FROM the outset the operations carried out in the Huon Peninsula differed in some respects from the previous experiences of the divisions concerned. The air-borne assault on Nadzab by the 7th Division opened a campaign through the Markham and Ramu Valleys to the coast which was largely concerned with air movements. The 9th Division, on the other hand, began with an amphibious operation, and early encountered the difficulties of beach landings and river crossings. Both divisions had to overcome the natural obstacles of difficult terrain, to decide how far forward it was wise to begin surgical treatment of casualties, and to arrange the regional details of transport of sick and wounded over a long and complicated evacuation route. Though the work of field ambulances was often widely different in its application from that of the Middle East, the principles remained similar, in particular the exploiting of the unit’s ability to split off small sections which still retained the functional capacity of the parent unit.

EVACUATION OF SICK AND WOUNDED

The 7th Division. Problems of evacuation from the 7th Division in this campaign fall into several phases; that centred round Nadzab in the action on Lae, that connected with the advance up the Ramu Valley and the final drive from the Finisterre Range to the coast.

On the initial march from Tsili Tsili on Nadzab a detachment from the 2/5th Field Ambulance accompanied the force; a second detachment of an officer and ten O.Rs. was found necessary only for the first two days. Sick were sent back to rearward bases at first, and as soon as the immediate objectives were secured, forward to Nadzab. Casualties among paratroops were treated by the medical personnel of their regiment, and those occurring among the A.I.F. by the ambulance detachment.

Medical requirements for the attack on Lae were met by the M.D.S. staffed by the headquarters of the 2/4th Field Ambulance, and A.D.Ss. set up according to need on the evacuation lines. Forward from the A.D.S. a detachment of an officer and eight other ranks linked the dressing station and the aid post. In accordance with the policy adopted in the Wau-Salamaua campaign and later, a surgical team worked at the forward A.D.S. Within the division during and just after the action against Lae native carriers were used, but the value of employing wheeled transport for evacuation was clearly evident, and jeeps were used as soon as practicable. Fittings were used on the jeeps to carry three lying patients: this method was found useful except where the roads were too rough for sick men, and likely to cause delay and discomfort.
MEDICAL CONDITIONS

After Lae fell casualties from the independent company at Kaiapit were brought by air to Nadzab where most of the work of the 2/4th Ambulance was then being done until this unit handed over to the 111th C.C.S. at Nadzab and moved on to set up its M.D.S. at Kaiapit.

Behind the forward troops the distance between the M.D.S. and the airfield was reduced as far as possible. Usually a jeep could take patients to a plane loading post on the airfield, consisting of an officer and nine O.Rs., but several more men were needed to look after the sick, as the uncertainty of air movements, particularly over the ranges, often kept the patients waiting for considerable times. Early starts were necessary too, owing to the small number of vehicles available, and movement often began as early as 5 a.m. Further, a smooth organisation was needed at the airfield as the planes could not stay long on the ground.

The need for a holding unit was soon evident in the Ramu Valley. The wastage of men with a relatively slight or brief illness made it desirable to return to their units all who could safely be so returned within a short period. Therefore a rest camp or convalescent section of a medical unit saved the loss of men sent to the base. Where two field ambulances were sustaining the medical care of the division one inevitably had to discharge some of the functions of a C.C.S., a static role for which it cannot afford the staff. Unduly high figures were reached for admissions in the clearing station and the ambulance: occasionally the versatility and elasticity of the latter units were strained too far, especially when we consider that the provision of the necessary accommodation was also in part dependent on the efforts of the members of the unit.

The 2/6th Cavalry (Commando) Squadron's organisation for medical evacuation illustrated the opposite aspect, that it was not merely the question of transport of sick and wounded to a unit equipped more or less for acting as a hospital, but the prompt handling of casualties on cavalry lines, with a medical staff moving along the axis of advance. The plan followed with the wounded was to arrest bleeding, apply a dressing with sulphanilamide powder, give morphine, and then leave the man temporarily under cover until he could be brought within the squadron's perimeter or evacuated to another unit. First aid measures were simplified; for instance, "sucking" in chest wounds was controlled by elastoplast until suture was possible. Where a severely wounded man had perforce to be moved before further treatment could be undertaken, injection of morphine (½ grain) combined with hyoscine (1/100 grain) was found valuable. This not only relieved pain but produced an amnesic state which greatly lessened distress. On occasion, morphine for injection was supplied to leaders of small parties of men in very rough country.

Air transport solved the problem of medical disposal when opportunity offered, as at Kaiapit on 20th September, when anti-shock measures and urgent surgical intervention were possible before the patients were sent out of the area. Occasionally time and facilities were lacking and early intervention was impossible, as in the rare abdominal wounds. The Thomas splint was invaluable in a severe injury such as compound fracture of
the femur, and when it could not be carried its loss was felt, as even a short carry would cause a severe degree of shock when no efficient method of immobilisation was to hand. Resuscitation was then a much more difficult problem.

More patients had to be sent back because of malaria than any other single condition. From 22nd September to 8th March, 228 cases of confirmed malaria were evacuated, and in addition numbers of men with undetermined fever were either treated in the forward units or evacuated. Dysentery was not a serious cause of man-wastage, owing to the prompt use of sulphaguanidine. When necessary this was supplied to forward aid posts.

In the early stages of advance up the valley, some difficulty was experienced in crossing rivers until air transport solved the problem. Patients taken by jeep to Kaiapit were ferried in rubber boats across the Umi River after the brigade had crossed. Air transport provided a quick comfortable route to Nadzab, saving a long trip by jeep to Kaiapit, but of course other problems could arise, such as bad flying weather or heavy casualties. These conditions could necessitate holding patients en route, which in turn created a demand for more accommodation and for another surgical team.

Goulston was brought up to the Gusap strip with his light section, and there set up a holding post for sick and battle casualties until planes were available to fly them to Nadzab. This post evacuated 136 patients in five days with very scanty facilities. The headquarters of the 21st Brigade was then at Dumpu, and as there were some severely wounded men needing treatment, a team under Major J. Loewenthal was brought up to deal with them on the spot in an extemporised theatre. A few days later patients were arriving faster than shelter could be provided, and no tents were available, but twenty beds for admissions and thirty beds for a surgical ward were then in operation at Dumpu. So well did these extemporised measures meet the need that a centre equipped for urgent surgery was open and ready in the foothills. The 2/6th M.D.S. was by that time holding 245 patients, and went on to establish records for a field ambulance. The day after this expansion began, the headquarters of the unit was at Uria-Ramu junction, and its “A” and “B” companies arrived by air from Nadzab. As the brigade moved up the Ramu Valley a medical detachment moved with it. The 2/6th Ambulance was flown by plane loads to Gusap, and when an M.D.S. was established at Dumpu minor conditions were treated there, and men more seriously ill were, if practicable or desirable, flown back to Moresby.

During the operations in the foothills of the Finisterre Range to the north of the Ramu Valley, transport of casualties was accomplished by native carriers and members of the medical units, and this arrangement satisfactorily handled the number of casualties encountered. Jeep transport proved very useful, though slow and often rough, owing to the difficult country traversed. Certain other drawbacks were observed. Delays were often inevitable when the number of patients was considerable, as the
vehicles were controlled by the Army Service Corps which had important duties to discharge. It was similarly difficult at times to secure transport for urgent cases.

As on other fronts natives preferred to make their own stretchers, though one-man tents served the purpose in some areas. The Stokes litter was found useful, especially over difficult trails, and was used with some success forward to the Evapia River as a flying fox to cross the water. During heavy rain a bridge was washed away over the Faria River, but this difficulty was overcome by detailing a ferry party of one N.C.O. and eight O.Rs. to take patients across the river.

At the beginning of January actions began on the higher ground leading to the attacks on important features, such as Kankiryo Saddle and Shaggy Ridge. The extremely difficult terrain increased the time elapsing between wounding and arrival of the casualty at a medical post. For this reason, in order to reach the A.D.S. before nightfall it was necessary that wounded men should leave the forward R.A.P. shortly after midday. Where possible, native carriers were used, but unit bearers collected wounded from the forward areas and handed over to the native squads at the forward aid post. The task was made more difficult by the shortage of trained medical orderlies. During the fighting on the ridges through lack of sufficient stretcher bearers and native carriers, many casualties could not be brought in to the A.D.S. for two days after wounding. Neil Robertson stretchers were found most valuable in moving wounded down the cliff sides, though the type of stretcher available was rather heavy for convenience. On certain parts of the mountain trails the razor-back ridges were so steep and slippery that field ambulance members had to pull themselves up by ropes tied to trees. These ropes also proved very helpful in carrying stretchers down.

While the attack on the Kankiryo Saddle was in progress, the ambulance section had the task of rescuing wounded men from a rocky slope too steep even for native bearers. The stretchers were brought up by a chain of men passing from hand to hand. Surgical teams were attached to the A.D.S., and after treatment patients were taken by jeep to the M.D.S. at Dumpu.

