Proceedings of the Twelfth Meeting of the
Antimalaria Advisory Commission.
Jerusalem, 27th May, 1926.

The following were present:-

Col. G.W. Heron, O.S.O., O.B.E., Director, Department of Health. President.
Mr. R. Briercliffe, O.B.E., Deputy Director, Department of Health.
Dr. J. Tucktuck, Medical Officer, Nablus.
Mr. W.K. Bigger, Senior Medical Officer, Samaria & Galilee.
Dr. J.M. Shapiro, Controller, Malaria Research Unit.
Mr. L. Cantor, Sanitary Engineer, Department of Health.
Dr. K.J. Rustomjee, Asst. Government Malariaologist, Ceylon.

AGENDA.

1. President's Statement.
2. The decline of malaria in Palestine during the past few years. Mr. Briercliffe.
4. The management of the antimalaria campaign during the early part of the season. Dr. Shapiro.
5. Demonstration of Village Cistern Covers.
6. Drainage principles as illustrated by work on the Cherkas Swamp. Mr. Cantor.
7. Progress of major drainage schemes:
   Wadi Musrara.
   Kishon and Haamein.
   Beisan.
   Huleh.
   Wadi Rubin.

1. President's Statement.

The routine work in the campaign against malaria has continued unabated, and the towns were again almost completely free from new cases during last summer and autumn. The routine work in the villages has also been prosecuted with vigour, and it is very satisfying to realize that the people themselves are continuing to take an active interest in the work, with the result that the permanent closure of /cisterns
cisterns or the fitting of mosquito proof cistern tops, has advanced very considerably.

Permanent work on closure and mosquito proofing of cisterns in the towns has on the whole proved a greater problem than in the villages, largely on account of the great numbers to be dealt with, and the considerable difficulty of fitting a standard cover and maintaining it.

There is every hope that in the near future the development of water supplies and drainage in the larger towns will result in the permanent closure of many cisterns and wells and considerably relieve the routine work of oiling and inspection, which to be effective must be maintained at a high standard of efficiency.

In the rural districts considerable advance has been made either in the completion or continuance of major works or the accomplishment of minor works. Of the former, the Kabbara reclamation is developing very satisfactorily though not by any means yet complete. Beisan irrigation and drainage has been maintained and developed and the situation there from the point of view of the decline in malaria has been most gratifying, and has been reflected in the increased activity of the population previously reduced to comparative impotence by generalized malaria. There remain two or three small and more distant marshes only to be cleaned up. The effect of the demalarializing of the town on the birth rate is being carefully watched.

Of the Kishon and Nammein we have good news. These two large antimalarial schemes that have been so frequently before the Commission are to be completely taken in hand by the Haifa Bay Development Company with the object of settlement and agricultural development throughout the whole of the marshy and fever-ridden district between Nazareth Road Haifa, Jidru and Acre. The Department is in close touch with the engineers of the Company, who have undertaken to carry out our requirements and to incorporate our antimalarial schemes while securing the development of this large tract of land.

Negotiations for the financing and putting into effect of the Wady Musrara Scheme, near Tel Aviv and Sarona, are well advanced, and £E.3750 of the sum of £E.3500 required, is already guaranteed, and the municipal contributions and Government aid should not much longer delay this very important scheme in a rapidly developing area.

We have not yet made any appreciable advance in the Wady Rubin scheme. The credit for the primary work has not yet been voted, though promised, by the Waif authorities. It is a matter of considerable importance that this area be dealt with in view of the very large pilgrimage annually in the early autumn to the shrine and the annual infection of a number of those making the pilgrimage from the Jaffa-Ramleh-Ludd districts and from more distant places.

There has been no material development in the Huleh district, though there are rumours of a transfer of the Concession and probable early reclamation of the whole area.

Valuable minor work in the regulation of the northern channels has been done and relieved to some extent the worst conditions
in the more populous areas. It is, however, quite impossible
to deal radically with this intensively infected basin until
such time as a large reclamation scheme is put into effect.

The irrigation work from Ain el Sultan has resulted in
considerable improvement of the situation at Jericho, but
requires some modifications, which will be effected I trust
this summer.

At Tantura a careful control and observation were made
throughout the past year with interesting results. It was
clearly established that the proposed drainage of certain
waterlogged areas around this village was unnecessary and
that effective control could be established without it.

The routine work in the newer Colonies has been quite
effective, and, with a few minor exceptions in the more
difficult situations, such as in the Hedara district, the
incidence of new cases has been almost negligible.

Dr. Kligler has recently been appointed Professor of
Hygiene at the Hebrew University. He still maintains his
connection with the Malaria Research Unit, but in an advisory
capacity. The Research Laboratory is to be transferred to
the University.

The Malaria Survey Section, during the absence on leave
of Dr. Carley, has not been represented but there is every
probability of a Doctor and Field Engineer being re-appointed
by the Rockefeller Foundation to continue valuable work which
we have awaiting them.

Recently, as you will hear during the meeting, Dr. Bigger
has been advising the Transjordan Government on the malaria
situation in that country, and the result of his investigations give the valuable contrast between adjacent countries,
in one of which antimalarial work has been pursued over a
period of years whereas in the other no work has as yet been
attempted.

2. Mr. Briercliffe said he wished to give some idea of the
extent to which malaria in Palestine had diminished since the
end of the war.

As far as possible he would deal with the whole of the
settled population which was estimated to be 730,000 persons
in the middle of 1925. Of the nomadic population of some
103,000 Bedouin there were no reliable figures.

