OPENING MEETING OF THE THIRTY-THIRD SESSION
of the Society held at
Manson House, 26, Portland Place, London, W.,
on
Thursday, 19th October, 1939, at 4.30 p.m.

THE PRESIDENT.
Sir S. Rickard Christophers, C.I.E. M.B., F.R.S., Colonel I.M.S. (retd.),
in the Chair.

PRESIDENTIAL ADDRESS.

MALARIA IN WAR.

BY
Sir S. Rickard Christophers, C.I.E., O.B.E., F.R.S., Colonel I.M.S. (retd.).

Recent events have modified the choice of a subject for my address to-night. I had originally intended to deal with certain aspects of the chemotherapy of malaria. It seemed to me, however, that whilst we are not bound to think of nothing but the war, most of us are naturally more concerned at the moment with this than with anything else and are therefore not in the most suitable frame of mind to give attention to such a relatively abstruse subject as chemotherapy.
Also I thought, especially if some discussion could follow my remarks, that an address on the subject I have chosen might serve a useful purpose in drawing attention to certain matters in which we as a Society have some responsibility. I especially invite discussion because there are probably some here who have had experience of war conditions and who will be in a position to make contributions of value.

**WAR MALARIA.**

That there is a connection between malaria and war is of course well recognized and though we need not suppose that the aetiological fundamentals are essentially different from those with which we are accustomed to deal in civil life, yet there are features of malaria when it occurs as a concomitant of war which are interesting and important enough to merit special consideration. In the first place malaria in such circumstances may be much more than merely one of the causes of casualties from sickness. It may modify or even determine the results of a campaign as history has several times shown. Again, though the essential aetiology may not be different, the epidemiology of malaria in an army in the field is likely to have features which are by no means necessarily those with which we are most familiar in our usual dealings with this disease. Lastly, and perhaps most important of all, questions of prevention and even of treatment are quite special in such a setting. There is a certain justification therefore for the term "war malaria."

War malaria, as we shall see, includes aspects of malaria incidence and control other than those in the fighting forces. And even the control of malaria in the fighting forces involves many considerations other than those at first sight most obvious.

In the first place, as Gill (1917) in a very thoughtful paper on the prevention of malaria in war points out, troops are not always engaged in active operations. They are employed even in peace-time to garrison stations and are maintained in large numbers in cantonments. Even if we do not consider the prevention and treatment of sickness in such circumstances a direct war measure, it has an indirect importance to war. It is not merely that such troops, if seriously affected with malaria, are likely to be useless when sent on a campaign. There is the even more important question, as we shall see, of them being a danger and distributing infection among other troops in the theatre of war. In fact failure to control malaria in stations and cantonments in peace-time and in troops held in reserve may be a most serious matter in war. On the other hand experience in control of malaria in stations and cantonments and the maintaining of troops in peace-time free from malarial infection constitute valuable war assets. Control of malaria in troops in peace-time is actually therefore very definitely related to control in war.

A quite important aspect of malaria in war is the provision of the immense
quantities of quinine and other anti-malarial drugs that may be required, not only in carrying out prophylaxis in the troops, but in the treatment of the large number of cases in hospitals in the theatre of war and at home. If drugs other than quinine have also to be employed it has to be considered how they are to be obtained or produced in war-time. It may be that drugs now familiar have to be replaced by other compounds with which we shall have to become familiar. I may mention in this connection the French atebrin equivalents and steps this country might have to take to produce its own atebrin or substitutes. Policy in respect to cinchona growing and quinine storage, as well as knowledge of and ability to produce in large amounts anti-malarial synthetic drugs are matters therefore which, developed in peace-time, would have an important bearing on control of malaria in war.

Other issues which bear upon malaria control in war are such questions as the supply of suitable stains (this was a serious difficulty in the early stages of the last war), the supply of suitable forms of Paris green and of apparatus suitable for spreading this possibly on an unprecedented scale, the sources from which personnel trained in malaria work in the laboratory and in the field are to be provided, and much else.