Valuable experience was gained and lessons learnt concerning evacuation of casualties in difficult country: these were recorded by a conference of officers concerned. The most important recommendations may be summarised as follows:

1. The R.M.O. should always be acquainted with the situation and keep himself informed.
2. Field ambulance officers should get to know the country.
3. The R.A.P. should be as far forward as possible.
4. In moving aid posts and supplies help is most desirable.
5. The ideal time for the casualty to reach surgical aid is six to eight hours. As bearers cannot travel at night it is desirable that attacks should be timed early in the day.
6. It would be ideal to have some natives allotted to the medical services with an Angau representative, or a battalion native liaison officer to control natives at the battalion end.
The 9th Division. The experiences of the 9th Division were varied during campaigning in the Huon Peninsula, and much effort and ingenuity were called for in the three fields of medical evacuation, by sea, land and air. In his report on the work of the 9th Division medical services in the Lae and Finschhafen campaign, Colonel Hanson remarked that facility in what might be called jungle war-medicine could only come by individual experience. Instances have already been mentioned of difficulties which arose in units or services untried in battle conditions. Work on the beachheads had to be adjusted to the local conditions; a medical unit had to be set up quickly and consideration of the absence of native bearers and the small numbers of bearers in the ambulance units demanded that the carrying distance should be short. Surgical aid was needed in M.D.Ss. within the beachhead, and dressing stations with attached surgical teams should be ready to move forward as required. Field Ambulance detachments were provided to act in close relation to each battalion. This principle of sub-division was carried out with each ambulance company, which was split roughly in two, and small “main” dressing stations were formed, comprising one or two officers and thirty-five men. Three of these four sub-divisions were allotted to battalions and the remaining fourth was kept in reserve by the ambulance commander for various duties as occasion demanded.

It was fortunate that during the landing operations casualties were largely limited to those arising from an early bombing attack; as it was, the arrangements for evacuation were disturbed and delayed. During the second stage of the operation communications were limited, and the A.D.M.S., finding that an inspection of any area involved a day of strenuous travel, had to rely on the medical officers in forward areas to use that initiative which had been encouraged during their training. A small craft for carrying patients from the Burep River to Red Beach and back would have been most valuable; the paucity of such transport made this impossible, but these runs by sea soon became better organised, and casualties could be handled with reasonable expedition. Hanson recognised that the utmost energy and drive were required of A.D.S. commanders to get their patients back to an M.D.S. in an operable condition. The physical strain on stretcher bearers was in some instances extreme.

Evacuation from the beachhead was not at first satisfactory, partly due to the lack of coordinated method: the experiment of attempting to weld the different methods of the American Medical Company and the Australian Medical Corps had not been successful. After the closing of the American Medical Company the situation was eased by the arrival of another Australian unit, the headquarters of the 4th Field Ambulance, on 10th and 11th September, and a permanently staffed beach post was established. This unit had some ambulance cars which were helpful except when the local mud was too tenacious, when hand carriage was the only alternative and occupied many of the hours of darkness.

After the capture of Lae arrangements matured for the return of patients in empty cargo planes, and by the end of September these
transport methods were so far stabilised that it was not necessary to keep the 2/3rd C.C.S. in this area. In January the 106th C.C.S., then stationed in Lae, was very busy, and during the previous quarter would not have been able to carry on without help from orderlies detached from the 10th Field Ambulance and the 2/7th A.G.H. Its numbers at one point actually reached the high level of 1,100 patients, and for a time in November 963 beds were occupied out of a bed state of 1,000.

No hospital ship or carrier was available for the transport of casualties from Finschhafen, a distance of seventy miles, which took the small open landing craft some eight to ten hours. This remained a responsibility of the 9th Division. In Lae there were no facilities for the handling of casualties from Finschhafen unless air transport was promptly available, a situation that neither the divisional detachment in Lae nor the extra-divisional organisation there could handle without subjecting the patients to a double move. For some weeks it was necessary to break the patients' journey at G Beach near the Burep River, admitting them to M.D.Ss. until the next day, when they were re-embarked and taken round to Lae in time for a plane. In addition beach medical posts were working at Scarlet Beach, Red Beach and "7,000-point" beach Lae. When the heavy section of the 2/3rd C.C.S. arrived early in October, a detachment of the 10th Field Ambulance accompanied it, for sea ambulance transport duties. This unit was used for some time for similar purposes, with a most favourable effect on transport of sick and wounded.

The occurrence of hostile action at Scarlet Beach, when part of the staffs of the 2/8th and 2/11th Field Ambulances had to move patients to Simbang by sea was an instance of the drawbacks of having restricted transport. This journey was made on two landing craft, which were so heavily loaded that two empty craft passing them on the turn into Langemak Bay stopped their engines lest their wash should imperil the unwieldy boats.

When the Australian attack on Sattelberg and Wareo began, an M.D.S. was built at Heldsbach, and later a divisional rest centre was opened at Siki Cove. These provisions, and the use of returning native porters for the carriage of sick and wounded, helped smooth evacuation greatly, as short-term illness could then be treated without undue demands on transport. The arrival of the 2/2nd C.C.S. also helped in the difficult period ended by the fall of Wareo and the subsequent drive up the coast. The 2/3rd C.C.S. found the strain excessive when the daily intake reached 150. The absence of an administrative headquarters close at hand was felt at first, until the advanced headquarters of II Australian Corps arrived in Finschhafen, and took over the supervision of evacuation from the D.D.M.S., much to his relief. It was impossible for distant formations to solve problems of movement which could only properly be dealt with on the spot.

In June, hope had been raised that a sea ambulance transport of more suitable nature than the various forms of landing craft might be fitted out for this campaign. In early November Stradbroke II appeared, and later
in the month U.S.S. *Norab* arrived. *Stradbroke II* was originally a luxury yacht, and on conversion to a coastal hospital vessel could carry twenty-eight patients lying and thirty walking. Bunks were provided below, but these were not satisfactory, as stretcher racks of standard size would have given simpler and speedier loading. Patients were transferred from the vessel to D.U.K.Ws.,¹ which took three stretchers per vehicle to the shore where ambulance waggons waited. Walking patients were taken direct to an airstrip. Though there was inadequate protection from the weather D.U.K.Ws. proved very useful. One such combined trip could be made every forty-eight hours, and occupied nine hours.

Plane transport used Nadzab as an intermediate calling place at this time, but arrangements were made to go direct from Lae to Moresby or to Dobodura. The next step was to make Finschhafen the terminal for air transport. The Lae evacuation post was medically managed by Captain J. R. Sands with a detachment of the 10th Field Ambulance. For the months of October and November the total patients handled numbered 1,382 and 966 respectively; so that from the establishment of the post on 5th October, 2,348 patients were transported to base up to the end of November. Of these 22.8 per cent suffered battle casualties, 26.4 per cent had malaria and 9.9 per cent had P.U.O. There was in addition a residue which included an average of 23.6 per cent of sick who were not further differentiated up to that time.

The sea-air evacuation from the Finschhafen C.C.S. to the 2/11th Hospital at Dobodura occupied twenty to twenty-two hours, and required transfer of the patients successively to barge, sea-ambulance transport, D.U.K.W., ambulance waggon, plane and ambulance. Supervision by a medical officer was practically constant, and disturbance by loading and unloading was minimal. Loading the ship from the barges was quickly done, as the barges went out to meet the transport before it anchored. Similarly, at Dobodura the planes signalled by flag if they carried patients and were met by stretcher bearers and ambulances. Food, shelter and medical attention were available while the patients awaited a plane. During the flight from Lae to Dobodura patients were attended by an orderly of the American Air Evacuation Company, and an evacuation post formed on the airstrip by a detachment of an Australian field unit.

When the American hospital ship *Norab* arrived, runs were arranged to alternate with *Stradbroke II*, but schedules were not always maintained. *Stradbroke II* broke down, but *Norab* maintained the run till the middle of December, when air transport was in full swing from Dreger Harbour, Finschhafen. Though these two S.A.T. did not lift the number of patients at first expected, they gave valuable service at a time when a break-down in evacuation would have been serious owing to the lengthening line of communication. While *Norab* was operating as an S.A.T. an additional barge was available to the A.D.M.S. 9th Division, and air transportation was working smoothly, which was fortunate, as *Norab* was the only craft

¹ Amphibious powered vehicles: craft named after the official factory serial numbers.
taking patients from Finschhafen by sea. It was found that patients thus evacuated returned sooner than those sent by air to Moresby. Before these ships were available, most of the evacuation from Finschhafen was by small craft under command of the 9th Division. At first there were fears that exposure and discomfort might prove detrimental, but the sea was calm at this time, and sea-sickness was rare, and the condition of the men on arrival in Lae was better than expected. Hanson, however, pointed out that members of the 2/3rd C.C.S., realising that the hazards of uncertain evacuation arrangements might react severely on sick men, selected those for movement with great caution, even though this policy tended to overcrowd their own unit. It was hoped that detachments of the 10th Field Ambulance could care for men in transit on the small craft, but there was usually no space available for them, and enemy air attacks on Scarlet Beach interfered with normal work and gave full occupation to these detachments. A proportion of men arriving at the medical base at Lae showed signs of deterioration after certain unavoidable hardships of travel, but on the whole this was not an appreciable risk.

Some of the difficulties attendant upon disposal of the sick and wounded began in the early stages of planning. Movement and regrouping of armed forces were inevitable results of an advancing campaign, and evacuation measures were often complicated thereby, as the sick and wounded passed in succession through several administrative areas. Even discussions at a high level between Allies did not always resolve difficulties, owing to differences between services in military organisation, in methods and in standards. For example early planning for evacuation involving the use of sea ambulance transports revealed differences in opinion regarding the attendance practicable or desirable on these ships. Arrangements for medical attention on board, for medical supplies, and equipment and for provision of food all gave trouble. To obtain suitable sea-going craft was also far from easy, for the types of craft most suitable for this purpose were not always available.

In January 1944 the facilities for air transport of sick were expanded by the use of the airstrip at Dreger Harbour. The 10th Field Ambulance supplied a detachment to this air evacuation post, and late in January this unit had approximately 100 personnel at Lae, fifty at Dreger Harbour and forty-five at Launch Jetty. The tasks they performed were concerned with the evacuation of patients from the 106th C.C.S. at Lae to base areas and the handling of patients sent by air from the 2/2nd and 2/3rd C.C.Ss. In addition the ambulance carried out local improvements in the post at Dreger Harbour, and provided for the reception and disposal of patients who arrived by barge from forward areas, or were sent from the C.C.Ss. by barge to Dreger Harbour and thence to base by air.