On the advice of the Malaria Commission of the League
of Nations, the Department of Health was placing great
reliance on the spleen rate as an index of the amount of
malaria in the country. Before discussing the spleen rates;
however, he would mention briefly the number of deaths from
malaria and the number of dispensary patients treated for the
disease during each of the past few years.

For the whole of Palestine, the deaths from malaria of
which the Department had records were as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>1920</th>
<th>1921</th>
<th>1922</th>
<th>1923</th>
<th>1924</th>
<th>1925</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>526</td>
<td>94</td>
<td>67</td>
<td>78</td>
<td>33</td>
<td>13</td>
</tr>
</tbody>
</table>

So far as any reliance could be placed on these figures
they indicated a satisfactory diminution in deaths from the

/disease.
The figures for Jerusalem town were more reliable and were as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total No. of Patients</th>
<th>No. of patients suffering from malaria</th>
<th>Percentage of Malaria patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1922</td>
<td>283,156</td>
<td>20,297</td>
<td>7.2%</td>
</tr>
<tr>
<td>1923</td>
<td>270,946</td>
<td>13,280</td>
<td>4.9%</td>
</tr>
<tr>
<td>1924</td>
<td>285,215</td>
<td>11,732</td>
<td>4.1%</td>
</tr>
<tr>
<td>1925</td>
<td>339,795</td>
<td>7,246</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

For as large a population as 730,000 persons it was obviously impossible to ascertain year by year the number of cases of malaria, but figures were available since 1922, of the number of patients treated at dispensaries and of the number of these patients who had been diagnosed (usually clinically) as malaria. In the towns of Palestine there were more than fifty government and voluntary hospitals, dispensaries and clinics where out-patients were treated. The percentage of malaria patients treated in these institutions served therefore as a useful index figure of the relative amount of malaria in the whole country, each year.

The figures for the last four years were as follows:

These figures were sufficiently reliable to show that the number of persons seeking treatment for malaria was only about a third of what it had been four years ago.

Last year the Medical Officers of the Department of Health carried out a spleen examination of more than 40,000 children in the towns and villages but unfortunately no such complete examination had been made in previous years.

For purposes of comparison, however, they were fortunate in having the statistics published by Dr. Yofe in the Revue de Medecine et d'Hygiene Tropicales (1920 No.3) of a careful and extensive spleen survey of school children in different parts of Palestine, made by him and certain other doctors immediately after the war — in December 1918 & January and February of 1919.

For the towns surveyed by Dr. Yofe, the following table set out, side by side, his figures of 1919 and those obtained by the Government Medical Officers nearly seven years later.
The population of the towns of Palestine in July 1925 was about 272,000 persons and the number of school children (i.e., children above 5 years of age) examined in November was 6549. 245 had slightly enlarged, 51 moderately enlarged and 6 greatly enlarged spleens. The spleen rate for town school children for the whole country was therefore, 4.6%.

Beersheba and Nablus were the only towns where the spleen rate was nil. Beisan had the highest spleen rate of any town, but the Beisan spleen rate had shown a remarkable annual decrease. In 1922 it was 48%, in 1923, 34%, in 1924, 24%, and in 1925, 16%. Beisan was the town where the most extensive and successful swamp reclamation had been carried out since 1919.

The Jerusalem records went back the furthest. In 1904-05 Cropper (1) found spleen rates of 36 to 60% in different schools, in 1912 Dr. Brunn (2), a former member of this Commission, found the rate to be 69%, for 1919 Dr. Yofe gave a rate of 54%, early in 1922 the School Medical Record Cards showed the rate to be 22% and now it was 0.8%.

The Arab village population in the middle of 1925 amounted to about 421,000 persons who inhabit 833 villages. It was the largest and, from the economic point of view, the most important section of the population of Palestine.

(1) Journal of Hygiene, 1905.
(2) Zeitschrift für Hygiene und Infektionskrankheiten 1913.
33,685 children in 541 villages had been examined in November 1925, with the following results:-

<table>
<thead>
<tr>
<th></th>
<th>No. of children examined</th>
<th>No. of enlarged spleens</th>
<th>% of enlarged spleens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Under 1 year of age</td>
<td>5807</td>
<td>321</td>
<td>61</td>
</tr>
<tr>
<td>1 to 5 years</td>
<td>11942</td>
<td>1064</td>
<td>388</td>
</tr>
<tr>
<td>Over 5 years</td>
<td>15936</td>
<td>1340</td>
<td>634</td>
</tr>
<tr>
<td>Total</td>
<td>33685</td>
<td>2665</td>
<td>1063</td>
</tr>
</tbody>
</table>

There were no previous figures with which to compare this table but it would form a useful basis of comparison for future years.

The spleen rates of many individual villages could, however, be cited to show the decrease of malaria which had taken place in them and as an example the figures for Beit Jibrin would be given. They were as follows:-

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of children examined</th>
<th>No. of enlarged spleens</th>
<th>% of enlarged spleens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>October, 1920</td>
<td>22</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>September, 1922</td>
<td>74</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>April, 1926</td>
<td>88</td>
<td>9</td>
<td>5</td>
</tr>
</tbody>
</table>

Of the 88 children examined in Beit Jibrin last month, 20 were less than 1 year old and none of them had enlarged spleens, an indication of a low malaria rate during the preceding year. Beit Jibrin was a village where annual clearance of vegetation and canalization of the neighbouring wadi had been practised since 1920.

