washington was informed that a high ranking officer was proceeding to South-West Pacific operational areas to investigate the reform of food utilisation in the American theatres of war. All information relating to the organisation of the Australian Army Catering Corps was freely available to the American authorities, and aroused great interest. Full cooperation was sought with the United States catering services then

in progress of formation, and was of course freely given by the Australian Army authorities in the United Kingdom and Canada.

The influence of the Australian Army Catering Corps undoubtedly spread widely, and the principles involved were important, as they ensured adequate energy for severe exertion, replacement of wear and tear, and sufficiency of protective food factors, with enough margin to allow for deficient ingestion or absorption. The A.M.F. ration was compiled to supply 4,500 Calories in a diet containing all essential food items. It was found that most persons consume roughly equal parts of fat and protein by dry weight, and if this ratio is disturbed the excess of either constituent is wasted. Though protein was not regarded as *per se* an important source of energy, its quantity was of necessity taken into account in computation.

The Operational Ration. This was introduced to supply the ration necessary for subsistence when the complete army ration could not be supplied because of military or physical conditions. An operational ration must fulfil certain requirements, and it is necessary that the soldiers understand these. Some of these conditions are as follows. All dietary elements must be present to satisfy hunger and the calls of nutrition, so as to present a balanced ration. It must withstand heat, and not deteriorate during storage. No cooking must be needed. Flavour must be maintained, e.g. there must be no rancid change in fat. Sterilisation must kill all eggs of moths or weevils. It must be in a container easy to open but strong enough to withstand air-dropping. Packs must be water-proof. Design must meet the current size and shape, and certain items can only be made by machinery. Enquiry proved that there was a general demand for sweet components of the ration, but it is curious that criticism of this feature was not uncommon in spite of the previously expressed desire of the troops.

"Operational Ration 02" (Table 5) was tried by the 7th and 9th Divisions with distinct success, but circumstances did not permit it to be tried in the field at the outset. The contents were divided into three separate meals each wrapped in a water-proof carton in one tin which could be opened with an attached opener. The calorific value was determined by analysis, and the vitamin content by standard physical and chemical methods.

Bread. Much attention was given to bread and baking. At the end of 1941 a decision was made to supply troops with "high extraction flour" with equal quantities of white flour added for baking. The object of investigation was to increase the vitamin *B1* content of flour. Close touch was kept with the work done in Canada in producing a high vitamin white flour. The subject is too technical for detailed treatment here, but is important, particularly as the question of wholemeal bread for civilians is involved.

An interesting experiment was carried out in starting field bakeries in the Ramu Valley. These were controlled and managed entirely by cooks, and the organisation was carried out by the Catering Corps. Warrant Officer A. T. Purdie described the set up of these bakeries. He found that

bread was on issue only once a week, and though it became mouldy at the end of the week the troops still ate it. Ovens were made from 44-gallon drums, and extemporisations were employed to provide trays and other utensils. One great difficulty was fuel, as most of this was water-logged, and all of it had to be dried, chiefly with the help of packing cases from the D.I.D. The brigade headquarters helped greatly and set natives to the task of supplying wood. In spite of difficulties, other and improved bakeries were set up and from three ovens built together 725 rolls were produced, 1,450 per two hours. Salt ration tablets were given to the men to counteract the effect of salt loss in sweat. The troops were now regarding the Catering Corps as of major importance, and the cooks realised the degree of help given them by the corps organisation, and the value of their own work.

A number of surveys were made of nutrition in troops, some while under training, others while engaged in operational areas. These enquiries were related to the rations available at the time of the survey, and in addition, information was obtained concerning nutritional planning and the food patterns characteristic of the troops for whom a correct, compatible and well-presented ration was essential.

Survey of the 7th Division. The nutritional surveys carried out on the 7th and 9th Divisions in New Guinea at the end of 1943 and the beginning of 1944 are of interest. They were carried out by Lieutenant H. E. Young in the capacity of a field research officer in nutrition attached to the Medical Directorate, Land Headquarters; the observations on which they were based were made during an inspection of divisional units by Lieutenant W. H. M. Schultze, catering adviser.

This inspection showed that some dehydrated vegetables (e.g. carrots and onions) were very satisfactory, but canned cabbage was unacceptable. Blue boiler peas were often eaten raw, though water difficulties occasionally gave trouble with germination. Bread was good, and after some explanation the correct addition of 6 per cent wheat germ to the flour was adopted. Both field bakeries and improved brigade bakeries produced good rolls and bread. Three rolls daily were issued to all men in forward units. Dried milk powder was preferred to condensed milk, which was chiefly useful in forward areas where the powder gave difficulty in preparation. Tea, sugar, fruit juices and salt were well supplied. There was a demand for chocolate fortified with vitamin *D*. Extra ascorbic acid was in restricted supply and was not a regular issue. The forward operational ration was extensively used by most brigades of experience, others coming up from the reserve were advised of the advantages it possessed, particularly in prevention of waste.

Cooking was found to present problems. In the Ramu Valley, for example, and at high altitudes, fuel wood was usually damp, and petrol was precious; all supplies had to be flown in, and at best could only be used to kindle the wood. Native carriage was scarce, though forward troops were still able to have two hot meals brought up from company kitchens by porters.

Egg powder and baking powder were much in demand. The "tropical spread" of the ration was not really popular: margarine was more desired. In certain localities green vegetables were obtainable, as in the Mount Hagen area, but only if air transport was available.

Survey of the 9th Division. The same difficulties were observed with powdered milk as with the 7th Divisional forward units. Tea and sugar were in free supply but serious wastage of tea took place through the breaking of plywood chests. Drums or tins were a preferable package, and should be within the weight convenient for a porter; sacks as a package were also found most unsuitable for transport of rice. The men found the blue boiler peas grew moulds, owing to the moisture. The same dislike of canned cabbage was noticed here too. Butter was popular with all troops, but was difficult to obtain except when the cold stores were near at hand. Cheese was also liked and full rations were consumed. Bread from the field bakery was good, preferably in the form of rolls. Biscuits were disliked. The staple food was "bully beef", but the 53-pound case was too heavy for a one-man load. Egg powder was more popular than previously, owing to the greater resource of the cooks, but herrings and salmon were disliked as much as ever. It was stated that cases were seen branded "Australian salmon, 4th Grade, for the use of troops". Fruit juice was ample in supply and much appreciated. The forward operational ration was most successful, and in emergency three men could subsist on three rations for two days. After a few days this ration was found to be too sweet. Fortified chocolate was very popular. Tests were carried out to ascertain the ascorbic acid content of various food items; no major variation was found from the normal values.

Milk was freely supplied, the most popular being unsweetened condensed milk. Many of the cans were blown on arrival at the bargeheads or units. The powdered milk was of very good quality, but mixing and subsequent distribution caused trouble. Dehydrated foods were good, and were most popular, except pears. As with some other items in the ration, the size of the can was too large for ready distribution in small units.

The meat and vegetable ration (M & V) was generally unpopular, and had the drawback that it was unpalatable when cold. It seemed to produce satiety readily, particularly for breakfast. Fresh meat was provided to all units where this was possible: in some instances distance of carriage was an adverse factor and wastage from deterioration occurred. "Canned heat" was supplied but in insufficient amounts; one to each two men was not enough.

The Director-General of Medical Services during 1944 had a series of nutrition bulletins prepared for distribution chiefly to hospitals, camp hospitals and convalescent depots. These covered methods of presentation of food in hospitals and all essential information concerning accessory food factors. The latter bulletins dealt with these substances from the point of view of modern nutritional teaching and examined the problems arising therefrom in the compiling of a service ration. The factors dealt with in these brochures were thiamin, ascorbic acid and calcium.

A special memorandum was also prepared in September 1944 for restricted distribution, dealing with the rationing of hospital patients. Less technical was a descriptive account of the nutrition of Australians in the tropics, and for the feeding of natives in New Guinea. This plan was based on six points (1) the study of food patterns, (2) analysis of the average food consumed, (3) average selection of foods, (4) experiments in trial feeding, (5) production and distribution and (6) training of the producers of food and its consumers.

Catering and Nutrition

The defects in Australian food patterns should be well known to those interested in nutrition. Analysis of this pattern in 2,000 Australian soldiers showed that the average adult Australian male had a daily intake of 3,300 Calories, with a ration of 90 grammes of protein. It was deficient in calcium, iron, vitamin *A*, thiamin, riboflavin and ascorbic acid when compared with standards of the National Health Council. The army dietary problem was to make good the deficiencies without sacrificing a good caloric ration, or a high intake of protein or without interfering too much with preference and taste. Sources of ascorbic acid presented a considerable problem, as it is lacking in many domestic diets. The germination method mentioned above was only successful where enthusiasm could be maintained and a certain degree of individual skill. Lucerne was also tried as a source but without practical success.