An aspect of war malaria which ought to be mentioned is the liability for malaria to be transmitted in theatres remote from the war due to the introduction in large numbers of infected returning soldiery. Numerous instances are to be found in the literature of cases of malaria contracted in this country from infection introduced from abroad; and even the possibility of local epidemics due to this cause has to be considered. Over and above such local effects may be a flare up of the disease from the direct and indirect effects of the war upon civil populations. A very marked example of this state of affairs occurred during the last war in the Emden district in north Germany. Since 1890 malaria cases in this area had been seen only in sporadic form, but during the war enforced neglect of canals and even of important drainage systems and other changes (brought about by the war) led to this area becoming seriously malarious with many thousands of cases of the disease. Even more wide-spread and serious effects followed the war in Russia and some other European countries: a state of affairs which led to the formation of the Malaria Commission of the League of Nations as was instanced by Colonel James in his Presidential Address two years ago.

What I wish, however, to deal with more especially to-night are direct experiences of malaria and the measures that can be taken for its control in armies in the field in malarious countries. In accordance with usual scientific procedure it will be well if we first examine the material on which we have to base any conclusions we may draw. Such material we might naturally expect to obtain mainly from the experiences of past wars. As we shall see, however, the only material of any real helpfulness in this respect are our experiences in certain theatres of the Great War. Very briefly the reasons for such a statement may be given.
Malaria in Previous Wars other than the Great War.

Knowing how seriously malaria affected our armies in the last war we may feel some surprise that we do not see more in classical writings of the effects of malaria in the many historical wars and movements of armed nations in ancient times. Some writers have even suggested that malaria is a relatively recent introduction in many countries. This, however, is very improbable. The most probable explanation is that the idea of malaria in the sense we know it, i.e., as a definite disease entity, is comparatively modern. The figure of the "fever tree" is from TORTI's great work which practically first established the miasmatic fevers as one disease. TORTI (1712) must have known more than anyone else in his time, or before his time, of malaria as a single disease, but his figure of this "fever tree" well indicates the absolute confusion there must have been up even to the eighteenth century and later in the diagnosis of fevers. We often see in the literature references to past times which seem to suppose that the ancients, whilst they did not know so much about malaria as we do, at least knew something. I think myself this is very doubtful. Of course they must have seen and been struck by tertian and quartan periodicity. But that they attributed these to "malaria" as we do is doubtful. Certainly the name "malaria" does not go back very far and we should be careful in interpreting old writers not to read into their statements ideas which we now may think obvious. Whether this is the explanation or not we do not get much to help us from these old times. The following extract, which I have taken from Dr. H. H. SCOTT's recent History of Tropical Medicine has, however, a very familiar ring to those of us who have had occasion to study war malaria. The extract reads as follows:—

"CELLI has endeavoured to trace the history of malaria in Rome and the Campagna from ancient times, obtaining his information, not from medical writers only, but from historians, poets, archaeologists. . . . Though the disease became prevalent in Rome after the second Punic War, about 200 B.C., CELLI does not believe it was imported from Carthage. It declined again during the days of the Empire until the end of the 4th Century A.D. and early in the 5th, when Rome was sacked by the Goths. The sacking of Rome in 1527 was followed by another recrudescence."

Even accounts of more recent wars are not very helpful and it is perhaps not without interest to recall the fact that it was only in 1881, i.e., about 60 years ago, that LAVERAN discovered the parasite. Very surprisingly, as it may seem if we had not realized this before, many of the wars we know well by name were before this time. It is only since about 1900 that the mosquito cycle has been generally accepted or recent ideas of the nature of malaria transmission developed. Hence up to and including the time of the South African War we need not expect to learn much from writings on the subject. As a matter of interest, however, I have compiled a list of wars since the time of the Napoleonic wars and given some brief remarks. (Table I.)