He would now consider a comparatively small rural population but one of great interest from the malaria point of view. The Jewish rural settlements of Palestine in the middle of last year had a population of about 27,000 people. Here again the earliest reliable figures for the spleen index were those of Dr. Icke. In the winter of 1918-19 he had visited 26 of the Jewish settlements and some isolated farms and his results were as follows:-
For the last few years this population had been under the care of the Malaria Research Unit for measures of malaria control. In 1923 the Unit found the following conditions among the children of the Jewish Colonists:

### Districts

<table>
<thead>
<tr>
<th>District</th>
<th>No. of persons examined</th>
<th>No. of enlarged spleens</th>
<th>% enlarged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Galilee</td>
<td>474</td>
<td>173 93 35</td>
<td>63.6%</td>
</tr>
<tr>
<td>Lower Galilee</td>
<td>731</td>
<td>244 101 41</td>
<td>65%</td>
</tr>
<tr>
<td>Samaria</td>
<td>436</td>
<td>156 60 9</td>
<td>52.8%</td>
</tr>
<tr>
<td>Judea</td>
<td>1175</td>
<td>328 58 5</td>
<td>37.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2306</strong></td>
<td><strong>941 412 90</strong></td>
<td><strong>50.7%</strong></td>
</tr>
</tbody>
</table>

In 1924, the Malaria Research Unit examined 5,466 persons in the Jewish Colonies and found 1104 enlarged spleens, a rate of 20.1%.

The Malaria Research Unit had carefully compiled records of the monthly case-incidence of malaria in the Jewish settlements under its supervision, which showed clearly the reduction in the number of cases of the disease each year. The figures were as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Average monthly population under observation</th>
<th>Average monthly No. of cases of malaria</th>
<th>Average monthly malaria incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1922</td>
<td>6725</td>
<td>352</td>
<td>5.7%</td>
</tr>
<tr>
<td>1923</td>
<td>10042</td>
<td>286</td>
<td>2.9%</td>
</tr>
<tr>
<td>1924</td>
<td>16466</td>
<td>173</td>
<td>1.1%</td>
</tr>
<tr>
<td>1925</td>
<td>22283</td>
<td>182</td>
<td>0.8%</td>
</tr>
</tbody>
</table>
In view of the foregoing considerations it was possible to conclude that there has been a very definite general reduction in the amount of malaria in Palestine since the end of the war.

With regard to the causes of the reduction his views were as follows:

(a) In the majority of the towns and the hill villages which have cistern water supplies, the chief cause of the reduction had been the Government measures of oiling and closing cisterns and wells.

(b) In the autumn of 1920 certain villages of the Hebron, Ramleh, Majdel and Jenin sub-districts had suffered from a very severe epidemic of malaria which followed the abnormally heavy rainfall of the preceding winter. In these villages the decrease of malaria had undoubtedly been due principally to the natural decline which takes place after an epidemic of this sort. Tel el Turmus was an example. No special antimalarial measures had been applied there since the epidemic ceased and yet the spleen rate had fallen from 100 to 56.

(c) The following were the rainfall figures of Jerusalem for the years since the war.

<table>
<thead>
<tr>
<th>Year,</th>
<th>Inches of rain.</th>
<th>Year,</th>
<th>Inches of rain.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1917-18</td>
<td>24.9</td>
<td>1922-23</td>
<td>19.95</td>
</tr>
<tr>
<td>1918-19</td>
<td>27.6</td>
<td>1923-24</td>
<td>21.5</td>
</tr>
<tr>
<td>1919-20</td>
<td>40</td>
<td>1924-25</td>
<td>12.13</td>
</tr>
<tr>
<td>1920-21</td>
<td>27.6</td>
<td>1925-26</td>
<td>17.37</td>
</tr>
<tr>
<td>1921-22</td>
<td>26.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The average rainfall for Jerusalem was 26.64 inches. It would thus be seen that since 1923 the Jerusalem rainfall had been below the average. In certain parts of the country, particularly in the coastal plain along the foot of the Judean Hills and in some of the hill wadies, springs and seepage areas had dried up as the result of the low rainfall and thus Anopheles breeding had been absent or greatly diminished in those places, and neighbouring villages had benefitted correspondingly. The effect of a few years of low rainfall must not, however, be exaggerated. The Transjordan rainfall had corresponded more or less with that of Jerusalem and he thought what Mr. Bigger had to say in a few minutes would show that malaria had not decreased in the villages of Transjordan as it had in Palestine.

(d) With regard to the Jewish Colonies and those Arab villages round which drainage works had been undertaken, he considered that the reduction of malaria was almost entirely due to the anti-larval measures which had been carried out. In the Jewish Colonies there were usually facilities for treatment but they seemed to have played little part in the control of the disease. He thought Dr. Shapiro would agree that in those colonies where
anti-larval measures had not been undertaken, there had been no reduction in malaria.

(e) They must not forget that since the war the economic condition of the country had improved and this no doubt had some effect in reducing the amount of malaria.

(f) The view had been advanced that after the war Palestine suffered from an epidemic of malaria similar to that which swept through Russia and certain parts of central Europe, and that the decline of the disease was a spontaneous post-epidemic one. Those of them who were in Palestine during the war and afterwards knew that this was an exaggerated view and that only certain rural areas suffered from epidemic malaria due to war conditions. The pre-war reports of Cropper, Brunn and Goldberg, and Hulhens show that in Jerusalem and other places malaria was as prevalent before as it was immediately after the war, and there are various records of Circassian, Jewish and German settlements having been "wiped out" or abandoned on account of epidemic malaria, during the thirty years preceding the war, while in the best watered parts of the country, the numerous "tels" indicating the sites of former Arab villages showed the effect malaria had in reducing the Arab population.

Col. Heron said what was now needed was a really wet year in order to see the effect of the antimalaria measures of the last few years. Excessive rainfall in the hill country would probably not prove of much importance but it might be of great importance in the plains and wadi districts.