Canned vegetables had some successes, but some failures. The same applied to dehydrated vegetables, practically unknown to the preparers and consumers of food before the war. Peas, beans, carrots and parsnips, and to a less extent tomatoes were accepted reasonably well from tins. Dehydrated cabbage, carrot, and to some extent potatoes were not successful.

Refrigeration where practicable made many individual items readily accepted; both fruit and vegetables were most welcome when refrigerated. Fruit juices were more popular as Australian troops grew used to them, and contact with the American troops increased the amount used. Naturally they were more popular when chilled.

Canned beef still held its high esteem as a source of protein, provided that the temperature was low enough to keep the fat solid. It was rather curious that rice as a substitute for potatoes was unpopular; as in the case of bread, the white variety was more acceptable than the brown. Wheatmeal was similarly not liked, but in hot climates its keeping qualities were poor, weevils attacked it readily, and the gristers originally supplied for its fresh preparation in units were found useless. Legume flour was chiefly of use in pea soup.

Butter, as previously remarked, needed refrigeration to prevent it from becoming rancid. Dehydrated butter, known as "tropical spread" was, in the opinion of the men, inferior to margarine. This was not surprising, as the spread required reconstituting with salty water. When "concentrated butter" was introduced, which contained more salt and some milk powder,



Casualty being taken aboard a barge on the north coast of New Guinea for transport to a C.C.S. (Australian War Memorial)



The 111th C.C.S., Alexishafen. (Australian War Memorial)



(Australian War Memorial)

A wounded infantryman being lifted on to a bush stretcher in the Tsimba area, Bougainville.



(Australian War Memorial)

Surgeons working at an improvised operating theatre on Bougainville.

it was rather more successful, but still needed reconstitution.

The above detailed observations were not always easy to integrate in a form which could be translated into action. Gutteridge, as the Medical Liaison Officer to "Q" Branch, recommended the establishment of a nutrition service which would include in its ambit the design and production of a ration scale, the distribution of rations, and the education of all concerned with food. This is a question of organisation and cannot be dealt with here, but apart from any such large-scale redistribution of advisory and executive functions, it will surely be admitted that much hard work had been put into the question of feeding the soldier, and the directorates concerned cooperated with its technical advisers in the direction of producing a better ration, more balanced and more palatable, and of transporting it to the men who needed it. Continuous enquiries were made at the receiving end, and continuous changes in material and methods were made when these were desirable and practicable. It is always necessary to remember that comparison with other rations are not always valid, as these are conditioned by the food pattern of different people.

Native Diets. The feeding of the native was a difficult and responsible task. A conference was held at Headquarters New Guinea Force in August 1943, attended by the Directors of Medicine and of Hygiene and Pathology, the acting A.D.M.S. of Angau, and the D.A.D.H. of New Guinea Force. These deliberations and subsequent reports from Angau clarified the position. The problem was twofold: the feeding of the general native population in Papua, and the feeding of the native labour force indentured through Angau to the Australian Army. The total native population involved in this instance was 750,000 excluding New Britain, New Ireland and Bougainville. Necessary war work was being carried out by some 20,000 natives.

The feeding of the whole native population was complicated by the interference with the living conditions of the natives by the war. They had been forced to leave numerous villages, for, as indentured labourers, they had been transferred from their accustomed communities to new surroundings. This badly dislocated the raising of crops and growing of vegetables, and reduced the amount of natural food available to them.

Some long-scale plans had been made, including the raising of soya bean, and processing of meal with the help of the C.S.I.R. Closer at hand were the problems of the labour force, on whose members the army relied so greatly to provide its requirements in relation to medical transport and supplies.

Brigadier Fairley pointed out that the native ration scales were closely examined, and that New Guinea Force had laid down in orders a ration adequate in calories and in vitamin *B* content. However, the scale was low in fat for native requirements. The natives were fond of fat, and consumed it freely if it was available; well marked improvement in their physical condition was evident when the fat ration was increased, though this did not apply to vegetable fats such as those derived from peanuts or maize.

The animal fats were much more valuable, but needed reinforcement with vitamins *A* and *D*, as in standard margarine. It was impracticable to give them vitamin concentrates, as these were too scarce. The quantity of fat suggested was two and a half ounces per native per day: this could be supplied in large packs, as the working parties varied in size from 50 to 150.

The supply of vitamin *B* was also discussed. Brigadier Furnell, D.D.M.S. of New Guinea Force, stated that the supply of concentrate such as "Marmite" was unjustified, as it seemed illogical to remove vitamin *B1* from rice by polishing, and return it as "Marmite". The ideal prevention of beriberi was surely by whole wheatmeal, though this presented some technical problems. A further difficulty lay in the dislike of the natives for unpolished rice. The D.D.M.S. recommended a maximum scale of food available till tomato juice, margarine, cod liver oil and dripping were to hand. Scales of rations suitable for light and heavy labour were drawn up. Further consideration was given to these subjects in another

Table 1
DAILY RATION SCALE FOR A.I.F.
(Basis of shipments Middle East)

Commodity	Scale in Ounces
Bread	16
or biscuit once weekly	12
Frozen meat	16
or preserved meat once weekly	10-1/2
Fresh vegetables	16
or peas or beans or lentils once weekly	4
Potatoes	12
Onions	3
Bacon	2
Cheese	1-1/7
Butter	2
Tea	3/4
Sugar	4
Milk	2-1/2
Salt	1/2
Jam or marmalade or golden syrup	2
Meat loaf once weekly	4
Salmon twice weekly	3
Herrings twice weekly	3
Pepper	1/100
Mustard	1/100
or curry powder once weekly	1/6
Flour or rice or oatmeal	2
Dried fruits	1

(In addition to the above scale, 1½d per man per day may be expended by units to provide extra perishable items of foodstuffs.)

On medical advice, a weekly issue of 16 ounces fresh oranges or 12 ounces of fruit juices containing anti-scorbutic elements may be made.

Table 2
A.I.F. RATION SCALE—MIDDLE EAST

	Ounces	Equivalents	Ounces
Bread	16	Biscuits	11-1/2
Meat, frozen (with bone)	14	Meat, preserved	11
or fresh, local (with bone)	16-4/5	with pickles	2/7
or boneless	9	or chutney	1/14
plus fat cooking	1-1/2	Vegetables, preserved	6-2/3
Vegetables, fresh	16	Comprising—Vegetables	
		tinned	2-2/3
		Beans, canned without pork	2-2/3
		Beans/lentils/peas dried	1-1/3
		If only beans/lentils/peas	
		issued	2
Onions	3	Potatoes, tinned	6
Potatoes, fresh	12	and onions	2
		or onions	2-1/2
		and beans/lentils/peas	2
Bacon, tinned	2		
or Sausages, tinned	4		
Butter	2		
Cheese	1-1/7		
Dried fruits	4/7		
Tea	3/4		
Sugar	4		
Salt (3/4 ounce for troops in			
Western Desert only)	1/2		
Jam or marmalade	2		
or golden syrup	1-1/3		
Milk, tinned	2	Milk, fresh	5
Pepper	1/100	Milk ex U.S.A.	2-1/2
Mustard or curry powder	1/100		
Meat loaf	4/7	Meat, preserved (to be issued	
		only when stocks of meat	
		loaf are exhausted)	10/21
Salmon	6/7		
Herrings	6/7		
or Sardines, pilchards, tinned	3/7		
Flour, rice or oatmeal	2		
Fruit, fresh (when available)	4		
or 1 Orange (in season) and/or			
1/2 grapefruit, whichever is the			
greater.	3 (8 men		
	to bottle)		
Ascorbic acid tablets	1 tablet		
	(0.025		
	gramme)		
Marmite	3/28		
Plus 6-1/4 mils per day per man			

Table 3

FIELD SERVICE RATION SCALE—MIDDLE EAST—Amended to 6/8/1942.