I have not included in this list many minor operations which are expeditions rather than wars, but some of these are mentioned in small type chiefly to
show the shortness of their duration. I have added the Abyssinian Expedition of 1867 as it is of interest in view of the more recent happenings in that country. On the whole, malaria does not figure very largely except in the famous Walcheren episode and the Chinese-Japanese war of 1897. In the case of some of these wars one would not have expected much malaria, but it is somewhat surprising that there appears to have been so little malaria in the South African War, as also in the recent war in Abyssinia.
It is only when one comes to operations in certain countries during the Great War that one begins to be given information of much utility. The experiences in this case are therefore worthy of the closest study since they constitute the basis upon which we must form most of our ideas regarding war malaria and its prevention.

**Table I.**

<table>
<thead>
<tr>
<th>War</th>
<th>Date</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAPOLEONIC WARS</td>
<td>1793-1815</td>
<td>Included the Walcheren Expedition, 1806 Cholera most noticeable feature</td>
</tr>
<tr>
<td>RUSSO-POLISH WAR</td>
<td>1831</td>
<td>Exposure, improper food and cholera chiefly noted. “Fever” also referred to in connection with shortage of quinine</td>
</tr>
<tr>
<td>CRIMEAN WAR</td>
<td>1854-6</td>
<td>So-called “typho-malarial” fevers prominent.</td>
</tr>
<tr>
<td>CHINA WAR</td>
<td>1860</td>
<td>Twenty-five weeks in country. British force of 2,674. Malaria only about 10 per cent. of strength</td>
</tr>
<tr>
<td>AMERICAN WAR</td>
<td>1861</td>
<td></td>
</tr>
<tr>
<td>Abyssinian Expedition</td>
<td>1867</td>
<td></td>
</tr>
<tr>
<td>FRANCO-PRUSSIAN WAR</td>
<td>1870-71</td>
<td>February to April</td>
</tr>
<tr>
<td>Soudan Expedition</td>
<td>1884</td>
<td>March to July</td>
</tr>
<tr>
<td>Nile Expedition</td>
<td>1884</td>
<td>Average strength, 5,213; 1,401 admissions for malaria in six months; 40 per cent. officers went to hospital</td>
</tr>
<tr>
<td>Ashanti Expedition</td>
<td>1896</td>
<td>Malaria chief cause of sickness; 41,734 cases.</td>
</tr>
<tr>
<td>CHINESE-JAPANESE WAR</td>
<td>1897</td>
<td></td>
</tr>
<tr>
<td>Nile Expeditionary Force</td>
<td>1898</td>
<td>10 months</td>
</tr>
<tr>
<td>SOUTH AFRICAN WAR</td>
<td>1899-1904</td>
<td>Enteric main problem. Little malaria</td>
</tr>
<tr>
<td>SPANISH-AMERICAN WAR</td>
<td>1898-99</td>
<td>May to February. American losses from disease, 5,277</td>
</tr>
<tr>
<td>Soudan War</td>
<td>1904</td>
<td>Expeditions up Blue and White Nile suffered severely from malaria</td>
</tr>
<tr>
<td>RUSSO-JAPANESE WAR</td>
<td>1904-5</td>
<td>Twenty-one months, 20 battles, 220,812 casualties; 2 per 1,000 malaria</td>
</tr>
<tr>
<td>ITALIAN-ABYSSINIAN WAR</td>
<td>1935-6</td>
<td>Apparently little malaria</td>
</tr>
</tbody>
</table>

**Note.**—Major wars given in capitals.

**Malaria Experiences in the Great War.**

Those experiences of most importance from our present point of view are (1) the Taranto experience, (2) the Macedonian campaign, (3) the Mesopotamian campaign, (4) the East African campaign, (5) the operations in Palestine. We may very briefly indicate the nature of these experiences in turn.
1. TARANTO.

Taranto came into prominence because it was early realized that troops proceeding on to Egypt and other theatres of war were becoming infected even by a short stay at Taranto. An account is given by ROBERTSON (1920). Attempts to provide protection by mosquito-proofed huts unfortunately met with difficulty. The huts provided were unsuitable for mosquito-proofing and if so protected were almost untenable in the climate of Taranto. Eventually the operations carried out had to be largely of an anti-larval type.