Further trouble occurred when Norab could not proceed north from Dreger Harbour, and Swan instead made the connecting trip to transfer patients for Lae to Norab. Unfortunately Swan sank as the result of an explosion, and only one medical L.C.V. remained for regular transport from Launch Jetty to Dreger.
At the end of December a decision had been made to expand the 2/2nd C.C.S. up to a capacity of 600 beds. In order to facilitate this the 2/3rd was instructed to cease admitting, and to detach to the 2/2nd a medical officer and thirty O.Rs. The 2/11th Field Ambulance began to prepare a rest camp at Scarlet Beach to hold 500 convalescents for periods usually not longer than fourteen days. This enabled the 2/8th Ambulance, which had been holding some 130 patients at Masaweng, to empty with a view to moving on 3rd January. The 2/3rd Ambulance which was situated at Bonga on the evacuation line of the 24th Brigade, meanwhile was holding 150 patients.

As the pursuit of the Japanese accelerated up the coast the first medical task was the prompt establishment of evacuation posts on the beaches as beachheads were captured. This was at first carried out by the A.D.S. supporting the reserve battalion of the forward brigade, but later the freeing of the 2/3rd Ambulance from Wareo enabled an A.D.S. to do this work.

The advance to Sio offered no special problems: the divisional front was relatively narrow, and the flanks well protected, and casualties were collected without difficulty. As the line stretched out, the journeys made by small craft became longer, but the advent of bad weather made the trip rough and occasionally dangerous. This made it necessary to increase the holding capacity of the forward medical units. Fortunately, the incidence of pyrexias declined, and the changing monsoon gave a following northerly wind which permitted evacuation to Finschhafen. By using three ketches fifty to seventy patients could be transported without hazards of fuel or weather against a head wind. The obstacles of bad weather did not prove as formidable as expected, and evacuation proceeded satisfactorily.

The 5th Division. The work of the medical services in the 5th Division from March 1944 onwards introduced a new phase in evacuation of the sick and wounded, since it was largely dependent on sea transport by barge. Airstrips were not available beyond Saidor and land transport was restricted by the local geographical conditions. In the sector from Saidor to the mouth of the Ramu River jeep traffic was only possible over limited stretches, as the coastal track was constantly intersected by streams. Fortunately most of the beaches were suitable for barges, though patches of jungle often grew to the edge of the water, and jetties were dotted only occasionally round the coast. The demands of operations in other parts of the S.W.P.A. limited the amount of sea transport which could be spared, but, although this amount was not sufficient for the movement of men on any but a limited scale, an adequate and reasonably comfortable line of sea communications was maintained.

NUTRITION

The whole question of rations and nutrition was given serious attention during the Huon Peninsula campaigns. Package and distribution were, of course, of great importance, and the latter in particular was fraught
with many difficulties. These difficulties varied in type and intensity at
different periods of the campaign, and the actual ration itself was directly
related to distribution, as mobile troops required food from a pack con-
taining the balanced day-by-day requirements of a small number of men
or even one man. The “operational ration” was devised to meet this need.
Early in December Lieutenant H. E. Young, who was a field researc
officer in nutrition at the Australian Headquarters, examined these prob-
lems in the area of the 9th Division. The use of tanks at this time made
it necessary to maintain a jeep track for supplies; therefore this set-up
did not represent the typical picture, but rather the more complex one
of jungle warfare with difficult lines of communication not always covered
by special carrier teams.

The opinion of the medical services was that mobile troops did not
receive sufficient vitamin B complex with their rations until the operational
ration came into use. Some of the larger packs used in the ordinary scale
were wasteful, and opportunities for the use of some components such
as margarine and wheatmeal were not always available. “Marmite” or
substitute often could not be obtained. Young in a nutritional survey of
the 9th Division estimated the ascorbic acid content of samples of the
ration obtained from cookhouses and A.A.S.C. stores. No major variations
from normal values were found, and the amount of this vitamin available
in the canned goods examined was within normal range. Fresh foods were
not obtainable there at that time.

The powdered and condensed milk supplied were found of good quality,
and tea and sugar were of ample quantity, though there was considerable
wastage of tea packed in thin wooden boxes permeable to moisture. Blue
boiler peas, designed to furnish vitamins, were not successful and often
arrived mouldy or fermenting. Margarine was satisfactory in quantity
and flavour, but the “tropical spread” was hated by most men. In several
of these types of tinned foods there was undue wastage owing to the large
size of the containers. A cold store at Finschhafen made it possible to
supply fresh butter to troops in the vicinity, with whom it was very
popular. Field bakeries did good work in localities where they could be
established, as at Finschhafen, but carriage in sacks to more distant areas
was not successful. Biscuits were plentiful, but were disliked by the men
and by many dental officers also.

The staple food of the division was bully beef, but the large size of
the case, 53 pounds, required two men for its carriage, and therefore
cases were broken so that a single load did not exceed 26 pounds, which
could be carried by one man. The meat and vegetable ration was not liked:
as a breakfast dish it was particularly monotonous, especially when served
cold to mobile troops. Fresh meat was most popular, but it could not be
transported far in that climate without deterioration: this reduced the
ration to 4 ounces. Ham and bacon were sometimes available, they kept
well and were greatly liked. Tinned herrings still evoked the dislike of
the men, and the poor quality of Australian salmon did not arouse popular
esteem. The troops grew tired of fruit juices, but in fact these were of
very good quality and were appreciated. The forward operational ration was most useful for troops like commando squadrons, though after the third day of use the predominant sweetness of this ration made the men tire of it. "Canned heat" on a scale of one can to two men per day was very valuable, and provided each man with three cups of tea a day; an increase would have been appreciated. It is interesting that ascorbic acid tablets, which were in fairly adequate supply, were asked for by the men, though to pack them in 100-tablet bottles was wasteful, as the tablets became moist. Fortified chocolate was most successful, and was regarded as a "morale builder". Wheat germ was supplied to provide vitamin B complex, but it was only with certain foods like wheatmeal that the men were willing to eat it. In general, Young found that deficiencies were due more to unsuitable size and design of packages than to difficulties of transport.

A similar survey of the 7th Division showed the general position in December 1943 to be much the same as in the 9th Division. Tinned vegetables were satisfactory, with the exception of cabbage, which few of the men would eat. Blue boiler peas were more edible than in some other areas; troops themselves showed enterprise in sprouting the peas, and ate them raw. The bread position was very satisfactory with two brigade bakeries staffed by personnel of the Catering Corps. Bread rolls were issued in the more forward units and were much appreciated. Wheatmeal was liked by most of the men when facilities for cooking were at hand. Ascorbic acid was often in short supply with the 7th Division, and for a time, until the lack was remedied by a member of the Catering Corps, salt was also not fully supplied. The forward operational ration was found to be very good, and throughout the 7th Division its liberal supply produced economical use of the regular standard ration, avoided monotony, and prevented wastage. It was realised by the catering nutritional advisory staffs that a certain amount of education was needed in order to ensure correct use of the operational ration. New formations entering an area were often not well informed on this subject. Fresh food was not easily obtained, but the arrival of an occasional plane load from Mount Hagen and small local purchases showed how it was appreciated. In the commando units a greater independence was necessary. The 2/6th Cavalry Commando Squadron baked its own rolls, and the men sprouted blue peas in tins or dixies while on the move.

It was found that 38 to 39 ounces per man constituted the minimum amount of daily ration which would prevent loss of weight. One unit used a ration of 32 ounces over short periods; but over a longer period nutritional disturbances could be expected. The "Q" Branch of New Guinea Force advised that the field operational ration, containing 3,750 Calories and fortified with vitamins, should be used in all operations where troops were engaged from other than base areas, and in all forward areas until the combined ration scale could be applied. It was further recommended that vital foodstuffs should be sent to forward areas in small containers till satisfactory distribution could be assured.
The field operational ration was particularly useful for patrols, but only one or two days' supply could be easily carried. Making up insufficiencies with the emergency ration was not regarded as desirable, but on occasion it was difficult to suggest another course, as the troops could not live off the country. However, long patrols of six days or more were usually exploratory in nature and native carriers could be taken.

Deficiency disorders. After previous campaigns cases of avitaminosis were reported, though these were not of serious type or degree. The vitamins deficient were ascorbic acid and the B complex. Loss of weight, muscular weakness, disturbances of sensation, oedema of extremities, and lesions of the mouth, lips and tongue were the most commonly seen signs and symptoms. These were observed after the rigorous conditions of the Owen Stanley Range, in the Wau-Salamaua sector, and after or during the Ramu Valley and Finschhafen operations. Early in 1943 the Director of Medicine wrote to the D.G.M.S. stating that there had been definite evidence of nutritional deficiency among troops in forward areas in New Guinea, and that the signs of B deficiency indicated that the amount in the diet of most troops was too small. He considered that, although there was a sufficient supply of ascorbic acid tablets for forward troops, the proper use of available foods would be better. He recommended fortification of bread in field bakeries and supply of dehydrated butter as helpful in attaining a balanced ration.

During the Huon and Ramu campaigns there were occasional clinical evidences of deficiencies noted in previous campaigns. Royle of the 2/10th Battalion and McDonald of the 2/12th Battalion noted that a considerable number of men were sent to the R.M.O. by platoon commanders as unable to cope with infantry training. Some of these were apathetic, and had no appetite, and examination showed some tenderness of the shins and analgesia of the leg muscles. A few had oedema, and in addition conjunctivitis and bleeding or ulceration of the gums. Not all these findings could be necessarily attributed to avitaminosis, but in view of the dietetic conditions prevailing in areas where it was hard to supply fresh foods, it seemed likely that there was at least some deficiency of the B complex. Intramuscular administration of vitamin B1, the only supplement then and there available, was followed by clinical improvement, which was not observed in a control group receiving distilled water only.