BASIS OF FEEDING A.I.F. IN OPERATIONS

Rations	Ounces	Ration Equivalents—to be issued when Fresh Rations are not available, or under special GHQ instns.	Ounces		
1. Bacon, MC	3	} or Eggs (2) up to 5 issues/week			
or bacon, tinned	2				
or sausages, tinned	4				
2. Beans/lentils/peas, dried	1	Biscuits, Service	9		
3. Bread (or flour 9)	12				
4. Cheese	3/4				
5. Curry powder or baking powder	1/30				
6. Fruit, dried	1				
7. Fruit, fresh, when available	4				
8. Herrings, tinned	4/7				
or salmon	3/7				
or sardines, tinned	2/7				
9. Jam or marmalade, local	2				
or golden syrup	1				
10. Margarine (note)	1-1/2				
11. Meat, frozen, with bone	8			Meat, preserved with pickles or chutney	6
or meat, fresh, local with bone	10				
or meat, boneless and fat, cooking	6				
12. Meat, preserved	1				
13. Milk, tinned	2			Milk, fresh Milk ex U.S.A.	5
14. Mustard	1/100				
15. Oatmeal	1-1/2				
or flour	2				
16. Onions	2				
17. Pepper	1/100				
18. Potatoes, fresh	12	Potatoes, tinned and rice or onions and rice	6		
Oil, cooking	5/7				
19. Rice	1				
20. Salt	1/2				
21. Sugar	3				
22. Tea	1/2				
23. Vegetables, fresh	8	Vegetables, preserved comprising vegetables, tinned Beans/lentils/peas dried If beans/lentils/peas only	3-1/3		
24. Ascorbic acid tablets (0.025 gramme)	1 tablet				
25. Marmite	3/28				
26. Rum — to be tagged with issues to gallon	1/2 gill				
or cocoa	1 pt				
or tea	1 pt				
27. Tobacco					
or cigarettes, per week	2 ozs				
28. Matches, boxes per week	2				

Table 4
 NEW GUINEA RATION SCALE FOR COMBINED FORCES
 A.M.F. SCALE

Commodity Effective 4th April 1943	Scale
BEVERAGES	Ounces
Coffee	1/5
Tea	5/16
CEREALS	
Bread	12
Flour	2
Rice	1/2
Wheatmeal	1
CONDIMENTS	
Mustard	1/100
Pepper	1/100
Powder, curry	1/50
Salt	1/2
FATS	
Butter (tinned)	1-3/4
Lard	1/2
FRUIT	
Dried	2
Fresh	4
MEAT	
Bacon	6/7
Cheese	6/7
Ham or fish	1-5/7
Fresh	13-5/7
MILK	
Condensed, sweet	2-1/2
RISINGS	
Powder, baking	1/25
SUGARS	
Jam or marmalade or golden syrup	2
Sugar	3-1/4
VEGETABLES, FRESH	
Fresh	12
Peas, blue	2/7
VEGETABLES, DEHYDRATED	
Onions	1/2
Potatoes	2
SUNDRY ITEMS	
Cake, fruit	3/7
Essence, flavouring	1/350
Juices, fruit or tomato	2
Powder, custard	1/8
Sauce, tomato	1/4
Spice, mixed	1/350
Tomato puree	3/7

Table 5
OPERATIONAL RATION
TYPE O2

	Total net weight not less than
MEAL 1	
Biscuits, carrot	3
Fruit and cereal block (type 1 or 2)	3-3/8
Meat component	4
Peanut butter	1-1/2
Barley sugar rolls	1
Caramel bar	1/2
Sugar tablets (2)	2/5
Tea leaf	1/12
Skim milk powder	1/4
Salt tablets (2)	1/16
Wooden spoon (1)	
MEAL 2	
Biscuits, wholemeal	2-1/4
Wheat lunch	3
Meat component	4
Cheese	1-1/4
Barley sugar rolls	1
Lime tablets	1/2
Sugar tablets (2)	2/5
Tea leaf	1/12
Skim milk powder	1/4
Salt tablets (2)	1/16
Wooden spoon (1)	
MEAL 3	
Biscuits, wholemeal	2-1/4
Chocolate block	3
Meat and vegetable component	4
Blackcurrant spread (or other approved spread)	1-7/8
Barley sugar rolls	1
Caramel bar	1/2
Sugar tablets (2)	2/5
Tea leaf	1/12
Skim milk powder	1/4
Salt tablets (2)	1/16
Wooden spoon (1)	
One pocket tin opener	

conference held in November 1943. Native rations showed slight deficiencies in riboflavin, vitamin C and vitamin A (4,000 units instead of 5,000). Paw paws were a good source of vitamins A and C. The need for the recognition of the greater demands of heavy exertion was important, especially in relation to diet. For example, only A-class carriers were suitable for work in a terrain like Shaggy Ridge. Lieut-Colonel J. M. Mack, A.D.M.S. Angau, pointed out that here, though the conditions were

Table 6
EMERGENCY RATION
TYPE A3

	Total average weight
	Ounces
Chocolate bars (2)	2.50
Fruit and cereal block (type 1)	2.13
Fruit and cereal block (type 2)	2.13
Prune blocks (2)	2.50
Caramel blocks (7)	1.66
Sugar tablets (4)	0.80
Tea tablets (6)	90 grains
Salt tablets (5)	75 grains

better than those on the Kokoda Trail, the climbing alone was an exacting feat. In a later report Mack stressed that most natives were subject to malaria, hookworm and dysentery, their infant mortality was high and their expectation of life relatively brief. The average diet of the native was deficient in fat and in first-class protein. At the time in question, the third quarter of 1943, sources of vitamin *A* were scarce (paw paw was probably the only one), and vitamin *C* could not be supplied in sufficient amount for the plasma concentration to reach a desirable level. There were in fact difficulties in the way of the native labour groups obtaining an ideal diet through service channels, though improvement in the ration produced improvement in physical status. It was necessary to remember, too, that the presence of endemic infections in the natives made it imperative to maintain a barrier between the white troops and natives.

Both were to some degree vulnerable, the Papuan natives to respiratory infections, the whites to malaria, dysentery, hookworm and other tropical diseases. A general instruction on these lines was promulgated by the Adjutant-General in March 1943. This directed that native troops and carriers should be accommodated in camps well away from white troop concentrations, that sick natives should be held only in native hospitals, that native orderlies should not be employed in ordinary service hospitals, that natives should be segregated from diseases such as measles, chicken pox, pneumonia and other respiratory affections, and that native troops and carriers should not overcrowd their sleeping quarters. These instructions did not directly affect questions of diet, but all matters relating to the health of the native labour force were of vital importance to Australian troops fighting in the South-West Pacific Area.

TROPICAL MEDICINE 1943-45

TRAINING

When the centre of gravity of the war effort of Australia moved to the north of the continent and to the area known as the South-West Pacific

Area, training in tropical disease became more intense and practical. Such training was incorporated in units actually within the tropics or in course of preparation for operations in New Guinea, and the resources in Australia were used to the full. The School of Public Health and Tropical Medicine at the University of Sydney undertook an important part of the education of service medical officers in tropical diseases. Special courses of training based on an abbreviated curriculum were also given to enable suitable medical officers to qualify for the university diploma. Practical training was given in a continuous series of courses for non-medical officers and others at the Land Headquarters School of Hygiene, and at the School of Jungle Training at Canungra south of Brisbane. At the Canungra jungle school tactics could be taught and practised in a formidable environment. It was no doubt dismaying to find that not only were vector mosquitoes a feature of the school's hazards, but transmission of malaria could and did occur there, and pointed a useful moral.

The Atherton Tableland became established as a centre for rehabilitation and training in Northern Queensland, and excellent hospital facilities were of value in helping to reinstate veterans from New Guinea in normal health. Valuable clinical research was carried out in the medical units, in conjunction with the laboratory and clinical research which was proceeding under admirable conditions at the research unit in Cairns. References have been made previously to the research work carried out there by a special staff under Fairley's direction. The successes gained by the armed forces in these last crucial years of the Pacific war would have been impossible had it not been for the scientific background which enabled the applications of preventive medicine to be made with accuracy and certainty.

It was also realised that instruction in preventive medicine must be made available to all ranks of the units engaged in tropical areas, and that special attention to the technical aspects of malaria control was essential. Malaria control units had been established while the A.I.F. was in the Middle East, and their scope and number was increased. During the first years of the war attempts had also been made to have entomologists appointed to the army, but with no success until Professor Ashby, a scientific adviser of the Government, represented the need to the Prime Minister, Mr John Curtin.

ENTOMOLOGY IN THE ARMY

Four entomologists were appointed during 1942, and on the advice of Fairley, Major Mackerras was appointed to control work in entomology at Army Headquarters. Additional malaria control units were established, and those already existing were used for preliminary mosquito surveys and carried out work preparatory for local control. The officers commanding these control units were chosen for their expert entomological knowledge as well as their field experiences. The other ranks were trained at the University of Queensland and in the field.