2. MACEDONIA.

The Macedonian experience was one of the greatest medical surprises of the war. Both British and French troops were affected, the total casualties from malaria being enormous and quite unanticipated. A very complete account is given by WENYON (1921), but numerous other writers have also dealt with different aspects of malaria as seen in this theatre of war. Altogether the operations covered a period of some three years occupation by the troops of a tract of country lying to the north of Salonica, as shown in Map 1. Prior to June, 1916, the troops were in position mostly on the line: Monastir Road, Salonica, Langaza and Bezik, and during this time in the first five months of the year there was very little malaria, fifty cases only. In June the line began
to move forward into the low lying valley of the Struma, extending up this river past Lake Tachinos to Lakes Bulkova and Doiran and thence to the River Vardar, in all a distance of about 60 miles. The French continued this line further to the west. After some ninety cases in June the incidence rose rapidly and in 1916 there were in all some 30,000 cases of malaria. Wenyon gives the following figures as a result of examination of men on duty during the winter of 1916-17:

<table>
<thead>
<tr>
<th>Men Examined</th>
<th>Parasites</th>
<th>Parasites</th>
<th>Parasites</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>977</td>
<td>216</td>
<td>232</td>
<td>251</td>
<td></td>
</tr>
<tr>
<td>828</td>
<td>1,031</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

so that roughly at least a quarter of the whole force would seem at this time to have been infected.

The measures taken included every known means of combating the disease; yet in spite of an amount of work which may be appreciated from the figures given later, Wenyon gives it as his opinion that "it is doubtful if any appreciable reduction in infections took place during our stay in the country." After the formation of a special Malaria Enquiry Laboratory to ascertain the facts and to formulate action to be taken, there was undertaken the drainage of swamps, clearing of streams, oiling and other methods of treating breeding places, fumigation and spraying, the mosquito-proofing of huts and dug-outs and the carrying out of quinine prophylaxis. The antilarval type of operations began with operations early in 1917 and were carried out on a much more extensive scale, at least ten times as great, in 1918. Some idea of the work done is given by the following figures:

- New trenches cut: 479,991 yards
- Old trenches renewed: 1,670,506 yards, i.e. about 1,000 miles
- Number of pools drained and filled: 9,690
- Water surface oiled: 1,157,192 square yards
- Brushwood cut: 363,315

The prophylactic dose of quinine was in 1916 usually 5 to 6 grains a day, but 10 grains a day, 10 grains on 2 days in the week, 20 and 30 grains a day were tried but none gave any encouragement. Wenyon says that the consensus of opinion was that quinine administration had little or no effect in controlling the disease. The only doubt this observer had was whether if quinine had not been given an even heavier incidence might have occurred.

A very interesting feature of the measures has reference to the use of mosquito-nets. Two forms were used: a bivouac net modified and altered until in 1918 a serviceable pattern was evolved, and a bell net pattern. I shall make some remarks later on the type and use of mosquito-nets under war conditions. On page 103 of his account Wenyon states that in his opinion "the mosquito net did more to prevent infection than all the other methods of malaria prevention together."
3. MESOPOTAMIA.

The operations in Mesopotamia are described by Christophers and Shortt (1921). The army operating in Mesopotamia, including combatants and followers, numbered approximately 400,000, of whom about one quarter were British. The area eventually occupied included the plains of the Tigris and Euphrates and parts of Persia and Kurdistan, a tract possibly about the size of England (Map 2). The troops which at first were located in the lower parts of the Tigris and Euphrates plain moved up after the taking of Kut to Baghdad and Mosul and eventually extended into Persia. At the Base at Busra, however, where a new port was created extending 7 miles along the river, railways constructed and other works undertaken—there were encamped throughout the period some 100,000 men. Nothing was previously known regarding malaria in this tract.