Ford and other observers at Moresby had at an earlier date seen several undoubted cases of vitamin B1 deficiency. In October 1943 Major N. M. Gutteridge, medical liaison officer with "Q" Branch (Nutrition), reported to the D.G.M.S. on the European ration in New Guinea. He pointed out that there was a deficiency of vitamin C in the rations of the troops, and that distribution difficulties had not been entirely overcome at that date. Air-dropping had improved the position, but shipping space was sometimes wasted by the canteen services in sending bulky breakfast foods and cordials which were deficient in vitamins. Emphasis was also placed on the "morale value" of certain items such as fresh foods, and fortified chocolate.
The Huon Peninsula campaigns viewed in retrospect show that considerable headway had been made in the nutritional side of the care of troops committed to action in this rough country with its obstacles of climate and terrain. Officers and men were attaining more experience, and were rather better educated in the scientific and practical side of the problems of rationing in the field, and distribution was better carried out. Having in mind the coincident wastage of troops by endemic disease the position was improving, but further advances were needed so that all effort might be applied where most needed.

**MOSQUITO-BORNE DISEASES**

The disease of prime importance was of course malaria, not only by reason of its disappointingly high incidence in the 7th and 9th Divisions, but because of its inroad into manpower.

*Dengue fever* was of much less serious import, and the force of individual attacks was soon spent, but its appearance in epidemic form dealt a swift blow at the formations it attacked. Its vector had also the inconvenient habit of biting in the day-time.

Epidemics occurred in Lae, Finschhafen and the Ramu Valley during the operations of 1943. The 9th Division in the coastal sector was heavily attacked. In December 828 cases were notified, and the A.D.M.S. in quoting 8,813 as the total incidence of the divisions, pointed out that men diagnosed as P.U.O. were excluded from the count, which was probably underestimated. The clinical features of the sandfly-dengue fever group of diseases are usually distinctive, but in the early febrile stage if no rash appears the diagnosis from malaria may be in doubt until a reliable blood examination has been made. The rather characteristic variation of the clinical picture from epidemic to epidemic may also cause temporary confusion. However, there was no doubt that a considerable outbreak of dengue fever occurred in both the 7th and 9th Divisions in the latter part of 1943 and early 1944. This alone showed that personal and group precautions against mosquitoes were not being observed effectively, though the more domestic habits of the *Aedes* required preventive measures rather different from those needed for anophelines. There was no certainty in 1943 that the *Aedes aegypti* was the only vector concerned, and experiments were carried out with a view of producing the disease from the bites of mosquitoes allowed to feed on patients with dengue. This research produced no results on this occasion, but early in 1944 further experiments were successful. This work culminated in the establishment of *Aedes scutellaris* as an effective vector of dengue.

Breeding was found mostly in shaded areas, and was commonest in rain water in discarded tins and drums or other containers, also in natural locations such as coconut shells and axils of trees. Some points of interest and importance arose in the epidemiology of dengue in the north-eastern part of New Guinea. Hanson drew attention to the difficulties of precise differential diagnosis, which were probably increased by the occurrence of sub-clinical attacks; but there was no doubt of the nature
MEDICAL CONDITIONS

of the epidemic even in the midst of a considerable incidence of malaria. The origin of this outbreak of dengue was less clear. It seemed likely that there was an infected reservoir of mosquitoes in Lae before it was occupied by Australian troops, but in some other areas, such as the beaches east of Lae, mosquitoes were numerous, but probably uninfected, since dengue was not clinically apparent. Cases occurred, however, within a week of the troops entering Lae, and a few probable cases were observed in units housing men who had been in Lae. Tami Island also proved to be an infected area: there were swarms of mosquitoes, and it had just been vacated by Japanese troops. New reinforcements also contracted the disease. From this data it would appear that the Japanese were the human carriers of the disease in these areas.

The position was not so clear in other areas such as Finschhafen, and in particular Heldsbach, where the first troops living there contracted a fever which appeared to be dengue. Owing to the lack of technical facilities there was some doubt at the time whether some of these fevers were malarial. It is possible that here too the disease was contracted from Japanese carriers infected before the Australians arrived in the locality. Preventive measures against the adult mosquitoes were thought to be insufficient by the D.A.D.H. of II Corps, Major T. M. Clouston. There is no doubt of the importance of natural or semi-natural foci of breeding such as untended coconut groves, and rock pools along the coast, but in addition, defections from hygiene enhanced the risk to troops in these areas, and, in greater degree, to troops entering at a later date. Personal protection against day-biting mosquitoes was difficult to establish and to enforce, but measures adopted against the adult insects were important. In the 9th Division no attempt was made at first to keep dengue patients under nets, because of the discomfort from heat, but later, nets were used till the end of the third day. To reduce the risk of infection among nursing orderlies alone was thought worthwhile.

The A.D.M.S. concluded that the Japanese were already infected, and that coastal areas would probably be infective to non-immune troops. The 20th and 26th Brigades were probably immune for some six months after their considerable exposure, nevertheless fuller precautions against day-biting mosquitoes were advisable.

In view of this epidemic in New Guinea the occurrence of an epidemic of dengue in Northern Australia in 1941 to 1942 was of interest. A conference was held in Brisbane on 29th and 30th May 1943 on the position with regard to dengue and malaria in Australia. Fairley pointed out that the disease was endemic in Darwin, but not in Queensland. In Townsville a sporadic outbreak spread widely among the Services and the civil population at the end of 1941. Moresby had been involved in an outbreak of dengue in the previous year, and its population, presumably partly immune, was not again troubled with dengue fever till early in 1942.

It would seem, looking back with knowledge of subsequent outbreak in New Guinea, that manifestations in Australia, both epidemic and sporadic were not necessarily directly related in causation, but were part
of the characteristic behaviour of the disease. Dengue fever as it occurred in both Australia and New Guinea, gave point to the value of epidemiological study, of biological research, of entomological investigation, and of practical application of the basic and specific measures of prevention. It was important not to regard dengue merely as a nuisance, but as a lesson in preventive medicine, and therefore the Allied Malaria Control Conference of New Guinea Force, formed in February 1943, devoted a meeting to a discussion of dengue fever in January 1944, when the inroads of the infection were evident. Ford drew attention to the severe epidemics which had affected troops on the north coast of New Guinea, especially in Morobe, Lae, Finschhafen and the Markham and Ramu Valleys. A large body of non-immunes entering an infected area such as these would be attacked by a rapid spread which would decrease the efficiency of men in contact with the enemy, both during the febrile and later depressive phases. Lae and Finschhafen in particular illustrated the importance of the possession of a malaria-free and dengue-free base.

Malaria. In both the 7th and 9th Divisions the incidence of malaria was considerably higher than had been expected. The epidemiological picture of the outbreak in these formations was that of a malarial epidemic; its magnitude and its possible implications had given rise to great uneasiness during the latter part of 1943, and by December was causing positive alarm. The Allied Conference on malaria control which met regularly in Moresby, had a meeting on 1st December on the topic of epidemic malaria at which Ford, the senior malariologist of New Guinea Force, gave an address. In this aptly timed account he pointed out how inadequate were many current ideas and views on the great difference between the sporadic and the epidemic inroads of malaria. Earlier in the year susceptibles had been more or less scattered, and only recently had large bodies of non-immunes been collected in the worst malarial areas. Here were the two requisites for an epidemic; a large reservoir of infection, augmented by that arising in the troops themselves, and a plentiful and efficient mosquito vector.

Ford further emphasised that on first inspection of some areas no anophelines might be seen, but it did not follow that this meant safety. On the contrary, the mosquito population would soon be built up in places where all the conditions favoured profuse breeding, and the apparently safe area became an acute menace. The importation of gametocytes in human carriers even into an uninhabited area could bring risk; therefore personal protection should be adopted from the beginning. The ability of the vector to adapt its habits to artificial breeding places like vehicle tracks, and cleared swamps, was a special danger, for, in Ford's words malaria "is a camp follower". The swiftness of the epidemic cycle was not always realised. At the end of the first week after the laying of eggs, adults were hatched, only two weeks more were needed for transmission to occur, at the end of the fifth week the first cases were seen, and after another week gametocytes were forming a human pool. Within two months at the beginning of this cycle infected persons could act as trans-
mitters, and the position became really serious. All this was well-known by the instructed, but it was not easy to translate this knowledge into action, such as personal protection, suppressive medication, destruction of adult mosquitoes and the use of plasmoquine as a gametocide, wherein its value lay.

At 7th January the malaria rates per 1,000 per week were as follows in non-operational areas: Moresby 4.7, Milne Bay 5.3, Buna-Oro Bay 3.7, Morobe-Lae 7.0, Bulldog-Wau-Bulolo 8.0. In operational areas the figures were: Finschhafen 31.1, Ramu Valley 29.1. The rate for the whole of New Guinea was 11.5. Special study of local conditions was often needed to interpret figures. For example in the Ramu Valley some breeding places differed from those seen elsewhere in New Guinea. At Dumpu, 1,000 feet above sea level, Captain D. O. Atherton found larvae breeding in quiet water in gravel beds and shallow channels. *A. punctulatus* flourished here, but was difficult to control by larval destruction; only measures directed against adults were successful, such as sprays and freon bombs. Ideally such areas were best avoided, but this was not always possible.