Captain F. N. Ratcliffe was made responsible for the arduous task of obtaining equipment and supply of materials needed for malaria control. At first even the names of necessary pieces of equipment had to be explained to the staffs of Ordnance and Supply and Transport organisations, but by the beginning of 1943 all the units had adequate supplies for their work. There were early difficulties in the methods of administrative control: entomologist officers thought it desirable to maintain control of technical aspects from the headquarters of the organisation, but this method was not popular with medical administrators in the field.

The influence of the recently appointed malariologists was soon felt in the field formations, where the guidance of the malaria control units passed by degrees into their hands, thereby solving many difficulties. During this period a number of changes were initiated which gradually ended the preceding phase of lack of coordination of both action and supplies, as illustrated in events of 1942 at Milne Bay.

During 1943 the technical and administrative aspects of malaria control made headway. Entomology attained the status of a directorate, with Mackerras as director and Ratcliffe as assistant director, but in the final organisation entomology was included in the Directorate of Hygiene and Pathology, which also included parasitology. A malariologist and an entomologist acted as advisers to the director of hygiene at headquarters. Mobile entomological units had been operating since 1942, each commanded by a major entomologist, and retained their original establishment.

A school of malaria control was organised with two wings, one to give basic entomological training at the University of Queensland, and the other wing at Cairns, controlled by the local malarial control unit. Final training was planned for students in the field, but complications with the headquarters organisation made this difficult to implement. The School of Public Health and Tropical Medicine completed the training with a series of short courses for medical officers, dealing with epidemiology and malaria control. A service was also established for the circulation of technical information, so that entomologists and members of malaria control units could be kept abreast of recent progress and research.

These overall plans for malarial control at first sight may have appeared to be elaborate, but were in reality simple, and set the technical side of the prophylaxis of malaria on a practical scientific basis. It had been hard to convince non-scientists of the need for field research, but the influence of these specialists was undoubtedly very valuable.

Mackerras pointed out that in New Guinea "the control of malaria in the field is primarily a matter of anopheline control or full atebirin suppression". The importance of exact knowledge of local mosquito vectors in an affected area, and of their relevant habits was proved repeatedly in later phases of the island campaigns. Biological studies permitted much greater accuracy in using "species sanitation" as a basic principle in all control. The work done fell into three categories; investigations, trials of method and material, and laboratory studies. Laboratory work was best pursued in institutions already established and well equipped. The

services were enriched by the willing cooperation of several civil institutions. The C.S.I.R. made available a section of its Division of Economic Entomology for full-time entomological investigations for the army. These facilities were controlled by Captain D. F. Waterhouse who, by virtue of a commission in the Reserve of Officers, was able to follow up the work into the field. Biological and chemical studies of control methods were carried out in this way.

In the University of Sydney Mr D. J. Lee conducted research under a Commonwealth research grant, and later worked under the direction of the Scientific Liaison Bureau. Using accommodation and equipment made available by the Department of Zoology, he provided a museum of mosquito material collected in the field, and was able to identify specimens promptly for the army malaria control units and mobile entomological sections. This material was codified and later published, thus widening the value of the work and making it of high practical value.

Dr G. A. M. Heydon of the School of Public Health and Tropical Medicine also carried out teaching work on parasitology for medical officers, and made studies of precipitins of blood samples sent from the field. Useful information was thus supplied concerning the relative degrees of importance of anopheline vectors of disease.

The mobile entomological sections were increased in numbers as their work and importance grew, and six were later appointed. In addition to the field routines which helped the malaria control units to establish themselves on a scientific basis, the entomological services played a substantial part in a number of investigations of importance to the armed forces. These may be summarised under the following headings:

Studies of repellents and development of insect repellent lotion; establishment of standards for mosquito and fly sprays and sprayers; control of scrub typhus by miticide repellent (work carried out by Major R. N. McCulloch); laboratory work at the C.S.I.R. on malaria oil and D.D.T.; development of aerial spraying by aircraft; biological studies of anophelines; systematic studies of mosquitoes by Messrs D. J. Lee and A. R. Woodhill; epidemiological studies on malaria; entomological work in connection with the research carried out in the Land Headquarters Research Unit at Cairns; and entomological work in connection with experiments on the transmission of dengue fever at the University of Sydney and Concord Military Hospital.

The work done by entomologists was outstanding in its value to the forces undertaking campaigns in country where malaria, mite-borne typhus and dengue were endemic. In the large-scale coordinated researches, in particular that carried out at the Cairns Medical Research Unit the work was unified, largely by the experience, authority and personal influence of Fairley. In the smaller projects, undertaken in the field in the disconnected intervals of routine investigations, there was often difficulty in maintaining the ideal of a detached atmosphere. Notwithstanding this, the practical value of the entomological services was proved, and they have also made contributions to knowledge.

In the light of army experience, Mackerras made suggestions for the most useful methods for employing entomological sections in forward operations. In New Guinea only one malarial vector was operative, but in other tropical countries the habits and breeding grounds of several vectors would need to be taken into account. It was therefore desirable for mobile entomological sections to accompany malaria control units in the early stages of advance. In forward operations involving a corps, three sections were needed for vector studies; for advanced bases studies of local flies and mites were advisable, and further biological data concerning mosquitoes were required.

In 1944 Mackerras was sent overseas to England and the United States to present the results of entomological research in malaria and typhus in the South-West Pacific Area, to give information regarding malaria control in the S.W.P.A., to enquire into recent developments in insecticides and repellents, and to emphasise the value of plasmoquine in the treatment of malaria and in the limitation of its spread. This visit was welcomed both in the United Kingdom and the United States of America. It illustrated the greater realisation of the value of personal contact and of the need for a scientific basis for the technical medical aspects of war in the tropics.

MALARIA EPIDEMIC IN CAIRNS

The importance of Northern Australia during a war in the Pacific concerned both military and medical conditions. In the tropical areas malarial transmission could occur; hence the great value of a non-malarious tract of country on the Atherton Tableland, where troops could safely be sent for training and rehabilitation. There were, however, areas in Northern Australia which caused anxiety. One of these was Cairns, the only area in the settled parts of Australia where epidemics of malaria occurred. Late in 1942 a sharp epidemic of benign tertian fever called for action, as there were troops in the area. Control was promptly undertaken, and as the dry season advanced, energetic measures caused the outbreak to wane. The problem was a wider one than that of an outbreak of *vivax* malaria among the civil population, though Sir Raphael Cilento, Director-General of Health in Queensland, had pointed out that the epidemic was extensive: in four months 500 cases were recorded, 50 of these being among service personnel. An account of this epidemic and the measures adopted has been given in *Clinical Problems of War*, Volume I of this series, pages 77-79, but some points may be mentioned here.

The Commonwealth Director-General of Health released Dr Heydon for special work on the local vector, as this had never been determined with certainty. It was found to be *A. punctulatus*, identical with the New Guinea vector. This was most important, as control was henceforth organised on a sure basis. There were large swamps on the outskirts of Cairns, but this vector hardly bred in the swamps, but in the clearer waters in other parts, and did not flourish south of Ingham. Army control units carried out preventive work and *Gambusia* fish were introduced into the swamps, and possible carriers of *falciparum* gametocytes were removed to a safe

environment at Atherton for treatment. With the cooperation of the United States Armed Services, the Australian Army, the Cairns City Council, and financial assistance by the Queensland Government a drainage scheme was carried out. A National Security Regulation gave the D.G.M.S. of the A.M.F. the power to examine civilians in defined areas and if necessary to treat them if infected. No Australian troops were allowed to stay in Cairns. These measures controlled the situation; it was recognised that though Cairns was officially proclaimed as "potentially malarious" it was really malarious in fact, and the risk of introducing malignant malaria to the mainland of Australia might have been serious, especially if contact of carriers and vectors was not prevented. The timely action taken to deal with this local epidemic of benign tertian malaria no doubt was of great prophylactic importance, and prevented the obvious dangers of introducing malignant tertian malaria to Australian battle stations within the 19th degree south latitude, a line which included Cairns but not Townsville.

CONDITIONS IN THE NORTHERN TERRITORY

Consideration of the risks of malarial epidemics arising in Cairns emphasised the greater risks of such outbreaks in the Northern Territory. This great tract of country was a potential buffer at the north of the Australian mainland, and an important defence area. The Commonwealth Department of Health had always been alive to the significance of the Northern Territory in the maintenance of health of Australia, particularly with regard to endemic or introduced infectious disease, in particular malaria. Colonel M. J. Holmes had studied this carefully and had valuable records of the occurrence of malaria among the aboriginal inhabitants. From the medical aspect, the Northern Territory was of great interest and importance, viewed as a defence area, and we may briefly refer to the problems encountered there.