The only authority mentioning it appeared to be Hirsch (1883) whose description is as follows, “On the other hand the disease prevails in its worst forms... as well as in a widespread endemic in the valleys of the Tigris and Euphrates from their mouths upwards throughout Mesopotamia.” As was ascertained during the early stages of the war we now know that there is a moderately endemic tract in the palm grove belt about Mohammerah and Busra where Anopheles stephensi is the vector, then a great belt of swamp and river extending up to Baghdad and beyond which is practically non-endemic, and then severely endemic tracts when the Persian and Armenian hills are reached. These facts when known were of the greatest assistance. The outstanding problem was control in the large Base area at Busra. The greater part of the area was palm grove land with its characteristic network of deep irrigation ditches. It was
not, however, only the conditions natural to the country which had to be considered, for in the course of the necessary operations for embankments, roads, hut foundations, wharves, etc., enormous shallow excavations of great extent had to be formed and, if left alone, these by leakage from the river became extensive sources of anopheles. No other decision was possible in the Base area therefore but to undertake large scale anti-larval operations chiefly of a protective nature. Troops, up country in Baghdad and elsewhere, it was found could be considered as relatively safe from any heavy incidence and it was only on entering the hilly country beyond that malaria once again became a problem.

### Table II.

<table>
<thead>
<tr>
<th>Type of Area</th>
<th>Number of Troops and Followers</th>
<th>Cases of Malaria</th>
<th>Admissions per mille per week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well protected:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magil</td>
<td>22,810</td>
<td>407</td>
<td>1·1</td>
</tr>
<tr>
<td>Makina West</td>
<td>9,637</td>
<td>221</td>
<td>1·4</td>
</tr>
<tr>
<td>Total</td>
<td>32,447</td>
<td>628</td>
<td>1·2</td>
</tr>
<tr>
<td><strong>Imperfectly protected:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makina East</td>
<td>4,810</td>
<td>336</td>
<td>4·4</td>
</tr>
<tr>
<td>River Front North</td>
<td>8,379</td>
<td>494</td>
<td>3·7</td>
</tr>
<tr>
<td>Total</td>
<td>13,189</td>
<td>830</td>
<td>4·0</td>
</tr>
<tr>
<td><strong>Unprotected or partially protected:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Transport</td>
<td>2,880</td>
<td>143</td>
<td>3·2</td>
</tr>
<tr>
<td>Hospital area</td>
<td>8,040</td>
<td>280</td>
<td>2·2</td>
</tr>
<tr>
<td>Ashar</td>
<td>6,345</td>
<td>296</td>
<td>2·9</td>
</tr>
<tr>
<td>Tanooma</td>
<td>2,440</td>
<td>103</td>
<td>2·6</td>
</tr>
<tr>
<td>River Front South</td>
<td>3,701</td>
<td>537</td>
<td>9·0</td>
</tr>
<tr>
<td>Total</td>
<td>23,406</td>
<td>1,359</td>
<td>3·6</td>
</tr>
</tbody>
</table>

The sickness from malaria was considerable, though not to be compared with the incidence in Macedonia. That the anti-larval operations at the Base had at least some effect is suggested by the following figures for September to December, 1918, i.e., for the chief fever season in that year. (Table II.)

In 1916-17 all units were supposed to be receiving prophylactic quinine, 5 grains a day. Every effort to secure actual administration was made. As information was gradually acquired and systematized it became evident that whilst some units were suffering from malaria and exposed to infection others were not to anything like the same extent. In 1918, by institution of a system of early notification of cases and visiting of different units those which seemed in little danger of infection were taken off the compulsory quinine roster and attention especially directed to such units as showed a heavy incidence or appeared to be in danger of infection.
One fact brought out was that admissions to hospital were but a small part of the actual malaria. In 45,846 examinations made for malaria parasites in the different hospitals about 19 per cent. were returned as positive. Actually in men on duty taken at random the following percentage infection rates were found:—British troops, 13.7; Indian troops, 27.4.