Fairley reported to the D.G.M.S. on the malarial position on 25th November 1943, stating that it was already serious in the 9th Division in the Huon Peninsula, and grave in the 7th Division operating in the highly malarious Markham and Ramu Valleys. The malarial rate per thousand per week was then 17.2, or expressed differently, 890 per 1,000 per annum. Total malarial casualties for the period 4th September to 26th November 1943 are well shown when expressed as a percentage of sickness casualties and of all casualties including wounds, in both divisions.

Among the forward troops of the 7th Division malarial casualties made up 90 per cent of all the casualties due to sickness, and no less than 83 per cent of all casualties, including battle casualties, were malarial in origin. The corresponding figures for the forward troops of the 9th Division were 60 per cent and 44 per cent. Fairley pointed out that these figures suggest a comparison with the incidence experienced in Milne Bay, but the effect on the force was not nearly so severe in the present instance because of the better general conditions prevailing in the Huon Peninsula campaigns. Control work was less promptly applied in the 7th Division, as the malaria control unit was not brought up for several weeks; the 9th Division had the use of control units at an earlier date. Front-line troops in the 7th Division attained a malarial incidence of 85 per 1,000 per week in the middle of October, and corresponding troops in the 9th Division showed the much lower figure of 34 per 1,000 per week.

Atebrin was plentiful, but, though there was no awkward period of transition from quinine as in Milne Bay, it was not taken regularly by many, as enquiry showed among patients in medical units. An occasional cause of delay in the distribution of atebrin to troops was the temporary loss of a package of the drug which arrived perhaps at night, and went astray among other supplies. When the divisional supply arrived, as it did at times, in relatively small packets, this could easily happen. In the week
preceding Fairley's report when ten weeks had elapsed since the beginning of operations (the classic period required for the building up of an epidemic) the total rate for the 7th Division rose to 93 per 1,000 per week, or 4,840 per 1,000 per annum. The total rate for 30,000 operational troops was 55.3 per 1,000 per week for this period, which coincided with the heavy fighting under difficult conditions which has been described earlier.

By this date it could be authoritatively stated that 0.6 to 0.7 gramme atebrin a week was an effective suppressive dose, as this had been scientifically proved by experiments on volunteers in the Land Headquarters Malaria Research Unit in Cairns. Notwithstanding these experimental findings, the situation was such that it was imperative to ensure that ample concentrations of the suppressive drug was maintained in the body circulation. Therefore the suppressive dose of atebrin for Australian troops in the Ramu Valley was raised to 1.2 grammes per week by order of the Allied Supreme Commander. The average rate per 1,000 per week for December was 43.7, and by January this dropped to 14.3, for the troops of the 7th Division were then in process of being relieved. This improvement was not immediately or solely due to increases in suppressive doses, as was seen when the 15th Brigade, already experienced in anti-malaria precautions in the Wau-Salamaua sector, was brought into the area early in January. Fairley's report also stressed the importance of all the preventive measures, including protective clothing, the correct use of nets, the faithful application of mosquito repellent lotion, the use of pyrethrum bombs in slit trenches and shelters, and the unremitting use of atebrin. There was no doubt that the regular application of repellent lotion was hard to inculcate. Hanson thought that the forgetfulness of fatigue was responsible for more omissions than carelessness. There were no diversions for the troops after dark to keep them awake, and in dawn or pre-dawn reveilles repellent lotion does not seem to have been used. In Lae an attempt was made to waken men at three-hourly intervals for the application of lotion, since they had no nets. As might have been expected it was unsuccessful.

Nets have been mentioned more than once: the A.D.M.S. stated that they were not carried, not used, or used only as a body covering on cold nights. An attempt was made to collect nets with the purpose of re-issuing them when practicable. Experience showed that enterprises like night landings caused some difficulties in the use of nets. A brigade commander found that after crossing the Busu River only half the brigade still possessed nets. Nets may not be much heavier wet than dry, but as Hanson remarked, "that extra two pounds of water must feel like the load of Atlas". Everything carried by the soldier should be as light as possible. Questioning of fifty men engaged in the action against Lae showed that only 10 per cent of them used nets for the whole period in the battle area. In some base areas, such as Moresby, dress regulations were relaxed by recent consolidated orders, but the medical opinion, including that of the Combined Advisory Committee in Tropical Medicine, Hygiene and Sanitation was
opposed to this. It was thought wise to prohibit shorts in all malarious areas, including Moresby.

Enquiry showed that many faults could have been remedied by greater awareness of the position and prompter action. Dengue was late of recognition in some areas; meanwhile no action was taken against day-biting mosquitoes. Nets were discarded, usually on the soldiers' own initiative; dress discipline was good in some formations, lax in others; atebrin discipline was not always good, and mosquito destruction was not always directed against adults as well as against larvae in infected areas. Because larval destruction was a special duty carried out by malarial control units, officers and men alike were prone to neglect the simple use of a spray to kill the adult insects.

Garbage destruction was often neglected, and until the ready cooperation of American colleagues was obtained, dumping of unconsumed food in base sub-areas by Allied troops and the Fifth American Air Force was for a time a nuisance and a certain risk. In all such matters constant vigilance was necessary. Indiscriminate dumping of empty tins gave unwelcome opportunity for breeding of the mosquito vectors of dengue in infected areas, but all infractions of the rules of hygiene were bad as they made the men constantly careless of other preventive measures.

The question of battle strain in relation to malaria has been raised. The medical officer of the 2/6th Cavalry (Commando) Squadron formed some conclusions on this point. Malaria was far the commonest reason for evacuation. Between 22nd September 1943 and 8th March 1944 there were 228 confirmed cases of malaria in the unit, not including men with unconfirmed fevers treated in the lines. The incidence of malaria was found to depend on the area of operations, the degree of mental and physical strain associated with an action, the fitness of the men, a condition partly dependent upon rations, and the standard of anti-malarial discipline. Severe strain seemed to predispose to malarial break-down with a declared attack, but it must be remembered that periods of strain are conducive to neglect of precautions. Where more than one cause was present the number of cases increased, for example in the Kesawai area which was a centre of active operations, and was surrounded by several old native villages. The favourable effect of firm disciplinary measures of personal prevention was clearly evident as the campaign went on.

During the last part of September and the beginning of October the unit was strenuously engaged, rations were poor, and the native villages in the area were heavily infected, the average spleen rate being 70 per cent for the area. Few personal protective measures could be observed, and by the beginning of October the results were manifest, as malaria appeared in the unit. The numbers evacuated fell when the men were able to have a brief rest, but a move to Kesawai produced a further rise. For the first quarter of 1944 the squadron was withdrawn to a comparatively safe area where conditions were good and there were few mosquitoes: with good discipline malaria dropped to one per week. It was thought that only a certain percentage of cases were primary, as a large
proportion of a draft of fifty-one reinforcements developed malaria within a few days of arrival. Infection had evidently occurred between the Canungra jungle school and Dumpu.

As the 7th Division pressed on from Nadzab with its inland mission, progress figures showed that the devastations of malaria were more serious than had been expected. That over 1,000 primary cases of malaria should occur in such an experienced formation in some two months was chastening, for there were actually good reasons why the incidence should be consistently falling. All measures for group and individual protection were available, but that these advantages were not made operative to full extent was obvious. An official report on this part of the New Guinea campaign stated that "there is still some laxity of personal anti-malaria precautions": this was an under-statement. There was undoubted carelessness in applying precautions, for in spite of educational measures the men assumed that no mosquitoes were in a neighbourhood if the only evidence of their presence was an attack of malaria.

The efficiency of preventive measures depended on the degree of constancy with which the suppressive was taken and other methods applied as shown by experiences in the field. Malariologists, Ford, English and Fenner, had been appointed to the higher formations in the field to coordinate the preventive measures, in particular the work of the malaria control units, and entomologists were appointed to work in mobile units under Lieut-Colonel Mackerras. The pathology and hygiene organisation under Colonel E. V. Keogh was sound and active but the malarial battle could not be won by the technical staffs and advisers only. The Allied Malaria Control Conference in Moresby, drew together Allied medical officers and others engaged in prophylactic scientific work, and disseminated useful and accurate knowledge.

With its headquarters in Brisbane under the chairmanship of Fairley, the Combined Advisory Committee was the technical adviser to General MacArthur, and drew on the medical resources of all Allied medical services. All important medical directives issued by MacArthur were based on recommendations of this body. Yet in spite of these advantages of organisation and of application of close study and scientific research, the malarial losses were formidable. The basis for preventive measures was sound and firm, but more drive was needed to ensure that the soldiers themselves from highest ranks down carried out the necessary measures. The centre and energiser of the campaign against malaria in the Australian forces was Fairley. His great ability and experience and equally great drive and personal influence were chiefly used to control and direct increasingly better methods of diagnosis, treatment and prophylaxis of the disease which could lay waste an army and render the best military planning of no effect.

The period of September 1943 to March 1944 was well covered in a report on malaria in coastal operations in the Huon Gulf and Huon Peninsula by Fenner. This dealt with the history of the troops concerned, their standard of control and the results.
The terrain was highly malarious; the military operations were highly successful. This campaign began with better prospects than others previously fought. Equipment was better, protective clothing was worn, mosquito repellent and atebrin were available, and mosquito control was applied at an early stage in the operations, the control units moving with the troops. Notwithstanding all this nearly 10,000 men were evacuated with malaria.