Here was a vast expanse of country, much of it harsh and sparsely settled, some of it empty of habitation over great distances. Motor transport was possible over most roads, though some were very rough. War requirements produced more roads, in particular a good north-south road by which most of the army transport travelled. Rail transport was limited to the railway which ran from Darwin through Pine Creek, Adelaide River and Katherine to Birdum. The chief medical installations were sited along this line from Darwin to Katherine, and it was used for the carriage of some supplies and the transport of sick by ambulance train.

There were numbers of landing strips near the more settled areas, and well-developed airfields in a few larger centres. These could meet military and civil requirements, and Darwin had a well-equipped airport. A very satisfactory method of air evacuation was in operation there; a Dakota plane was equipped with webbing supports for stretchers, and could carry twenty-four patients in comfort.

The climatic year was roughly divided into dry and wet seasons. Rainfall was chiefly seasonal, the rains falling mostly over a well-defined wet

season during the period January to March. The dry season was hot and dusty, but save for the discomfort of glare and dust gave rise to no special medical problems. Agricultural activities were carried on with success: the supply and transport services directed farms from which the army was supplied with vegetables from a cultivated area of some hundreds of acres. In some areas the growth of grass was remarkable, even reaching a height of eight to ten feet. Severe thunderstorms were experienced at times, and lightning struck trees and telegraph wires, and even the ironstone ridges. One death occurred from this cause. These violent manifestations of nature were only occasional, and mostly seasonal.

The wet season brought risks of flooding in some parts; heavy falls often flooded rivers and blocked transport, and on occasion caused considerable difficulties in hospital areas. Early in 1944 heavy downfalls caused a rise of fifty feet in the Adelaide River, and flooded the 119th A.G.H. in that area. Flood waters rose to within a few inches of the wards, and disorganisation of the pumping machinery caused failure of the water supply. Patients were promptly removed by train and returned a fortnight later. The Katherine area was also low-lying in parts and the 121st A.G.H. site was subject to flooding after heavy falls. This season also caused considerable physical discomfort by its extreme humidity and greatly increased insect breeding. Minor lesions were frequent on the skin, and readily became infected. *Miliaria rubra* was very common and was often followed by troublesome dermatological sequels. These were the subject of some valuable research by members of the A.A.M.C. Indolent ulcers sometimes appeared on irritable or exposed areas, and needed careful treatment.

Care was taken to provide an adequate dietary, and the standard of rations was satisfactory, though a degree of monotony was difficult to overcome.

During the latter war period the Northern Territory acquired an unenviable reputation as a begetter of various physical and mental troubles among members of the defence force. It must be realised that the period under review was relatively remote from the time and circumstances of the enemy raid on Darwin in February 1942. There was no reason to think that any disturbances of morale noted during that earlier period had persisted as a military background. The defence forces in the Territory had extended greatly, and were well officered and organised. Nevertheless there were independent factors at work in the forces during the period they were stationed in the Northern Territory which were not productive of content among the men.

Monotony and relative lack of amenities and entertainment fostered a certain degree of depression, which was sometimes in evidence among men who had suffered mild forms of endemic disease. Many of the men were distant from their homes and this distance, combined with the impracticability of leave was prominent in their minds. It must be pointed out, however, that similar sundering by distance was present in the Middle East, without appearing as an important cause of lowering of

morale. The instances are, of course, not parallel, for the men in the Territory had no defined objective before them, and few had opportunity to engage in such campaigns as were leading to victories against the Japanese forces in New Guinea.

Colonel N. D. Barton, D.D.M.S. of Northern Territory Force, noted that increased numbers of men complained of minor discomforts for which they often consulted specialists. These complaints showed a pattern characteristic of functional conditions; for instance, eye symptoms were a frequent cause for complaint, though relevant organic states were seldom discovered. Glare and dust undoubtedly caused symptoms in some, but not to a degree greater than was common even in more troublesome climates. All consultants noted that, irrespective of their specialties, certain complaints made by the men were practically constant, especially the local climatic conditions. Mild psychological disturbances were common, particularly in men who were not occupied in duties which appealed to them as productive or intrinsically of value.

Colonel D. M. Salter, when D.D.M.S., considered that some men were kept over-long in a dull environment in which there seemed little prospect of change. Change, he pointed out, was important, and was a necessary part of rehabilitation, which also required forms of occupation of a purposive kind, other than routine duties. Such occupation was largely lacking, and in small units particularly this was a serious drawback to the maintenance of morale. It can be understood that many men felt that the watch-dog function of the Northern Territory Force was not conducive of interest in duties which seemed to them to bear little obvious connection with national defence. Yet this is not all that may be said on the appearance of what was undoubtedly a mild anxiety state or psycho-neurosis.

Since the end of the 1939-45 war more light has been shed on "tropical fatigue" as an entity. Research has laid some stress on the importance of the discomforts of the tropics as a physical component of the fatigue which manifests itself as a lowered output of energy, interruption of a normal sleep rhythm, diminished appetite, and some degree of physical deterioration. Men exposed to undue heat over a long period may show such signs, and suffer from various localised discomforts which may interfere with work and sleep. Lack of sleep is surely important. A curious feature of "tropical fatigue" is its potential reversibility. Effort can help to reverse the existing effects of fatigue; such effort may even require fortitude, and may be called forth by an emergency or a real and sustained need. Removal to a cooler climate, as is well known, may likewise produce a favourable change in the physical condition. It is important to recognise both a physical and a psychological factor in this condition, and to see the need for a judicial approach. It is interesting though not unexpected that service women seldom made complaint. The connection with morale is also significant. The term "tropical neurasthenia" was sometimes applied to this state, but this was not a happy name, for sojourn in the tropics is not of necessity the only causal factor, and it is inadvis-

able to use a name which assumes that this environment is necessarily inimical to health.

Malaria

Much more important was the problem of malaria in the Northern Territory. The native inhabitants, living chiefly along the lower reaches of the principal rivers, were subject to a low grade of malaria of endemic type. In the areas where settlers congregated the danger of the outbreaks was real, especially when a carrier of M.T. was introduced, and considerable epidemics of definite severity had occurred from time to time. These outbreaks tended to be self-limited and to vanish with the onset of the dry season, commonly re-appearing in the next year, but only if conditions ripe for transmission were reproduced in the meantime.

The danger of attack by the Japanese from the north was hard to estimate, but there was no doubt that the difficulties in maintaining an effective defence force would be greatly enhanced if malaria was free to spread and so to destroy the capacity of susceptible troops. Therefore it was essential that the anopheline population of the Territory should be controlled at least in its areas of greatest potential concentration. The prevention of malaria was successfully carried out in an effective if unorthodox manner. The troops of the Northern Territory Force were mostly in the more dangerous areas from the point of view of malarial propagation, but the stationing of several malaria control units at strategic points provided a striking force that could be brought into action at any time when a local outbreak threatened. All natives were segregated; refugees arriving from malarious countries from the northern islands were also segregated and removed, and special measures were taken to control other possible carriers. A routine order prohibited and prevented service personnel coming from endemic areas from entering the Territory, and when key personnel made short-term visits to the area, special care was taken that adequate suppression was ensured. A very careful check was kept on the identity and movements of persons who might be in the Territory without warrant.

During the last three years of the war very few indigenous attacks of malaria were observed. It was a remarkable exposition of preventive medicine to keep the Northern Territory free from epidemic malaria during a period when there was a high concentration of troops. The dearth of mosquitoes capable of transmission had a curious result, that the entomologists were unable to discover the identity of the vector responsible for the last epidemic.

The care bestowed on malaria prevention was rewarded by a low incidence of dengue fever also, and its figures dropped to a very low level. This was due in part to the war on vectors, but the development of immunity in the force probably also played some part. Control was the easier to apply because the endemic areas were Darwin and to a less extent Katherine, where control measures could be applied. Thursday Island, previously with a high infection rate, was also brought under control for dengue. The only other important endemic disease was dysen-

tery; practically all cases were of bacillary type, though occasional amoebic infections were observed. Dysentery was mildly endemic in Alice Springs, and often occurred in men who had travelled north by road. The facilities for the washing of mess gear were poor, and water was scanty along the road: improvements in arrangements lessened the infection rate. No Shiga infections were reported, the commonest type was Flexner. On the whole the health of men in the Northern Territory Force was good, and the keeping of the door shut to malaria during the war years was a notable achievement, carried out in an unusual way.