Dr. Briercliffe said that while he recognised the importance of energetic quinine administration during an epidemic, he was doubtful whether the treatment given in ordinary times had had much effect in bringing down the malaria incidence.

Dr. Shapiro cited Yessod-Hammala and Mishmar as two Jewish colonies in which the Hadassah Medical Organization had a doctor and clinic where fairly good treatment for malaria was given. For the last two years the Malaria Research Unit had been trying to work in conjunction with the doctors of these colonies in examining and treating cases but in spite of this Yessod and Mishmar still gave a very high malaria incidence and there had been no reduction in the rate for new infections. Jisr was a similar place. In none of these places had control of Anopheles breeding been attempted. Ekron and Merchavia were examples of colonies where treatment had been given for many years without any effect on the malaria incidence but where malaria had disappeared since anti-larval measures had been instituted.

Dr. Bigger thought treatment useless so far as the Arab villagers were concerned. They would not continue it for more than a day or two after the attack.
Col. Heron said the system of treatment in villages, started by the Department of Health in 1919 had been discontinued because it was expensive and not effective.

Dr. Shapiro said that when a population like the Bedouin population which had had no previous treatment, was given quinine, they responded much more quickly to short courses of treatment than the Jewish population which was accustomed to taking quinine.

Dr. Kustomjee asked how much sugar the Jews and Bedouins took in their diets since an excess of sugar in the blood seemed to favour the development of the malaria parasite.

Dr. Bigger said there was practically no sugar in the Bedouin diet. He thought the extent of the epidemic in 1920 had possibly been underestimated. In the Jenin sub-district there was only one village unaffected by it.

Dr. Tucktuck thought that possibly the epidemic would not have been so severe as it was, if the antimalaria personnel had had their present knowledge.

Col. Heron agreed. Not only were the doctors and sub-inspectors much better trained now but the villagers themselves knew what to do. In 1920 they were not ready and measures had been applied after the epidemic had started. In future, measures will be taken when an epidemic is foreseen.

3. Mr. Bigger said that the following remarks were based on a somewhat rapid survey of northern Transjordan, made between the 5th and 17th May, 1926.

As the time available was short he decided to examine the towns and to choose representative groups of villages as far as this was possible. As many children as could be collected were examined for enlarged spleens and a search was made for Anophelus breeding places in each of the towns and villages.

Unfortunately, though the time chosen for the survey was satisfactory from the point of view of Anophelus breeding, harvesting was commencing and in consequence it was difficult to collect large numbers of children for examination. Even in places where there were schools, from 25 to 50% of the school children were absent.

The country surveyed fell into three natural divisions which corresponded with the political divisions, the Belkaa, Jebel Ajlun and Irbid district.

The Belkaa was a sparsely populated dry country intersected on the western side by a few large wadis containing perennial streams. The settled population was mainly confined to the western part and the water supplies of the villages were in almost all cases springs and malarial incidence was not high.

The following places were examined:—

- **Amman**—110 children examined; 9 stage I and 1 stage II spleens found = 9% A stream ran through the town.
- **Buxton** obtained *A. superpictus* there in August, 1921.
Es Salt. 115 children examined; 11 stage I spleens found = 9% (One recently from Damascus). The town had the reputation of being free from Malaria; the M.D. doctor and others informed him that cases did not occur except in people who had been out of the town. A large number of the inhabitants spent part of the summer in their vineyards which, when far away, were provided with cisterns. There were, however, some excellent breeding places for A. superpictus in the wadi close to the town and he was rather of the opinion that it is unnecessary to look so far afield as the vineyard wells for the source of the malaria. As there was so large an exodus to the vineyards in summer it was easy to get a history which will remove the source of infection from the town, but histories were notoriously unreliable in the country.

Wadi Sir. 50 children examined; 2 stage I spleens found = 4%. This village gave him the greatest surprise of all as at first sight one would have expected a high spleen rate. The village, a forty year old Circassian settlement, was built on the side of a wadi at the bottom of which, five minutes walk from the village, was a fine perennial stream part of the water of which was used for irrigation and for working mills. Many places suitable for breeding A. superpictus were examined but no larvae could be found. Another part of this wadi was reputed to be one of the external sources of Malaria in Es Salt. The low spleen rate here, however, rather supported his remarks above.

Zerka. 28 children examined; 12 stage I spleens found = 43%. The situation of Zerka was almost exactly similar to that of Wadi Sir. The village was a Circassian settlement of about the same age and the stream was about the same distance from the village. The only difference was that Zerka was surrounded by desert and only cultivated the river valley, while Wadi Sir had arable land around it and the valley was narrower so that the river was less used for irrigation and the people did not spend so much time in its immediate vicinity.

A. superpictus larvae were found in considerable numbers near the village.

Sweileh. 25 children examined; 4 stage I spleens found = 16%. One of these had come from Es Salt a month previously. The water supply was a few small springs close to the village and some small marshy patches were formed by their overflow. No breeding was found.

Fahsis. 30 children examined; 6 stage I spleens found = 20%. There were many springs in the wadi which formed small streams. Some marshy places round the springs were examined but no breeding was found.

Roseliah. 20 children examined; 4 stage I spleens found = 20%. This spleen rate was valueless as most of the people were recent immigrants, some of them within a few months. He could get no children of the permanent inhabitants except the four who had enlarged spleens. Conditions here were similar to those at Zerka though no larvae were found.

Madaba. 43 children examined; 7 stage I spleens found = 16%. One of these children was from Es Salt two months previously.