Some of the troops concerned had little previous malarial experience, the 9th Division had been in Syria as occupation troops only; the 4th Brigade had been for several months in Milne Bay under the 5th Division, whose control was good; the 8th Brigade Group had no previous relevant experience. The troops were staged at Milne Bay and Buna; discipline at Buna was only fair. There was no question that the malarial risk was high in Lae and Finschhafen; the Japanese suffered heavily, 308 died out of 708 admitted to one of their field hospitals in the Huon Gulf area. An estimate was made of the malarial risk in the areas in which Australian troops were engaged at the time of the operations. This showed that the risk varied from very low to very high, but it was high in most of the important areas, and a low apparent risk was no earnest that military occupation might not increase it dangerously. Conditions were favourable for survival of adult mosquitoes long enough to enhance the risk of a rising infection rate. It was most important to realise that low anti-malarial discipline increased the risk of a gametocyte reservoir among the Allied troops. In Lae and Finschhafen adult control was ineffective; in Lae gametocyte carriers were promptly segregated, with the result that larval control was rapid and effective, whereas in Finschhafen this segregation was ineffective and larval control was consequently slowed.

The malarial risk was high during the first month after the landing, and it was only after this that control reduced the risk. Fenner made an analysis of the capture of Lae, the capture of Finschhafen and the enemy counter-attack, with the following offensives on Sattelberg and Wareo, and the final capture of Gusika-Wareo line.

Though allowances must be made for the different nature and intensity of these actions, the sick wastage figures as given in Fenner’s report are most significant, as will be seen from the accompanying table:

<table>
<thead>
<tr>
<th>Date and place</th>
<th>4th-17th Sept 1943</th>
<th>22nd Sept-10th Dec</th>
<th>3rd Dec-1st Mar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lae</td>
<td>Finschhafen</td>
<td>Gusika to Saidor</td>
</tr>
<tr>
<td>Killed and missing</td>
<td>150</td>
<td>291</td>
<td>83</td>
</tr>
<tr>
<td>Wounded</td>
<td>397</td>
<td>1,037</td>
<td>186</td>
</tr>
<tr>
<td>Malaria</td>
<td>62</td>
<td>3,400</td>
<td>4,300</td>
</tr>
</tbody>
</table>

The troops chiefly concerned were as follows: Lae: 20th Brigade, 26th Brigade, divisional troops 9th Division, 24th Brigade, 4th Brigade; Finschhafen: 20th, 24th, 26th and 4th Brigades; Coastal campaign: Bonga to
Fortification Point, 4th and 20th Brigades; Fortification Point to Sio, 20th and 26th Brigades; Sio to Saidor, 8th Brigade. The number of cases of malaria occurring as an immediate result of the capture of Lae was 1,612, those from the Finschhafen campaign were 3,597, and as a result of the coastal operations 2,927.

This analysis pointed out that, though malarial wastage had been used as an index of fighting efficiency of troops engaged in the tropics, this factor is only one and too much importance can be ascribed to it. It was right that due attention should also be paid to the length of service in New Guinea, the physical condition of the troops on arrival there, the severity of the fighting, and the provision of reinforcements. The quality of rations and the efficiency of arrangements for medical care and convalescence were also important. Certain of these factors were well illustrated in the records of the 9th Division and the 4th Brigade. This brigade was much longer in New Guinea before the active operations than the division, five months as against one month, and had no reinforcements, whereas 3,400 reinforcements reached the 9th Division. The percentages of malarial wastage were comparable, 44 per cent of the division including reinforcements, and 43 per cent of the brigade, but the brigades of the 9th Division were still an efficient force some weeks after the end of active fighting, whereas the 4th Brigade had its battalions reduced from a strength of 1,658 to 952, many of whom showed a deterioration in physical condition. A more striking example had been seen in the Buna-Sanananda campaign, after which the troops engaged showed very definite reduction in physical vigour and capacity, and needed rehabilitation. The actual wastage was not so high in troops committed to driving the Japanese out of the Huon Peninsula as it was after the battles in the Buna area. The supply position of food, anti-malarial stores, in particular atebrin and nets, was more satisfactory and reliable in the 1943-44 campaigns; mosquito control was better organised and carried out.

Mosquito control warrants some further notice. Control by units was not very satisfactory during active operations. Hand sprayers suffered a high wastage rate, and the troops were not familiar with the use of freon dispensers, except in medical units, most of which achieved reasonable destruction of adult mosquitoes. Larval destruction was also poorly carried out by units until operations were over; this was hindered by loss or damage of knapsack sprayers.

Malaria control units were available early in the landings, and did useful work in adult destruction except in areas where protective blackout was enforced. Larval destruction produced prompt good results in Lae; in Finschhafen the tardiness of arrival of a second control unit hampered the work, as did also shortage of labour. Along the coast more prompt action was possible and the malarial risk at Masaweng, Sialum and Kelanoa was thereby lowered. Segregation of the gametocyte reservoir could be only partially achieved where native porters were used during operations, and where development of bases brought increased numbers of natives into these areas. In Lae, the 5th Division lost no time in
settling the native population away from the planned base. In Finschhafen, there were difficulties in removing a considerable number of natives. In medical units too many patients had to be treated without nets, which were seldom sent with the soldiers from their units. Narrowness of the standard ambulance stretchers and the native-built beds prevented proper rigging of the nets; the only effective solution to this difficulty was a wider stretcher. In some areas there must have been considerable numbers of gametocyte carriers; their reduction could have been achieved by better standards of anti-malarial control.

Recapitulating the position observed with regard to disciplinary factors, it must be admitted that the general standard was low, because it was not thoroughly enforced. Elementary dress regulations were not widely observed, and bad examples were set by some who should have known better. Repellent lotion was used, but in haphazard fashion, and its application by troops on duty after dark and at dawn was not controlled. Atebrin administration was not closely enforced, and the omission of occasional doses soon allowed blood concentrations to drop below safe levels.

Much has been said about nets already but five faults stood out as significant: (1) neglect of officers to ensure that men carried their nets, (2) failure to replace unserviceable nets, (3) lack of supplies of nets of suitable weave, (4) failure to inspect nets for defects, and (5) lack of supervision on the mode of their employment. It is difficult to assess the degree of protection nets can afford during operations, but it was an appreciable factor. At a later date, at the end of March 1944 the whole of the 7th Division, then nearing its time of relief, showed a malarial rate of 11 to 15 per 1,000 per week, while the 18th Brigade, undertaking a difficult operation, had a rate of 25 to 30 per 1,000 per week, rising later to 45. A factor in this rise was probably the accidental leaving of nets behind.

Slips and failures were often conditioned by human factors, and are not wholly unavoidable, but they were too many in these campaigns. This may be again reinforced by figures: during the period 5th September 1943 to 17th March 1944, 9,942 men were evacuated to medical units with malaria out of a total of 28,059 Australian troops engaged on the northern coastal areas of New Guinea. The greatest danger appeared to be due to early infection by adult mosquitoes already in the areas on arrival of the forces, and to inefficiently controlled breeding both in base areas and the areas occupied by front-line troops. The fighting units needed further discipline and training, and more malaria control units were necessary, with adequate transport, stores and equipment. The sooner in an operation such measures could be put into effect the better would be the degree of control achieved.

The relative safety attained in staging and concentration areas such as Milne Bay, Buna and Kelanaa showed how preliminary hazards to troops assembled in these sub-bases could be minimised and practically abolished. The next objective was the more thorough diffusion of these principles and practice through all troops sent or likely to be sent to forward areas.
These generalities cannot readily be applied to different units or formations unless all factors are known and taken into account. The 7th and 9th Divisions, for example, had very different assignments; though both, in the main, were in highly malarious areas. The 9th Division was relieved by the 5th Division on 20th January 1944, while the 7th Division was not fully relieved by the 11th Division until 8th April. The 7th Division had suffered an alarmingly high malarial rate in December, but after a higher dosage of suppressive atebrin was ordered, the formation showed a much lowered rate, and was able to continue active operations. Early in January the 21st and 25th Brigades were relieved, and the 15th and 18th Brigades began the assault on Kankiryo Saddle on 19th January. The 15th Brigade in particular had made the most of its experiences in the fighting before Salamaua, and had evolved and carried out a most successful anti-malarial discipline. The average malarial rate for the formation was only 7.6 per 1,000 per week during the fighting which drove the Japanese out of their holdings along the coast north of Bogadjim. Though the relieving divisions continued this drive up the coast, the original objectives of the 7th and the 9th had been gained, and rehabilitation of the men soon began and was successfully carried out once they had been transferred to the Atherton Tableland. A high malarial relapse rate was soon manifest after suppressive atebrin had been discontinued, a practical demonstration of the prevalence of B.T. infections, and the efficiency of atebrin as a suppressive. This practical proof came in a very convincing fashion, just as the scientific proof had been obtained in the Medical Research Unit at Cairns. Notwithstanding the military success of these campaigns, and the ability of the medical services to keep enough men fit to continue active fighting till the end was gained, the cost had been high. The effect of this wastage of men persisted for some months till the health of the men was restored to its previous high level. Loss of weight was common, post-malarial anaemia also needed treatment, and hookworm, also a significant cause of anaemia, was found to be fairly common, but yielded readily to treatment.

Further campaigning of Australian forces lay ahead, and it was natural that the Australian military command should turn to the medical directorate for a full solution of the problems of preventive medicine.

**OTHER INFECTIOUS DISEASES**

*Mite-borne typhus fever.* The end of 1943 was a period in which the incidence of typhus fever in New Guinea reached its peak. Both before and after this period of time the characteristic patchy incidence of the disease was observed. Units would move into another area, and the incidence rate would fall, or rise, according as mites were prevalent in the sites occupied by the troops. Twenty-nine cases diagnosed as scrub typhus were observed among the first 700 admissions to the 2/6th Field Ambulance. At this time too, a drive was made to insist on regular and correct application of mite repellent lotion, dibutyl phthalate. Thus two important factors governed the incidence, location and the proper use of
The 2/4th Field Ambulance M.D.S. at Dumpu.