References have already been made to the researches in malaria carried out in the Army Research Unit at Cairns. Brief consideration of the contributions to scientific medicine during the Japanese war show clearly how the scientific basis for the war on tropical disease was surely established. More and more the value and importance of this work was emphasised, and the Atherton Conference on Malaria held in June 1944 showed how intimately the work and findings of the Research Unit had impressed the combatant officers who were present. The knowledge that grew concerning the processes of malaria, its suppression and treatment with drugs old and new, made the realisation of military planning possible. The impact of tropical diseases on Australia might have been much more serious had it not been for preventive medicine, and the story tells itself without further emphasis.

HYGIENE REORGANISATION⁴

The Standing Orders of the Australian Army Medical Services lay down the necessity for each military district to take steps to train all ranks in hygiene and sanitation, and under static conditions directions were given for an annual course of instruction of officers and other ranks. More important still was the inculcation of the principles and practice of hygiene in areas where active military operations are taking place. Before the outbreak of war little more was done than to ensure that officers commanding field hygiene sections gave instruction to officers of militia field ambulances.

After the outbreak of war more effort was made in some commands to hold schools, and field hygiene sections, being divisional units, gave some appropriate instruction to members of units in training. By August 1940 a permanent hygiene school was established by Headquarters Eastern Command, under direction of Major E. S. A. Meyers, the Assistant Director of Hygiene. In June 1941 the use of a large private residence in Clovelly, N.S.W., was obtained for the school, courses were arranged for thirty officers and men, and a museum of hygiene exhibits and sanitary appliances was set up there. In August 1942 the school came under control of the Allied Land Headquarters, and became the Land Headquarters School of Hygiene and Sanitation. Under command of Major Shannon

⁴ This section is compiled largely from material supplied by Colonel M. J. Holmes, formerly Director of Pathology and Hygiene, and Major H. Shannon, formerly officer commanding Land Headquarters School of Hygiene.

this school did much good in helping many officers and men to a greater knowledge of hygiene in relation to a fighting force.

Many of the courses were but brief, such as induction courses, and there were difficulties in maintaining contact between a stationary base unit and work in the more or less distant field, but the school played a useful educative part in hygiene training. General training policy was decided by the Director of Military Training and the D.G.M.S., while the D.D.M.S. of the area was responsible for local administration. In 1943 steps were taken to keep the school in touch with hygiene personnel in the field, to whom medical journals were also sent to enable them to keep in touch with recent developments. Another useful activity was the holding of a ten days' course for commanders of field units. Experienced medical officers were drawn upon for the tutorial purposes of this course. More facilities were availed of at the School of Public Health and Tropical Medicine, and it was found possible to extend a combined course to six weeks, of which four were spent at Clovelly at the hygiene school, and two at the jungle warfare school at Canungra. Groups of twenty platoon and company officers were taken into Clovelly every two weeks for this course, and a comprehensive programme was thus carried out. Between October 1943 and March 1945, when the Canungra phase of the course was discontinued, some 400 officers completed this training. In June 1944 the name of the school was altered to the Land Headquarters School of Hygiene, as the emphasis on sanitation gave a wrong impression of the aims of the establishment.

Criticisms were not lacking, and were salutary, though some could hardly be obviated by the staff of the school. A preponderance of lectures was hard to avoid, and the practical application of instruction on the part of trainees was not always in evidence. This difficulty was clearly set out by an experienced medical officer as follows:

The modern soldier is advised in lectures of the necessity of

- (a) water discipline and water sterilisation,
- (b) food protection,
- (c) wastes disposal routine,
- (d) safe excreta disposal,
- (e) control of insect vectors of disease.

Yet reinforcements graded as D.P.1 still reach operational troops

- (a) completely undisciplined in field ablution and water sterilisation,
- (b) grossly negligent in food protection and wastes disposal,
- (c) given in apparently high percentage to promiscuous defaecation in the field,
- (d) with inadequate training in mosquito, fly and mite control.

The hygiene training of troops for operational areas in the tropics demands the closest scrutiny of camp conditions, and it is submitted that the strictest enforcement of hygiene discipline in its smallest detail upon all ranks must be observed during the initial training. Until this is achieved, lectures and lecturettes can be nothing more than an ineffective pretence.

The influence of the school was good and widely diffused, and when the soil was prepared and the seed planted, it was the responsibility of individuals of all ranks to follow scrupulously the measures laid down in the field, so that these might bear the fruit of prevention of disease. This

question of responsibility was of great importance, and its value in producing good results in the following of hygienic rules and thus in the prevention of disease was seen again and again during the war years. Good examples were seen in the disciplinary control of hygiene during the siege of Tobruk, and in the later phases of malaria control in New Guinea. It was realised with greater clearness as time went on that action and the reason for action must be firmly linked in the soldier's mind. A serious difficulty which occurred in many schools of training was the poor standard of literacy of numbers of men sent to take part in hygiene courses. This was largely a function of the unit responsible for their choice, but it was found that as a clearer concept of the real functions of hygiene organisation became general, the standard rose. This enabled the question of individual responsibility to be more constantly before the junior leaders and officers, right up to the commanders.

Courses were arranged for the induction of junior medical officers and for regimental medical officers, but from May 1944 more systematic training of newly-joined medical officers was adopted. A five weeks' course was arranged at Darley, Victoria, followed by a two weeks' course at Clovelly in military hygiene. Up to the end of the war 160 medical officers were so trained. At this time too a three weeks' course was given to R.A.N. ratings, and this proved very useful to men who were engaged in duties in beach installations. Allied medical officers participating in courses in tropical medicine at the university school were also given some periodic instruction in methods of hygiene. In 1945 a course was conducted for assistant patrol officers for the Australian New Guinea Administrative Unit (Angau).

In 1944 and 1945 facilities were also given to a group of medical officers from the three armed Services to take a special three months' course for the Diploma in Tropical Medicine and Hygiene at the University of Sydney. This was outside the scope of the Hygiene School, but the duties of potential Deputy Assistant Directors of Hygiene were borne in mind during the course.

A Land Headquarters school of malarial control was also raised and as the wider concept of hygiene gained recognition a closer alliance between this and a hygiene school was favoured.

In the field it became more evident that instruction and supervision were necessary at all levels. To implement this, cadres were required from which schools or other forms of practical instruction could be expanded. These considerations, together with the growing importance of the mechanism of carrying practical hygiene of the soldier into daily life led to a critical examination of the system prevailing at the beginning of the war. It was evident that elaboration and improvement of the existing didactic methods of training were not sufficient, and alterations in the system were required.

The need for reorganisation of the hygiene services was further evidenced after the war when, after a War Office Standardisation Conference in London, the British Army abolished divisional field hygiene sections and

replaced them by a pool of sanitary assistants under a D.A.D.H. at divisional headquarters. Australian reorganisation went further than this scheme, but the principle remained the same.

It is significant that in the middle of 1943 when the operational strain was most severe in the S.W.P.A. and when manpower wastage was at its height, the greatest need for improved hygiene consciousness was felt.

On 20th August 1943 the D.G.M.S. pointed out to the Director of Military Training that even in the Moresby Base Area where malaria control had practically abolished anophelines from the area, half the cases of malaria were new infections, indicating a lack of intelligent cooperation by the men, and therefore a fundamental weakness in their training. In an infantry brigade in the Wau area the average weekly first attacks of malaria made up a wastage of nearly 70 per cent annually. Dysentery was almost as important as battle casualties as a waster of men.

The reports of the D.A.D.H. II Australian Corps on the hygiene training of the corps were disquieting; he described the individual hygiene practice as deplorable. In all three divisions a poor personal standard of hygiene persisted from the Middle East, where conditions of terrain and climate lessened the risks which were so much greater in the islands. In spite of the stress laid on the urgency of the problem, the efforts of the R.M.Os., and the work of schools, vacated camp sites showed how bad the hygiene standard could be. The D.G.M.S. summed up the position by saying:

If the present lamentable state of affairs is to be improved, hygiene training must be integrated into individual training of the soldier, and must be given by platoon commanders, troop leaders and by their N.C.Os. It must be maintained throughout the training period and during service in units.

He further pointed out that formations were failing to fill their allotments to the Land Headquarters School of Hygiene.

HYGIENE IN THE FIELD

In 1939 the system was that operative during the 1914-18 war, though the unit later known as the field hygiene section was formerly called a sanitary section, a name open to serious objection, since it suggested what was indeed a fact, undue concentration on the manufacture and supervision of sanitary appliances. The field hygiene sections were divisional units, and while good work was done by these units, there were considerable limitations to their scope and performance. They were intended to be inspectional and advisory in function, but they were often diverted to carrying out constructional work or disinfection or instructing units in these activities. For this purpose they had tradesmen on the establishments. In the 1914-18 war the sanitary sections were not competent to cope with a war of rapid movement, as they were often detached from their divisions and employed in workshops in fixed areas. This tended to lower the concept of hygiene, and the same disability applied to the field hygiene sections of 1939 onwards unless their command rested with medical officers. These units were not always commanded by medical officers, but sometimes by officers with the status of health inspectors.