Madaba was a purely cistern village and was probably typical of the whole of the south-eastern part of this area where there was no natural water. Most of the cisterns in the town were very dirty.
dirty and swarmed with species of Culex and Stegomyia. Drinking water cisterns were a considerable distance away; some of them were examined but no breeding found. These cisterns were perhaps too frequently disturbed for Anopheles breeding. In the Latin church buildings in the town, however, there were some ideal cisterns containing clean water and infrequently disturbed and in one of these *A. bifurcatus* larvae were found.

Jebel Ailun was a comparatively thickly populated and very well watered country. Nearly every village had one or more springs and most of the wadis contained perennial streams. Spleen rates varied with the amount and distance of the water, from 10 to 35% while villages whose lands extended to the Ghor had even higher rates, e.g. Kafrinj 40%.

The following places were visited:

Abbin. 30 children examined; 3 stage I spleens found = 10%. The water supply was a birkeh which dried about June and a few dirty cisterns unsuitable for Anopheles breeding. No breeding was found.

Anjara. 33 children were examined; 5 stage I and 1 stage II spleens found = 15%. There were a small spring in the village and a spring in the wadi Kafrinj some distance away. A man was seen here with a spleen reaching to ...be Burney's point.

Ajlun. 56 children examined; 12 stage I and 2 stage II spleens found = 34%. There was a large spring just below the village running down the wadi to Kafrinj and some had irrigation channels near the village.

Kafrinj. 46 children examined; 16 stage I and 4 stage II spleens found = 43%. A large stream exists in the wadi below village (10 minutes away). There were many bad irrigation channels bringing water half way up the hill. *A. superpictus* larvae were found in the wadi. Many people go down to the Ghor in summer.

Sakib. 21 children examined; 4 stage I spleens found = 20%.

Nahleh. 16 children examined; 4 = 25%.

Tkitteh. 21 children examined; 5 stage I and 1 stage II spleens found = 24%. These three villages were in the same wadi. Sakib was at the head of the wadi with a small marshy spring which nearly dried in late summer. Nahleh was further down the wadi with more springs and perennial water in the wadi while Tkitteh was further down stream with still more water in the wadi and some marshy springs near the village.

Sur. 33 children examined; 7 stage I and 1 stage II spleens found = 24%. There were several large springs below the village in which *A. superpictus* larvae were found.

Arjan. 20 children examined; 6 stage I and 1 stage II spleens found = 35%. Several adults were seen with stage III spleens. There was a large spring and stream in the wadi below the village.

Bann is similar to Arjan but sufficient children could not be collected.

Gareh is one of the few cistern villages of the district. 15 children examined; 3 stage I and 1 stage II spleens found = 25%. *A. bifurcatus* adults were found in two of their five cisterns.
Jarash. 56 children examined; 17 stage I and 3 stage II spleens found = 35%. There was a large spring about two or three kilometres from the town which after filling an ancient birkeh, now nearly full of earth and in consequence forming an extensive marsh, flowed down the wadi close to the town. As it passed the town the water was largely employed for irrigation. Irrigation and mill channels were very bad and there were many possible breeding places though no larvae were found except in the birkeh near the spring where enormous numbers of Anopheles larvae were present.

Irbid district was a very dry country with a large population almost entirely dependent on cisterns for their water supply. The Malaria incidence appeared to vary only with distance from the Ghur and the valley of the Yarmuk in the north. The following were examined:

- Remtha. 58 children examined; 10 stage I spleens found = 17%
- El Huan. 75 I = 20%
- Irbid. 80 children examined; 17 stage I and 1 stage II spleens found = 22%

A. bifurcatus larvae and adults were found in cisterns.

- El Huan. 27 children examined; 8 stage I and 1 stage II spleens found = 33%. This village was about one hour from Umm Hels and many people went down to el Hamme.
- Irbid. 44 children examined; 25 stage I and 9 stage II spleens found = 77%. A few A. bifurcatus adults were seen in cisterns. All the people went down to el Hamme in the Yarmuk valley at times.

These spleen rates were particularly interesting as giving some indication of what conditions would be in parts of Palestine had no antimalarial work been done. Prof. Swellengrebel had pointed out that the Palestine figures generally only showed the difference between conditions in about 1919-20 and those of the present, and that as there was undoubtedly an epidemic in parts of Palestine at the end of 1920, a large part of the reduction was natural and not the result of antimalarial work.

He considered the following figures were strictly comparable and therefore gave some idea of the actual result of the work done.

### A. Cisterns only.

<table>
<thead>
<tr>
<th>Transjordan</th>
<th>Palestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbin</td>
<td>Osarin</td>
</tr>
<tr>
<td>Ladaba</td>
<td>Akaba</td>
</tr>
<tr>
<td>Remtha</td>
<td>Bursa</td>
</tr>
<tr>
<td>El Huan</td>
<td>Baka</td>
</tr>
<tr>
<td>Irbid</td>
<td>Berokin</td>
</tr>
<tr>
<td>Osara</td>
<td>Fusin</td>
</tr>
</tbody>
</table>

- A. bifurcatus larvae and adults were found in cisterns.
- Some of the people went down to el Hamme in the Yarmuk valley at times.
B. Cisterns but people work in other malarious places.