Carrying wounded of the 57th/60th Battalion to the A.D.S. at Saipa.
Green Sniper’s Pimple.

Stretcher bearers arriving at the R.A.P., Shaggy Ridge.

(Australian War Memorial)
Stretcher bearers carrying a patient from a forward aid post to the R.A.P. during the fighting on Shaggy Ridge.

The 2/9th Battalion dug in at forward positions on Shaggy Ridge.
On the way from Shaggy Ridge to the A.D.S. at Guy’s post.
miticide: of these the latter was under the control of the soldiers themselves. Fortunately, individual proof of the effectiveness of this lotion was easily established, as "mokka" bites no longer worried the men who used the preventive.

In the Markham and Ramu Valleys dibutyl phthalate was available to the troops from the end of November 1943. During September and October the 21st and 25th Brigades had forty-two and fifty-two cases of typhus respectively; during October and November, while in a more static role the incidence was twenty-seven and thirty-four cases, but in December on similar duties, when mite repellent was used, the numbers fell to eleven and ten. The 15th and 18th Brigades relieved the 21st and 25th in January, and during two months of active patrolling and fighting, still using repellent, reported thirty and three infections respectively. In the following months the numbers were negligible. Enquiry showed that in practically every instance infected men admitted failure to use repellent or incorrect mode of use. McCulloch in his study of the control of scrub typhus pointed out that the decline in the infection rate may have been due in part to decline in the degree of infestation of the areas occupied by troops, but the only cause known for this would have been stabilisation of camp sites, which did not apply in the Ramu Valley. Similarly, the possibility of the formations concerned avoiding infested areas was quite apart from reality. The conclusion seemed well based that the correct use of anti-mite fluid would control typhus in a force in the field.

In November 1943 the 7th Division promulgated an instruction on the prevention of scrub typhus in which concern was expressed for the rising incidence, and the method of use of the repellent was clearly described. In addition practical instruction was given to the men, and a quantity of 3 ounces per man per fortnight was laid down.

In the 9th Division areas the problem of typhus caused similar anxiety: in the Lae area, including Nadzab, sixty-six cases were reported in the twelve months preceding December 1944, and in the Finschhafen area including the coastal terrain up to Saidor, the number was 194. The totals for the two divisions were practically the same, and the same decline in numbers was seen in almost every area after the middle of 1944.

Diarrhoeal diseases did not cause a serious degree of disability in these campaigns. In some settled areas and during some campaigns the risk of spreading bowel-borne disease came almost solely from within the affected units. In operational areas of New Guinea this was not always so; other sources of infection were the Japanese and the natives of the country. Since the demonstration of its power to arrest an epidemic of dysentery on the Owen Stanley Range, great faith had been reposed in sulphaguanidine, and its production in Australia had made its wider distribution possible. During the operations of both the 7th and 9th Divisions outbreaks of diarrhoea had occurred; some of these had followed the occupation of areas recently held by the Japanese, others were associated with

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*Allan S. Walker, Clinical Problems of War, p. 195 (Volume I in this series).*
increases in the fly population. The latter were occasionally associated with the presence of numbers of Japanese dead before the areas could be cleaned up, sometimes they were more simply due to neglect of rigid sanitary precautions. Even in this country of high rainfall there was occasional scarcity of water in inland areas where supplies did not always permit enough for washing. Water was generally drawn from fast-running shallow streams, but bulk sterilisation was usually not possible during the early months of the campaign. At Scarlet Beach only two water-tank lorries were available for the division, even so late as a month after the landing. The only alternative, sterilisation by individual sets, had obvious drawbacks, as it was so hard to supervise, and in addition the sets at first supplied were faulty, the sterilising tablets disintegrating before they could be used. Later issues were improved, but a good deal of faith had been lost in them. It must be admitted that it is extremely difficult to dissuade soldiers or civilians alike from drinking water which, despite its deceptive clarity, may be infected. Further, it was realised by the responsible advisers in matters of hygiene, that to trust to an undoubtedly effective drug like sulphaguanidine to neutralise any serious results following the ingestion of infected material, was introducing a wrong principle. Consequently the hygiene services, working under a reorganised method, steadily policed methods of sanitation.

Brief consideration must also be given to the potential danger of a serious epidemic of dysentery among natives in New Guinea. The real possibilities of such an outbreak were obscured by the limited contacts with native communities made by most medical officers, except those of Angau, and by the usually mild nature of outbreaks of dysentery in both service and native populations. A striking example of this was seen at the end of 1943 in the Chimbu area west of Bena Bena, and east of Mount Hagen where there was an Angau post. Dysentery broke out at the end of October in the central plateau, which carries a high population, probably 200,000, of whom 50,000 were in the area concerned. From 13th November 1943 to 15th January 1944, 3,000 natives were admitted to hospital, and more than 100 of them died. The actual mortality was probably considerably higher than this; it contrasts sharply with the complete absence of fatal cases in the Australian Forces. The onset of the disease in severely affected natives was acute, and without specific treatment dehydration and collapse were manifest, and within a week of onset death occurred. Sulphaguanidine had a remarkable effect on these patients. Even when administered on the fifth to the eighth day, the general condition showed rapid improvement, the stool ceased to contain blood and mucus, and in four to eight days became normal, with full recovery of the patients in two weeks or less. A special medical officer was made available by the D.D.M.S., New Guinea Force; he investigated the outbreak and gave advice on measures of control. With a neighbouring population of 50,000 open to attack by the epidemic, the danger was great. New hospital huts were erected to house some 700 patients, proper sanitation installed, and movements of natives controlled. Jeeps and trailers were supplied for
transport purposes, thus saving the use of transport trains and limiting
ordinary road travel with its risk of spreading infection. Other areas were
affected by spread from Chimbu, such as Bena Bena, but Chimbu, with
its high population remained a hazard for some time. Some 50,000 tablets
of sulphaguanidine were used, and even this amount was inadequate. This
epidemic shows how dangerous such an outbreak could become, and how
serious a disease bacillary dysentery is in its uncontrolled form.

The incidence of infective hepatitis may here be considered, as it should
be included as a disease spread from the alimentary tract. During 1943
many cases of infective jaundice were seen in base hospitals; most of these
came from the forward areas, probably owing to the closer contacts of
groups of men whose hygiene was not as faultless as could be desired.
The incidence of hepatitis rose from 3.93 per 1,000 per month in 1943
to 9.25 per 1,000 per month in 1944. No doubt the rising figures for most
infectious diseases seen in fighting formations were due to the greater
impact of the infective agents upon men exposed to hardship in all con-
ditions of living.

Skin disorders also began to increase in number during this period; on
a much larger scale this corresponded with the experience of the A.I.F.
in the Middle East. There was no doubt that as the campaign progressed
skin infections increased in number. Great increase was also observed in
other dermatoses not primarily infective, but related to the greater traum-
atic insults and physiological strain imposed on the skin of men living
and fighting in a tropical climate. There was still a tendency to cast most
of these dermatoses into the category of “tinea” often with unfortunate
results. The feet and the flexures were often involved in lesions of the
skin causing considerable disability, which the necessity for wearing pro-
tective clothing tended to increase. At this stage the rising graph of malaria
with its alarming peak in December 1943 obscured the frequency of dis-
orders of the skin, but by the middle of 1944 their incidence had risen
to that of malaria and began to exceed it. Perhaps only dermatologists
saw clearly how great a wastage was to come from this source.

SURGICAL TEAMS

During the operations in the Huon Peninsula and from the Ramu
Valley to the coast, surgical work followed established methods, with
sufficient elasticity of organisation to conform to the military needs of the
circumstances. Different factors were introduced in combined operations,
and amphibious landings, and the increasing use of air transport and
evacuation by sea-craft called for appropriate arrangements. A surgical
team was detached from the 2/7th and one from the 2/11th A.G.H. to
carry out surgical work during the fighting on the Huon Peninsula. Other
teams were assigned to this work in the Ramu Valley, and where the
military situation demanded more help, other teams were formed. The
principle of lessening the distances and times of transport of wounded as
far as practicable was maintained, so that surgery was carried out well
forward in many instances.
The composition of the surgical team from the 2/11th A.G.H. illustrated the use made of well-equipped personnel. Two surgeons, Morris and Bolger, and three orderlies comprised the team. Two of the O.Rs. had experience, one was well trained in the Middle East in theatre routines, another had experience in surgical wards and was soon adapted to theatre work, while the third was valuable as a batman and could prepare patients and wash theatre linen. Another orderly would have been of great value. This team landed with the headquarters of the ambulance in the actions on Lae and shared in preparation of an M.D.S. with operating and resuscitation tents. Later they took part in a landing at Scarlet Beach against Japanese resistance. Extemporisations were necessary in this action, and resuscitations were carried out in the open with bottles of serum hanging on trees. After some weeks of hard work this team participated in the transfer of patients, mostly non-surgical, by barge down the coast when the enemy counter-attacked. A team from the light section of the 2/3rd C.C.S. accompanied the patients, and worked with the staff of the main section of the unit. This example shows how a team could be picked from a medical field unit, which cooperated with the team both in technical procedures and in general care of the members of the team, who had to rely on the housing unit for maintenance.

These arrangements illustrated how the methods of using a surgical team in these campaigns were much less elaborate than those necessary for a formally established and fully equipped mobile surgical team. It was found advantageous to be somewhat self-contained, and circumstances of evacuation dictated the length of time necessary to hold patients. Row has stated that the administrative and tactical side of field surgery is most important, and that the average surgeon finds the actual operating the easiest part of all. Forward teams had also to be prepared to move with the ambulance detachment with which they were working: the type of accommodation found convenient for removal and re-erection has been described elsewhere. In bush carpentry Sisalkraft was found most versatile and convenient, and facilitated movement or rapid erection of shelters, for instance, for early use in amphibious operations. Tents were useful, but had disabilities. The American pyramidal tent could easily be blacked out but was hot: the E.P.I.P. tent was weighty and needed mechanical transport, but otherwise was roomy and convenient. A floor of corduroy helped to keep the feet dry; most operating tents were dug in to a depth of about four feet for safety in attack.