If this rate were at all general there should have been on any one day, 1,000 British and 8,000 Indians (excluding cases in hospital) with parasites in their blood. On an average, however, those actually admitted to hospital for malaria in a day were 27 and 31 respectively. Admissions therefore did not represent the same thing as infections.

Most of the “specially affected units” were found to have previous “histories.” They had been serving in East Africa or stations on the Persian Gulf. In an effort to trace infections to local conditions, 60 per cent. of admissions after investigation had to be returned by us as “casual,” i.e., the case was difficult to trace to any definite source. At one time many units coming from India were more heavily infected than those who had been some time in the country.

In regard to the value of quinine prophylaxis the only thing that can be said is that, as in WENYON’s experience in Macedonia, the incidence might have been even heavier if it had not been carried out. Mosquito-nets were issued but their erection and use was beset with difficulties. Some remarks will be made later on this subject.

4. EAST AFRICA.

Regarding operations in East Africa little need be said beyond the fact that they involved an average strength of about 50,000 allied troops and that admissions for malaria in the two years 1916, 1917 have been estimated at 120,000.

5. PALESTINE.

Of the Palestine operations an excellent account is given by SEWELL and MACGREGOR (1920). The capture of Gaza took place on 7th November, 1917. In December malaria began to assert itself in the Summeil and Sarona area about the mouth of the river Auja. A mosquito survey in January, 1918, showed that the vector was chiefly *A. bifurcatus* breeding in wells, not anopheles from pools etc., and the troops in the orange groves were the most affected. In April, 1918, the intended advance was postponed and the troops became stationary. The position occupied from this time to September was a line about 25 miles long stretching north of the Auja as shown in Map 3. The country occupied was notoriously malarious with marshes, streams, wadis and many sources of anopheles. The main efforts at control were of the anti-larval type. Marshes were drained, streams canalized, banks of the river Auja rectified, wells and cisterns oiled. Mosquito-proofed huts were used in dangerous places and
wherever possible the sites of camps selected. Evacuation of cases and quinine prophylaxis were also adopted. The anti-mosquito operations appeared to a considerable extent to have reduced breeding to a minimum at a time when it might have been optimum. On 19th September, 1918, the whole Corps moved forwards into country that had previously been in occupation by the enemy.

Actually from this time on the troops suffered severely from malaria. To what extent this was due to infection contracted after the move or the result of moving troops already infected it is I suppose not possible to say.

PREVENTIVE MEASURES APPLICABLE TO TROOPS IN THE FIELD.

Viewing things from the point of view of these experiences what is to be said of the nature of measures of control that it was found possible to employ and their apparent relative importance in respect to effectiveness? Very briefly we may summarize experience regarding such measures.

(1) THE MALARIA LABORATORY.

Experience shows clearly that the first item is the constitution of a Malaria Inquiry Laboratory, as this kind of laboratory was termed in Macedonia. It will be obvious that without an adequate organization to ascertain the conditions, decide upon the steps to be taken and to watch over and supervise these, hopeless confusion could result. In the last war these laboratories were, so to speak, an afterthought and more or less due to chance individual effort. If they are recognized as being a vital requirement in the medical organization they should in future be planned beforehand.
(2) ANTI-LARVAL OPERATIONS.

The experiences I have outlined in the different theatres of war are sufficient I think to show that, whatever other measures may be adopted, the necessity of carrying out anti-larval operations will almost certainly arise. Even if such measures are not applicable to troops in active war manoeuvres, they are almost certain to be called for to protect base camps and lines of communication. It is unnecessary now to discuss in detail the various measures included under this head. Probably Paris greening on a large scale will greatly modify the problem. But the detailed requirements for a measure like Paris greening on a large scale should not be left to be worked out on the spot, taking up time whilst effective action is perhaps held up for this and the necessary material, equipment and personnel experienced in its use. All such matters should be thought out and arranged beforehand.