<table>
<thead>
<tr>
<th>Transjordan</th>
<th>Palestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malka. 33%</td>
<td>Kefr el Dik. 12%</td>
</tr>
<tr>
<td>Kafat. 13%</td>
<td></td>
</tr>
<tr>
<td>Deir Ballut. 14%</td>
<td>Kefr Laka. 14%</td>
</tr>
<tr>
<td>Saviah. 16%</td>
<td>Hajjeh. 16%</td>
</tr>
<tr>
<td>Hajjeh. 16%</td>
<td>Kafir Hasen. 16%</td>
</tr>
<tr>
<td>Kafir Thilth. 19%</td>
<td></td>
</tr>
<tr>
<td>Sennireh. 22%</td>
<td></td>
</tr>
<tr>
<td>Kisha. 28%</td>
<td></td>
</tr>
</tbody>
</table>

C. Cistern villages but close to highly malarious places which people frequent largely.

<table>
<thead>
<tr>
<th>Transjordan</th>
<th>Palestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umm Keis. 77%</td>
<td>Tal fists. 85%</td>
</tr>
</tbody>
</table>

D. Streams used for irrigation close to village.

<table>
<thead>
<tr>
<th>Transjordan</th>
<th>Palestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jerash. 35%</td>
<td>Jenin. 4%</td>
</tr>
<tr>
<td>Beis an. 16%</td>
<td></td>
</tr>
</tbody>
</table>

The Palestine villages mentioned above have only been selected because he himself had worked out the spleen rates and the personal element was therefore eliminated. The figures shown were if anything rather above the average for Nablus district.

Other parts of Transjordan could not strictly be compared with Palestine as similar conditions were not generally found here. It was, however, interesting to note that where some comparison of unworked places in Palestine could be made with similar places in Transjordan the rates for Palestine were higher so that possibly Transjordan had never been so badly infected as Palestine.

For instance Balker, a purely cistern village in Safad district, when included in Palestine in June 1924 had a spleen rate of 33% which was considerably higher than that of any purely cistern village seen in Transjordan.

Also Deishum in Safad area which was more or less comparable with Kafiringi had a spleen rate of 57% as compared with 48% for Kafiringi.

Jerusalem too gave spleen rates in pre-war days of from 30-60%.

Col. Haron thought the comparatively low spleen rates in the Transjordan villages suggested that there had been a general reduction of the malaria incidence in Transjordan as well as in Palestine and that the index of any success achieved by the antimalaria measures in Palestine was the difference between the present rates there and those in Transjordan.
Dr. Bigger considered that the Transjordan incidence had always been less than that in Palestine. Although Transjordan had a lower average rainfall there were many flowing wadies, but no swamps. This was accounted for by the topographical features of the country viz: a drop of 4000 ft. in a very short distance to the Jordan Valley, while in Palestine the drop was only 2000 ft. in a very long distance to the Mediterranean coast.

He had seen no ground which would hold water and form swamps and only one suitable breeding place (at Jerash) for A. slutz. Apart from the cisterns where A. bifurcatus bred, the breeding places he had seen had all been suitable for A. superpictus.

Mr. Briercliffe mentioned an Army report of 1919 (by Major General Sir Walter Lawrence) which pointed out that of the different Occupied Enemy Territory Administrations, O.E.T.A. (South) (Palestine) was much more malarious than O.E.T.A. (West) (Syria) or O.E.T.A. (East) (Transjordan).

Dr. Shapiro asked what the malaria season was in Transjordan. He said the absence of A. slutz should prevent the spring malaria season which occurs in Palestine. In Palestine A. slutz was the chief rural carrier of malaria. A. superpictus might not be such an important carrier as A. sergenti which bred in slower streams.

Dr. Rustomjee asked about the economic condition of Transjordan.

Dr. Bigger said it was poor; last year the crops had failed and he himself when in Jerash, had eaten barley bread as there was no wheat.

4. With regard to the management of the antimalaria campaign in the rural settlements in the early season of the year, Dr. Shapiro said that the work started in the winter months when with very few exceptions mosquito breeding was practically nil. The months of January and February were ideal ones for killing off hibernating mosquitoes. The Malaria Research Unit found for this purpose the method of "smoking" to be the most serviceable one; the mosquito was half asleep, sluggish and when disturbed by the smoke she readily flew to the single spot of light and air, where she was either killed by hand or, when a trap was used, she eventually stuck to the castor oil, with which the glass walls of the trap was covered. Thus, the inspectors were ordered thoroughly and systematically to "smoke" all the stables, store rooms, cellars and living rooms and to return again to those places where a large number of mosquitoes were found on the first "smoking". It was their experience that where the hibernating mosquitoes have been thoroughly cleaned in the winter, the first breeding of Anopheles in the spring was considerably delayed.

The next step was to attempt to destroy the hibernating larvae in the swamps. After the heavy rains were over, usually
about the middle of March, the inspectors went over all the known and potential breeding places, to look for larvae and to measure the temperature of the water. This inspection had to be done on a bright, warm day - since the larvae had a tendency to hide at the bottom of pools on a cloudy and cool day. Where any trace of breeding was found with a water temperature above 15°C, larvicides were used on the swampland places that could not be immediately eliminated by some channelling. This general petroilization if properly done served also to lessen considerably the number of the first new mosquitoes that might escape early in the season.

On the heels of the first petroilization came the big problem of channelling and cleaning of the pools and cleaning and regulating of the streams.

In doing this work several things must be remembered:

1. The period of the year during which the cleaning was to be done. In 1925 cleaning started early in March - the rains ceased early then - and in April there was another crop of vegetation. This year with one or two exceptions the cleaning started about the middle of April.

2. The length of time to be allowed before the people were induced to do the work. Usually the owners of the land or the inhabitants who are interested in eliminating malaria in their vicinity, agreed to work after they were made to understand the benefit they would derive. But often written orders for work had to be issued in accordance with the Antimalaria Ordinance; and if the written order was not complied with and court procedure had to be resorted to, much delay was encountered. It was now the end of May, and the Malaria Research Unit had two places where the work had not even been started.

3. The period of Arab holidays and of harvesting. During the Ramadan holiday it was difficult to get the villagers to contribute labour or even to work for money. Therefore if early work was to be done it must be started soon enough to be finished before the fasting season was well advanced.