Holmes protested strongly against this policy without result. Expert direction and guidance could not always be obtained from the divisional medical staff, as the D.A.D.M.S. was often too busy with administrative duties, and during periods of operational stress, had too many other responsibilities to control the hygiene sections. Holmes pointed out that only about one-third of the members of a field hygiene section (twenty-eight O.Rs.) had rank or training fitting them for supervision or instruction, and the unit itself was not able to act as an adviser to the divisional command. Both the commanding officer and his few senior N.C.Os. were largely busied with administrative and clerical duties, and in practice the field hygiene section system was cumbersome and not flexible enough. It frequently broke down under the exigencies of warfare, especially in a war of movement. When a division covered a wide area, personnel of the field hygiene section had to be got together again for the move, and again dispersed when the division reached its new destination. In a war of rapid movement the field hygiene section as a divisional unit became unworkable, and in the Middle East dispersal of these sections lessened their value considerably under such conditions. In New Guinea in the early stages of operations, troops were frequently moved by brigades attached temporarily to New Guinea Force, and the field hygiene sections had only restricted opportunity to work except as area units.

In Australia it was significant that when field hygiene sections were formed, only the commanding officer and some N.C.Os. were usually called up at first, as the remaining members were not used in an advisory capacity but were dispersed to camps as these were filled. Thus these sections were not trained as units, and R.M.Os. were not encouraged to take an active interest in matters of hygiene. Instances occurred in Australia and New Guinea where a more flexible mechanism might have prevented outbreaks of infectious disease.

The field hygiene section N.C.Os. dispersed to camps in each command had too low a non-commissioned rank and status, and little attention was paid to them by camp commandants and officers commanding units. Naturally, well-qualified men such as health inspectors were not attracted to field hygiene sections, and preferred to enlist in other units. In some instances, in fact, field hygiene section N.C.Os. were employed in doing the actual sanitary and conservancy work of camps instead of supervisory and instructional work. There were too few of them in any case to supply all camps, and consequently the hygiene N.C.Os. were allotted only to the larger camps, the smaller camps getting scant attention. To increase the number of available N.C.Os. it would have been necessary to increase the number of these half-formed hygiene sections and this was not desirable.

The break-down of the field hygiene section system in the commands led to the adoption of unauthorised practices, such as the appointment to camps of hygiene N.C.Os. responsible direct to the camp commandant and not to the officer commanding the field hygiene section. In such cases the A.D. of H. in the command often found it impracticable to get any

reports from such camp hygiene N.C.Os. or to keep effectively in touch with hygiene conditions in the camps of the command.

It will be seen that both in the forces in the field and the commands in Australia there were many defects in the hygiene system, leading to ineffective operation. In the army in the field, there was inadequate machinery within units to enable each unit to bear its responsibility for its own hygiene, the fundamental consideration in any effective system. The field hygiene section system was not well adapted to give units the necessary inspection, supervision and advice for prevention and control of disease under all exigencies of service. With the projected move to put field hygiene sections under command of non-medical officers, it was obvious that these sections would become still less competent to carry out this function. Within the commands in Australia the system was still less satisfactory.

In these circumstances consideration was given to a reorganisation of the hygiene service on new lines. This plan for a reorganised hygiene service was devised and sponsored by Colonel Holmes, who was the Director of Hygiene and Pathology for the Australian Military Forces, and was in civil life a senior member of the Commonwealth Department of Health.

The principal desiderata aimed at were:

1. To strengthen unit initiative and efficiency in hygiene by providing an adequate hygiene set-up within each unit, and to enable the unit to effectively carry its responsibility for its own hygiene.
2. To enable instruction and training in the details of hygiene to be continuously carried within each unit by qualified unit personnel.
3. To give to responsible hygiene personnel adequate rank and status to enable them to carry out their duties effectively within units, and to attract to these appointments well-qualified men such as health inspectors.
4. To provide initiative, and expert direction and supervision and advice in the prevention and control of disease and maintenance of health by expert medical officers holding appointment on Army, Corps and Divisional Headquarters.

THE NEW SYSTEM

It was decided to recommend the abolition of the existing field hygiene sections and the adoption of the following system:

1. The appointment to each Army, Corps and Divisional Headquarters of a medical officer (with rank of major or higher) under the D.M.S., D.D.M.S., or A.D.M.S. respectively and with knowledge and experience in epidemiology and behaviour of diseases and the control of disease vectors. Such a medical officer is not only in a position to initiate, direct and supervise control measures and training but, by virtue of his position at headquarters, he is able to maintain touch with headquarters staffs in quartermaster-general, engineering and ordnance branches and so facilitate the availability of materials and supplies to units for hygiene work.
2. The appointment to each brigade group of one hygiene officer (lieutenant) A.A.M.C. For these appointments it was proposed to select suitably qualified persons such as science graduates or fully qualified health inspectors with training in medical entomology, epidemiology and disease transmission and control.

3. The appointment to each unit to which an R.M.O. is attached, of one hygiene staff-sergeant (A.A.M.C.). For these appointments it was proposed to select persons preferably with health inspector qualifications, and with some grounding in epidemiology and other special aspects. It was proposed that the hygiene staff-sergeant working under the R.M.O. should report also to the brigade hygiene officer, who in his turn should report to the A.D. of H.
4. The appointment to each unit without an R.M.O. of a hygiene N.C.O. (non-A.A.M.C.) of lower rank than staff-sergeant; such N.C.Os. to be under the direction and supervision of, and to report to, the brigade hygiene officer.
5. For commands (or L. of C. areas) within Australia or elsewhere, the provision on each command Headquarters of—
 - (a) One medical officer A.D. of H. (rank of major or higher);
 - (b) A pool of area hygiene officers A.A.M.C. (rank of lieutenant) and of warrant officers and staff-sergeants A.A.M.C. (hygiene inspectors). The number of these hygiene officers, warrant officers and staff-sergeants varied with the size of the command. They were to be under control of the A.D. of H. and to be allotted to area and camp commandants as required. In addition division, brigades, etc. under command control had, of course, with them their own allotment of hygiene officers and N.C.Os. as provided on their war establishment.

Transport. Provision was made in the new organisation for transport of hygiene officers and N.C.Os.

Disinfectors, etc. The high and low pressure steam disinfectors were placed under the control of the A.D. of H. for use as required in the division or on the command (or L. of C.) areas. It was proposed that the mobile baths also should be under control of A.D. of H.

Training. In order to provide for training of officers and N.C.Os. for hygiene appointments in armies or in Commands or L. of C. Areas, and also for refresher courses, and other aspects of training, it was recommended that in addition to existing L.H.Q. or command schools of hygiene, mobile training cadre or school should be provided on the war establishment of each corps and also in each force (N.G. Force and N.T. Force).

Corps Training Cadre. For this purpose it was proposed that a cadre of A.A.M.C. hygiene officers (2), staff sergeants (3) and hygiene tradesmen (carpenters and tinsmiths, etc.) (4) should be placed on the war establishment of each corps and force, and suitably equipped for training purposes including provision of a heavy lorry for mobility.

Adoption of New Hygiene Organisation. These various recommendations were adopted in principle and the new organisation began to come into operation about the middle of 1942. It developed by stages during subsequent months.