(3) QUININE PROPHYLAXIS.

It would be unduly optimistic in face of the experiences in the last war to regard quinine prophylaxis as a measure which can at any time be relied upon easily to control malaria in an army in the field. In fact in our troops under these conditions quinine prophylaxis, as ordinarily carried out, must be regarded in the light of actual experience as of somewhat doubtful value. The question is whether this is because, as the measure is ordinarily carried out, the necessary proportion of the troops do not receive the required dosage. If we believe this then stricter and more effective administration should be aimed at.

If anything is to be achieved in this respect far more attention must be given than at present to preparation and organisation. The ordinary quinine parade is not only a somewhat troublesome interruption to busy units but to some extent, and often to a large extent, it is necessarily ineffective. For many of the strength are almost certain, at any given time for which the parade may be fixed, to be away from the unit, even supposing all men doing various odd jobs in the unit itself are collected. Men may be away drawing rations, others engaged with transport, some attached to or working with other units. Many officers may do their best to overcome such difficulties, others do not. The men themselves may be interested or they may not. Those issuing the quinine may for various reasons not give the full strength or quantity. All these things must be seen to by the units themselves, for it is obvious that there is no possibility of an inspecting officer, or a number of such officers, actually themselves seeing, say, 100,000 men taking their quinine daily.

If then the effectiveness of this measure by improved administration is to be increased, it must be by such steps as ensuring recognition of its great importance by the Higher Command, by previous propaganda among officers and men and by clearly thinking out of details by which administration is most likely
to be facilitated. Obviously all this should be done before the army is in the
field and not left for someone to cope with de novo on the spot.

Are we satisfied that quinine prophylaxis ought to be adopted and this
effort to assure at least successful administration undertaken? If so, under
what circumstances, at what stage and with what dosage, etc? If quinine is to
be used what form should this be in? If other drugs are to be used what drugs
are available? All these are points that can be better decided before than during
operations.

(4) PROTECTION.

(a) Mosquito-proofed huts.—ROBERTSON states that at Taranto he regarded
mosquito-proofed huts as the most effective measure against malaria in the
circumstances with which he was faced, but was unable to get huts of a suitable
pattern. As this might again be an important method of control to be applied,
the possibility of devising suitable types of hut would be worth careful con-
sideration. But such consideration should be given before the occasion for
their use actually arises.

(b) Mosquito-nets.—WENYON’s remarks about mosquito-nets in Macedonia are
not to be lightly dismissed. The mosquito-net is the method of prevention effective
vastly beyond all others in the hands of the intelligent individual. The difficulty
of utilizing the method in the case of troops is, however, admittedly very great.
I do not think, however, that the method has had a fair deal. There has not
been sufficient thought given to details. Merely to issue nets, leaving it to
someone in the field to devise methods of using them and to get them used is
no way to proceed. WENYON notes that two forms of net were supplied in
Macedonia, a bivouac form and a bell form. Things are not so simple as that.
The proper type of net is a matter that requires the most serious consideration,
as also do the means by which it is to be supported and the method in which
it is to be used. If all this were carefully done and officers and men made to
appreciate the necessity for such a measure it might not be so impossible to
carry out. It is not supposed that such protection could always be provided
in the front line, but experience shows that in an army there are usually troops
at the base and lines of communication where protection of this kind is extremely
desirable.

Ideas regarding the care of troops have changed very much even in the
course of my own personal experience. With electricity and modern facilities
there is nothing preposterous in the idea that men might be accommodated in
mosquito-proofed huts with electric fans or provided with mosquito-nets under
conditions in which these can be used. But all this requires a good deal of
thinking out, preparation and experiment before the event. Again the Higher
Command must be brought to appreciate the importance of the measure. Officers
and men must be taught the importance of using the nets properly, just as no
doubt they must be taught the use of a gas mask with all the details necessary
to this.
(5) HOSPITAL ORGANIZATION FOR BLOOD EXAMINATIONS.