On the other hand if the work started later in the spring one must aim at finishing it before the harvesting season began.

One must also consider the amount and kind of cleaning to be done so as to make it inexpensive and to finish it in the shortest time. In some places thorough cleaning of vegetation on the surface of the water and on the banks was required, in other places just partial cleaning or channelling might suffice; there were places where only paths on the overgrown banks were made to allow the inspector to reach the wide pools thickly covered with horizontal vegetation and use Paris Green.

Along with and following the work of cleaning and regulating of swampland places, periodic inspection for breeding was going on, and larvicides were used where necessary. In deciding upon the choice of a larvicide the cost and effect were considered; the inspectors were trained to use the larvicide in such manner as to get the greatest result with the minimum of material.

To check the results of the work, periodic searches for mosquitoes were made in the houses and stables. Usually points were selected in each corner of the settlement in the direction /of the
of the various swamps; in the course of these searches the
favourite hiding places of mosquitoes were detected; these
might be particular houses, a certain room here and there or
even a certain favourite corner in the stable. These searches
were made at least once a week.

One more phase of the campaign was to be mentioned; the
detection and treatment of parasite carriers.

In places where the summer or autumn infections during
the preceding year were heavy they usually carried out blood
and spleen examinations either of the whole population or at
least of those who had malaria attacks and treated those
showing any signs of a chronic infection.

The examinations and treatment were done during the
months of February and March, but this work continued even
through the later months when necessary.

Col. Heron said that Dr. Shapiro's note was of great
interest because there was an impression among many malaria
workers that there was nothing to do in the winter.

Mr. Briercliffe demonstrated a number of cistern covers
which had been supplied by the Medical Officers of Hebron,
Ramleh and Ramallah. They were examples of the covers at
present in use and which had been standardized in those sub-
districts. In tracing the evolution of these covers he pointed
out that a standard type of wooden cover was first fitted
extensively by the H.O. Jenin to the village cisterns in his
area about two years ago. After several months, however, the
wooden covers became cracked and warped from exposure to the
weather. The Ramallah type of cover was then introduced and
was a simple iron lid hinged on to the coping stone and which,
when closed, could be padlocked. It cost only P.T. 30, but
the coping of the cistern had to be made of good, well-dressed
stone. The Hebron cover was somewhat similar but was heavier
and was hinged into an iron frame, so that a less expensive
coping to the cistern opening could be used. This cover cost about
P.T. 50. It was supposed to be automatically self closing by
means of a spring catch but the catch had a tendency not to
work and to keep the lid open. Without this catch, it would be
a very good cover. The Ramleh cover was a sheet of steel
sliding in a metal frame. It worked on the principle of the
original wooden covers used at Jenin. Apart from the tendency
of the sliding panel of steel to get bent and so not fit accu-
rlately, it was a good type of cover and cost P.T. 50. A small
model of a similar cover used in the Nazareth villages was also
shown.

Imported cast iron man-hole covers which could be brought
in Jerusalem from P.T. 45 to P.T. 50 and which were very
suitable for closing the openings of town cisterns to which
pumps had been fitted, were demonstrated. For village cisterns
filled with pumps, a cheap and simple cover was being fitted in
the Nablus district.

With regard to the village cistern cover the questions of
price, durability and simplicity were very important and it
could not yet be said that a perfect cover had been produced but
all the iron covers shown were suitable and were a great advance
on wooden covers.
6. The following is a summary of the exposition given by Mr. Cantor of drainage principles as illustrated by work at Cherkaz Swamp:

1. **Description of swamp area.**
   
   **(a) Location.**
   - 4 Km. east of Khudeira Station.
   - 4 Km. north-east of Colony Khudeira.
   - 1 Km. south-east of Gan Samuel.
   - 3 Km. south of Cherkaz Village.

   **(b) Area affected as water-logged ground.**
   - Dry weather conditions: 135 dunams (35 acres) approx.
   - Rainy season: 360 acres (90 acres)

   **(c) Soil conditions.**
   - Loam and clay overlaying sand. Bog areas under water pressure consisting of matted vegetation and black fine silt overlaying sand.

2. **Cause of swamp.**

   Series of springs without proper outlets, and seepage from higher land.

3. **Method of Improvement.**

   Original scheme submitted to Antimalaria Advisory Commission altered by field conditions.

   Main outlet to Wadi Khudeira from the Railway ditch was modified by connection to the existing drainage channel of the Dardarra swamp.

4. **Drainage principles utilized.**

   (A) Impounding dam for flushing lower channel and for irrigation of adjacent land.
   (B) Open ditches for main lines where ground conditions were favourable.
   (C) Permanent concrete lining for outlet channels due to low-lying areas to save gradient.
   (D) Sub-surface drain tile.
   (E) Intercepting ditches at slopes.
   (F) Relief wells for water logged areas under pressure.
   (G) Combination inspection chambers and sand traps.
   (H) Filling of low levels.
   (I) Storm water diversion channel.
   (J) Spring control.
   (K) Maintenance.

5. **Impounding dam for flushing lower channel.**

   **(a) Main outlet extended to Dardarra drainage channel and a distance of 225 m., giving a storage capacity of 24 to 30 hours under normal conditions.**

   **(b) Negotiations under way to utilize water for irrigation of adjacent fields.**
(c) Impounded waters released daily flood lower channel and tend to eliminate breeding when channel is kept clear.
(d) Railway culvert interferes with Dardarra swamp outlet and requires cutting 30 cm. depth to avoid filling of the swamp area to obtain necessary gradient.

Essential that Railway authorities are kept informed on construction of new bridges and culverts where drainage schemes may be affected.