At Finschhafen two operating tents were used, one on each side of the main traffic track of the field ambulance: this permitted one theatre to be used by the unit staff, and another by the surgical team. Separate preparation and resuscitation tents were used here and were most desirable. A little later at Sattelberg a roomy comfortable theatre was constructed from salvaged galvanised iron; it accommodated two theatres.

Mobile lighting equipment was necessary: pressure lamps gave a good light but were hot and not trouble-free. Generator sets were very satisfactory; the American field unit operating lights and generator were used by
the surgical teams with the 2/4th Field Ambulance in the Lae-Nadzab area, and were found most satisfactory. A signalling lamp was found most useful as a spotlight. The weight of operating equipment was important. Morris pointed out that a surgeon working at an advanced dressing station can restrict equipment to a weight of 400 pounds. Most of this could be sub-divided into 40-pound lots, using a tin of plaster as a weight. An autoclave could also be carried if divided into three parts.

The mobile nature of teams may be illustrated by the following details of movements over several months. In the Markham and Ramu Valleys surgical teams were available for work with the units of the 7th Division from September 1943. Captains W. P. Ryan and Leggett worked with help from Majors Stuckey and Goulston at Lae, and Captain F. D. Smith with the 18th Brigade. A team was attached to the M.D.S. at Nadzab at the outset of the campaign, and later at Dumpu. In December surgical casualties were treated from the 2/6th Commando Squadron, 2/25th Battalion, and the P.I.B. in the Kesawai area. At the end of 1943 a surgical team established a post with the 2/4th Field Ambulance, to serve operations on the Kankiryo Saddle and the action of 2/10th Battalion at Shaggy Ridge. Early in January Leggett went on foot with two orderlies to Geyton's post, behind the 2/12th Battalion, and set up a surgical post there, while Ryan and Smith went to Guy's post. In February Ryan returned to his unit, the 2/9th A.G.H.

In the preparation and assembling of the equipment of these teams a definite advance had been made in July 1943, when the D.G.M.S., in consultation with Colonel W. A. Hailes, Director of Surgery, had tables drawn up setting forth the surgeons to be called upon for teams and their locations, and indicating which units held the equipment and which were responsible for the training of orderlies. This training was designed to enable the orderlies to carry out responsible work efficiently in the team, and was given a practical basis. The supplies arrangements ensured that stores were available and packed ready for immediate despatch in hardwood boxes that could survive the journey to New Guinea without loss or wastage. Authority was given later on in 1944 for one additional set of ordnance equipment for a surgical team from each of six general hospitals (2/1st, 2/2nd, 2/5th, 2/6th, 2/7th and 2/9th) and for the issue of one set to the 2/4th and 2/12th Hospitals.

The question of age for surgeons was raised. No special physical preparation had been made to fit them for a task which was arduous and called for long hours; and the A.D.M.S. 9th Division suggested that a certain amount of training, as by marches with full packs, would be advisable at the unit of origin of each team. A blend of youth and experience was found advisable; it should be noted that illness was not uncommon among members of teams which had been working continuously for some weeks or longer. Ackland expressed the opinion that eighteen hours of continuous work was the upper limit of the amount of work which should be asked of members of a team. Where two teams were working in the same centre, the surgeon and orderlies worked eight hours in the theatre;
and then eight hours seeing patients as they arrived, or supervising post-operative treatment. The order of duties was changed daily so that each surgeon could have eight hours’ rest each day. Selection of patients for operation always needed judicious care; so too did selection for evacuation. For example it was not desirable to send away patients with wounds of the chest, or abdomen, who travelled badly, and except in early stages, those with wounds of the head. This was particularly difficult when a trying journey faced the patients, such as the 60-mile trip by sea in small barges from Scarlet Beach. Men in Thomas splints might be moved successfully on barges, but would have small chance of survival in the event of enemy action. Even in exceptionally rough country such as the Finisterre Range a man was carried in a Thomas splint with little discomfort with the aid of sedation.

Morris pointed out that during a period of three months in the latter part of 1943 his team dealt with 400 casualties, and although this number was often surpassed in the 1914-18 war, the surgeons were very busy during certain periods, such as those following sustained actions. The difficulties of climate and terrain need no further emphasis, nor the hazards of disease; their nature made the comparison of results in different areas very difficult. Attempts were made to produce results in the surgical treatment of abdominal wounds comparable with those of Major T. Giblin in the Middle East. New Guinea doubtless gave a much more unfavourable background for this critical type of surgery, and these conditions probably accounted for a recovery rate not exceeding 33 per cent.

In organising work for two surgical teams it frequently happened that one surgeon out of four was temporarily not available through illness; some refinements of surgical work had to be omitted, but none which were of real import. For example, gloves were usually worn only for major operations, as sweating was so profuse, and gloves had a short life. Trousers, boots, gaiters and water-proof apron, cap and mask were worn; gowns were not worn except for wounds of abdomen, head or femur. Sheets were also reserved for major operations: water-proof squares soaked in an antiseptic were otherwise sufficient.

Phosphorus bombs were used in at least one enemy attack. Fragments were seen smoking in the wounds, even at a deep level; these were extracted as far as possible and water applied, as well as a copper solution, followed by boric lotion. A special instruction was circulated to all medical officers setting out the procedure to be followed.

The routines adopted for wounds of various regions were those already well known to the surgeons of Australian armed forces, and the standards of the work done were kept high, not merely by the keenness of the men themselves, but by educational methods, such as clinical discussions when opportunity arose and by the use of consultants in an advisory capacity. An experienced surgeon was detailed to an area for a period, during which he consulted with medical officers in relation to surgical problems. Hailes and his surgical consultant colleague, Littlejohn, kept in close touch with their officers, and the latter, freed from many of the
headquarters routines, gave medical officers in forward areas the benefit of his activity and surgical skill and judgment.

Gas infections of wounds were fortunately rare. Captain J. W. Perry in a special investigation found that at the end of 1943 the frequency of Clostridia in New Guinea corresponded to that found in previous actions. Though antiserum was used for cases of undoubted infections, adequate excision of wounds and blood transfusion were thought more important. Littlejohn maintained constant vigilance on this need for correct degrees of excision, and it is fair to state that the relative rarity of serious anaerobic infections of wounds was a result achieved by an efficient system of evacuation in most difficult country, the construction of improvised forward surgical centres, and a correct application of surgical principles. The external conditions in New Guinea were those favouring the development of gas gangrene, and that so little trouble ensued is a tribute to the whole surgical organisation: in other words it was a successful application of preventive surgery. Further advances were exploited in the use of penicillin, then being found so valuable in the campaigns in Italy, and the results of suture under protection of penicillin were promising.

During January, the team under Captain W. P. Ryan at Guy's post, with assistance of extra orderlies, was able to give continuous service to men wounded during the action for Kankiryo Saddle. Help was also given in anaesthetics and resuscitation by Edelman in charge of Guy's post and Captains J. Fairley and Bracken. In this post 82 operations were performed, one on a man with acute appendicitis: ready cooperation between the team and the ambulance unit resulted in a high degree of efficiency.

Opportunity was given for members of the ambulance staff serving in detachments to visit other neighbouring posts so as to familiarise them with the country and to increase their degree of independence. The need for a high standard of work entrusted to nursing orderlies was stressed by officers working with surgical teams, especially when seriously wounded men, such as those suffering from abdominal injuries, have to be kept in a forward area during an anxious post-operative period. It was essential that the medical officers realised the magnitude of their own responsibility both in directing treatment and in educating orderlies in carrying it out.

On 10th February, after the action at Shaggy Ridge, a conference of R.M.Os. and ambulance officers was held and certain conclusions reached from their joint experience have already been summarised. In general, evacuation of casualties was successfully carried out, but their movement was greatly helped by the moderate numbers, spread over a long period. All transport was insufficient, only a few native bearers were available, the terrain was difficult and the climate was trying. These conditions multiplied difficulties, such as lack of cover for patients, and increased the time taken for casualties to reach forward medical posts. This disturbance of the time factor in bringing casualties in for surgical treatment added to the risk which would have been more evident had the numbers been greater.
The general conclusions reached were that the R.M.O. should always be kept informed of the affairs of his unit, that ambulance officers should have opportunity for familiarising themselves with the country, that aid posts should be as far forward and as central as possible, that reasonable facilities should be provided not only for the movement of wounded, but also of equipment. In this connection it is interesting that the natives needed to close Geyton's post numbered 181, made up as follows: eight teams of twelve to move patients, twelve to carry surgical gear and five medical material, forty-five to move kitchen equipment and rations, sixteen to carry tents and seven to take stretchers. The need for Angau representation for control of natives at the battalion end was also stressed.

During the engagement one of the old problems emerged again from the work of surgical teams, that is, the question of administrative authority. This was discussed during the first Libyan campaign, and was then amicably settled, though it recurred at intervals later. At the beginning of the final action on Shaggy Ridge Refshauge brought up the matter for settlement by the A.D.M.S. as to who was in charge of the work, the commander of the field ambulance or the officer in charge of the surgical team. The A.D.M.S. clarified the position and pointed out that the surgical team was not regarded as an independent unit, but attached for duty, rations and discipline to the field ambulance. This problem is liable to recur both in service and civilian circles; its best solution no doubt lies in basing conditions of work on a firm agreement between the parties concerned.