Advantages of New Organisation. The principal advantages of the new organisation are—

- (1) It emphasises the basic principle that each unit is responsible for its own hygiene, and it provides for each unit the necessary skilled personnel to enable the unit to carry out its hygiene responsibilities under all the exigencies of service;
- (2) It puts units in a position to improvise and construct necessary sanitary appliances instead of depending upon a field hygiene section to supply them and thus renders the unit self-reliant under all conditions;
- (3) It is under expert medical supervision and control with expert A.A.M.C. hygiene personnel from headquarters down to individual units;
- (4) It provides suitable rank, status and authority for hygiene officers and N.C.Os. thus enabling effective performance of duties;

- (5) By providing for commissioned rank and high N.C.O. rank for suitably qualified non-medical personnel, it attracts the skilled type of man (such as science graduates and health inspectors) necessary for inspectional and instructional work;
- (6) It places the hygiene medical officer (A.D. of H.) at headquarters where he can use his influence to most effect in his relationship with headquarters staff, both in initiating and implementing measures for prevention and control of disease and in ensuring availability of necessary materials and supplies;
- (7) It provides for the D.A.D.H. a direct line of A.A.M.C. hygiene officers and N.C.Os. down to each unit thus enabling him to keep directly in touch with health aspects of each unit;
- (8) It provides for direct access and report by each hygiene officer and R.M.O. etc. to D.A.D.H. Divisional Headquarters, thus permitting pressure by divisional headquarters on any C.O. who neglects his responsibility for the hygiene of his unit;
- (9) It provides for training of hygiene officers and N.C.Os. and for continuous instruction of pioneer hygiene and water duty personnel of units. Unit equipment, as, for example, water vehicles, requiring skilled use, are kept at all times under the skilled supervision of the hygiene staff-sergeant attached to the unit;
- (10) It gives to the R.M.O. of each unit an experienced and permanent N.C.O. (A.A.M.C.) of adequate rank under his own control, and on whom he can rely to assist him in the selection and training of the hygiene and water duty men of his unit, and of any special squads required for special duty (e.g. malaria squads). The R.M.O., thus reinforced, should have much keener interest in and enthusiasms for these aspects of his duties. It thus strengthens initiative and the effectiveness of hygiene within the unit.
- (11) It is economical in manpower, dispensing with the unnecessary privates, tradesmen, cooks and clerical staff of a field hygiene section;
- (12) It enables D.A.D.H. and hygiene officers and N.C.Os. to give their whole time to hygiene duties, whereas under the field hygiene section system much time was employed in the administration and movement of the unit in the field;
- (13) It is elastic and adaptable to the need of a division in the field on a line of communications area or any other military administration. It can expand or contract according to actual requirements. In field operations where, for instance, a division may be widely dispersed, and even units such as battalions split up for operational purposes, the system remains effective for each unit carried within itself its own hygiene set-up.

The D.G.M.S. recommended the adoption of the new organisation, an official instruction was promulgated on 3rd July 1942 and late in 1942 field hygiene sections were disbanded.

Naturally certain developments and modifications were found desirable. One of the most significant was the expansion of the Corps Hygiene Training Cadre approved on the War Establishment of New Guinea Force into a hygiene school fully equipped with teaching material and lecture facilities, and the ordinary requirements of a military unit. Further trial of the new organisation proved that it was flexible, and experienced officers were able to exploit this feature, which enabled the plan to be fitted into widely varying terrain and circumstance.

In June 1943 the outlook towards hygiene in New Guinea was found by Major K. Brennan, D.A.D.H. of New Guinea Force, to be most encouraging and sympathetic. The reorganisation worked well, and was favourably viewed by the D.M.S. of First Army. An Administrative Instruction was drawn up by Major English which consolidated all the orders concerning health and hygiene. This simplified both the supervision and teaching of hygiene. English further commented on the improvement wrought by the new method. He found that this improvement had been evident during the eighteen months elapsing after the introduction of the altered establishment: this was due to a number of factors. These were a general increase in knowledge and experience of hygiene officers, the influence of schools and training, on combatant as well as technical personnel, a general awakening of hygiene consciousness; a stricter enforcement of methods and the spreading of knowledge of epidemiology. He considered that the appointment of malariologists and entomologists had done much to place the general cause on a more scientific basis. At corps level the need was felt for more skilled assistance to the corps A.D. of H., so that he could send a competent technician round to demonstrate and implement methods. The establishment was insufficient for the work to be done in some parts of Australia, where the units concerned were responsible for the hygiene of a wide area. The existence of an Allied Services Hygiene Board in Western Australia was found to be of particular value.

The reorganisation was not so easily applied in small units, but even in the absence of definite instructions most of the units allotted an N.C.O., not belonging to the A.A.M.C., for the work of hygiene control, and this worked well. The Corps Hygiene Training Cadre became the New Guinea Force Hygiene School, with adequate facilities, and was already busy giving courses for officers, including R.M.Os. and frequent courses of instruction for water duty personnel.

Water supplies for troops were not satisfactory in all places, and Holmes maintained that the number of water tanks available was insufficient, and would not be able to supply demands in Australian military areas should action take place. Sterilisation of water supply was faithfully performed by units as a rule, and education of the water personnel produced a more palatable drinking water with a correspondingly favourable result on the troops' reaction to the methods of hygiene. Very few units in the Moresby area used the filtration apparatus on water carts, but filtration was carried out there at the pumping station. Water sterilising outfits had given a great deal of trouble, many of these having lost efficiency through effluxion of time and the action of climatic conditions. Replacement to ensure fresh material was desirable. Water duty men, not members of the A.A.M.C., worked under the unit medical officer, and carried out chlorination and detasting and helped in filtration.

Water sterilisation may here be briefly summarised. In the South-West Pacific Area filtration was given up, because it was not essential. Units sending for water found that if they filtered as well as chlorinated they

received less than their requirements. The pump and filter units often gave trouble, mainly because the driver had not been adequately instructed. The mobile army truck could filter 500 gallons in half an hour with a pressure pump. Australian-made filter earth was found satisfactory on test, working as well as the imported *Kieselguhr*. In some instances fouling of wells had been unavoidable by reason of the high water table, and a conservancy system of sanitation was necessary in order to maintain a pure water supply. Individual chlorination had to be trusted to some extent, but it was not satisfactory. The tablets varied in friability and hardness and in solubility, and in any event there was reason to doubt if soldiers would be any more punctilious about this duty than other obligations of hygiene. Where possible, bulk chlorination or chloramination was satisfactory if a correct technique was used. On few occasions only were the results unsatisfactory: this was due to insufficient chlorination. It was desirable that water duty men and other unit hygiene details should attend refresher instructional courses at corps or division in the field, or at the Land Headquarters school.

Later experiences in hygiene were of interest. Some of these have already been incorporated in medical notes on campaigns, such as the Huon and Ramu operations. Brief references may be made to others. A mobile hygiene training cadre was established in II Australian Corps, and after planning and preparing material in the Land Headquarters Hygiene School in Sydney, moved to the Atherton Tableland in April 1943. Here the cadre moved from unit to unit and held courses for officers and N.C.Os. In October 1943 the cadre moved to New Guinea with corps headquarters, and by October had trained 589 personnel of all ranks in hygiene and water duties. The instructional staff also had the opportunity to work under attachment to the 7th and 9th Divisions under operational conditions. This enabled necessary variations to be made in methods and materials, and placed emphasis on improvisation in the field.

Schools were held during 1944 also, when II Corps had become I Corps. From the middle of July 1944 to the end of March 1945, 1,873 personnel of all ranks had received instruction in hygiene, water purification and mosquito control. In April 1945 the cadre moved to Morotai and men were attached to the 7th and 9th Divisions for the periods required during the operations on Borneo. Some need was felt for the provision of self-contained mobile workshops, but the cadre proved elastic and satisfactory as a practical means of disseminating knowledge and methods of securing adequate hygiene in the field.

Lieut-Colonel C. E. A. Cook prepared a special report on the Oboe (Borneo) operations, and made it clear that the ideal of thorough indoctrination of the individual soldier was the pivot of hygiene training. To attain this it was necessary to maintain effective company and platoon training. The method adopted was the use of standard lectures, suitable for the individual soldier, the training of unit instructors, special lectures to senior officers, the holding of courses designed for specialist personnel, and insistence on uniformity and high quality of standards. This standard

was on the whole high, but often weakest among reinforcements. Soldiers not subjected to this training were lamentably deficient in some instances. In one case, during the final operations, neglect of basic precautions produced a badly fouled area, originally virgin jungle, from which an outbreak of Schmitz dysentery arose. On the whole communicable disease was well controlled. Skin diseases were very common; a survey of 1,200 men in May 1945 showed that 27.3 per cent of all ranks were suffering from some form of skin disease, and these affections accounted for 25 per cent of first attendances at R.A.Ps., and up to 20 per cent of all evacuations to medical units for conditions other than injury.

A special factor was introduced into local conditions by the presence of prisoners of war and repatriates. Medical inspection of all these were promptly made, and repeated immediately before any movement took place. Clinical and laboratory investigations to reveal important communicable diseases were carried out at Morotai and if necessary treatment was begun. The problems set in hygiene during this important last stage in the Australian war against Japan were successfully met, and an encouraging view could be taken of the working of the reorganised hygiene services. It was a bold step to make radical alterations in the principles and practice of the hygiene service during active operations, but the results amply repaid all the thought and effort involved.

AUSTRALIAN GENERAL HOSPITALS

As the scope of the war enlarged, the need for more accommodation in service hospitals also increased throughout Australia. These served the military forces of Australia, and also received and cared for casualties from the more forward areas. The high quality of the technical staffs and the amount of accommodation available for the purpose gave them special value, particularly as they were semi-permanent in nature, and could be moved if necessity arose.