It is impossible that any one laboratory organization can make all the examinations necessary for clinical purposes and notification of cases. For this purpose hospitals must themselves have the necessary equipment. Not only must microscopes be available, but the necessary slides and stains as well as at least one technician fully familiar with the technique and detection of parasites. Much could be done here by forethought in standardizing and simplifying technique and in teaching, for not everyone knows the technique at first, who yet might become quite a useful worker with a little teaching.

These are the main methods of prevention which have been employed under war conditions. As regards any choice or selection it seems certain to me that in the event of an army operating in a malarious country all the methods will be called for and all ought to be prepared for. We dare not neglect quinine prophylaxis and must attempt to get it properly carried out. Faced with conditions such as I have described in some of the theatres of war the desirability of anti-larval operations should never be ignored. We must be prepared to use both these methods and others which time has not allowed me to deal with. Actual experience itself points to such a view as the correct one over and above any or every theoretical consideration.

THE NECESSITY OF PLANNING AHEAD.

I now come to the most important of the points I have raised in my address, in fact to the whole object of my remarks. I have repeatedly referred to the necessity of planning ahead. How is this to be achieved. It is a very serious question and one that should not be left as before to chance. I do not know what probability there may be that operations may again be undertaken in which large bodies of troops are employed in malarious areas, but if there is such a probability, then time should be taken by the forelock and an effective advisory organization for malaria constituted and its working established well ahead.

We know that personnel and equipment for one or more Malaria Inquiry Laboratories will be necessary, that hospitals will be required to make large numbers of blood examinations and should from the beginning be in a position to do so adequately. We know that mosquito-proofed huts will be asked for and mosquito-nets tried out. All these things could as well be thought out beforehand as at the time they are required. Paris greening will be required on an enormous scale. What are the requirements for such large scale application? What is the programme as to quinine and atebrin or substitutes for atebrin? What teaching in practical matters for subordinate staff will be necessary? What subordinate staff is actually available? Who are the people who might be thinking, planning and experimenting about these things and how are they to come together and collaborate?
DISCUSSION.

It is most desirable if there is any question of operations in the present war in a malarious country or countries that all these matters should be dealt with well in advance and whilst the going is good.

REFERENCES.

TORI, F. (1712). *Therapeutice specialis ad Febres quasdam Perniciosas*.

DISCUSSION.

**Dr. C. M. Wenyon** (in opening the Discussion): I am sure we have all listened with the greatest interest to our President’s account of malaria in war, and the various factors which govern the spread, treatment and prevention of this disease under war conditions. In thinking of malaria and war, all of us who are old enough to remember the last war, and who had some experience of malaria then, inevitably find our minds turning to what we saw in the malarial countries in which we happened to be. I, myself, picture conditions in Macedonia and all my ideas on the subject are coloured by my experiences in that country, where I happened to be one of the few who more by good luck than good management escaped infection. Dr. Manson-Bahr thinks of Palestine, and Sir Rickard Christophers of Mesopotamia, where they were actively engaged. As regards East Africa, I saw Dr. Hanschell come in and I know he had to deal with malaria under very difficult conditions in the expedition he accompanied across Central Africa from the West Coast to Lake Tanganyika.

In referring to malaria in Macedonia, Sir Rickard rightly said that the infection of the army there came as a great surprise. Before that time there was little information available about malaria in South Eastern Europe, but since then extensive investigations have been undertaken, largely under the auspices of the Health Section of the League of Nations. Now we know that many parts of South Eastern Europe besides Macedonia are heavily infected with malaria, which is endemic or hyperendemic amongst the local populations. We know now that from the point of view of a campaign there are many parts which would be just as dangerous from the malarial point of view as Macedonia. As a result of the terrible experience of the last war in Macedonia, East Africa, and Palestine, malaria has been seriously studied from the practical point of view by medical officers in the Army. In India, for instance, a great deal has been done to apply modern knowledge to the prevention of malaria amongst troops, not only in cantonments, but also on active service. These