6. Open ditches for the main outlet channels are about one metre width at bottom with slopes 1 to 1.

Continual cleaning and grading of channels are necessary to maintain satisfactory flow.

Concrete inverts are recommended for future improvement.

7. Permanent concrete channels 20 x 20 cm. are sufficient for the dry weather flow of 375 litres per minute, but the storm water is diverted to earth channels adjacent. Precast sections were butt jointed and did not prove satisfactory as the portions cast in situ owing to settlement and eventual seepage.

8. Sub-surface tile drain proved of variable success at the beginning owing to underlying sand strata and omission of inspection chambers, sand traps and clean-out pits. These were made proved of service and assisted in maintaining the pipe lines clear of sand. The protection of the tile drain outlets into the open ditches are to be provided.

9.Interceptor ditches located at the change of slope lines functioned in a slight measure, owing to the special conditions of a pervious layer being below the impervious section. Springs are disclosed at the inverts so that conversion into closed drain is proposed to eliminate continuous cleaning & maintenance.

10. Relief wells.- Water-logged ground existed in extensive sections after the main swamp area was drained. Surface ditches cut across the wet ground patches failed to improve conditions.

Owing to the heavy, impervious mass of peat and clay that restrains the water under pressure, relief wells penetrating to the lower strata were made. Wooden cement barrels used as casings in the trial pits proved very economical and useful. A more permanent concrete pipe casing is proposed when necessary. The floating raft-like ground surface heaving to and fro under action immediately subsided after piercing the surface. Water spurted under pressure when the cutting was first made. Connection of relief wells in series was made to the drainage ditches and have produced the necessary result. Earth augurs are to be utilized for future inspection.

11. Combination inspection chamber and sand traps were installed at spring outlets and along the tile drains to prevent blocking with sand. Considerable fine sand was brought to the surface and filled the concrete channels, causing overflow by silting. The sand traps assist effectively in maintaining the lines clear.

/12.
12. Filing of low levels adjacent to the concrete channel of the main outlet was necessary owing to the low depression. The necessary gradient was maintained by raising to required level from adjacent banks. Additional filling will be required for completion to prevent seepage at sections and to remove the storm water discharge into the controlled channel.

13. Storm water diversion channel was necessary at the low level crossing adjacent to the concrete lining 20 x 20 cm. section. The flooding of the wide spreading natural channel endangered the concrete work which was not in section sufficient to carry off the heavy storm flow. Filling of the adjacent ground and raising the banks to a sufficient height will make a combined dry and storm water ditch.

14. Spring control for water supply was arranged for the villages at favourable points and protected by casings. Additional safeguards against polluting of the springs will be made. Various spring outlets were collected by tile drain into one basin collector so that the volume of water is sufficient for the filling of the water jars etc.

15. Buffalo wallow hole was provided adjacent to the village area at the upper end of the drainage system to permit breeding of the beasts. The pool is 15 x 20 m. and the herds should be at home with the surroundings.

16. Maintenance of the system will be of great importance due to varying conditions enumerated. Character of soil, depth, varying strata, vegetation and combination of system will necessitate proper supervision to be maintained.

Conclusions.- The general drainage principles involved in obtaining the results, demonstrate the necessity of arranging the work over a longer period of time to note the effects of each operation. Flushing of channels below the dam, that are in a bad state of repair, tended to aggravate the conditions during discharge of impounded waters. Particular attention should have been given to the main outlet as part of the scheme.

Test pits at various parts of the swamp area should have been made to indicate strata conditions. Intercepting ditches as provided could be otherwise arranged. The use of sub-surface tile drainage could have been deferred to a later period, when the sand formation was encountered. Use of relief wells, observation chambers and sand pits are essential features for the type of work involved.

In general the results can be considered satisfactory when the proposed improvements are completed.
Col. Heron said that although the first work done at Cherkas had not been a success, it was only by trials of different methods that experience could be gained. In all parts of the world malariologists were trying different types of drainage and the experience obtained at Cherkas had been of much value for future work in Palestine.

7. Col. Heron said he had touched on each of the different major drainage schemes in his opening statement.

Wadi Musrara.- The drainage scheme was more or less complete and the financial difficulties were the only worry. Guarantees had been obtained for the total cost of the scheme less about £E,900 but he hoped that with the financial assistance of Tel Aviv, Sarona and Montifiori and with concessions from the Government Railways in connection with the transport of material, the scheme would soon be under weigh. It was an important project since the wadi lay in a rapidly developing area.

Kishon and Haarza.- The Haifa Bay Development Company, the concessionaires for the area, had undertaken to carry out the extensive drainage works required and there was a good prospect that the work would be completed in a year or two.

Kefbara.- Dr. Shapiro said the swamp was eliminated in the northern area and the land was being ploughed. Work was progressing on the southern swampy area and would soon be finished. Then a six-metre wide channel would be cut from the Seven Hills area to the sea to eliminate the mosquito breeding areas near the sea.

Beisan.- Mr. Bigger said there remained nothing to be dealt with except Tel esh Shoq and part of the old bed of the Jerom. The Sanitary Engineer would be asked to take levels and give his advice with regard to drainage and meantime mosquito breeding would be controlled by means of Paris Green.

Huleh.- Col. Heron said it was probable the present concessionaires for the area would not retain the concession. Mr. Bigger thought that malaria could in time be eliminated by getting the local inhabitants gradually to carry out minor drainage works.

Wadi Rubin.- Col. Heron said that a definite promise of support for the scheme had been given by the Moslem Supreme Council but that up to the present the money had not been forthcoming.

He mentioned a small drainage scheme which would be carried out at Megiddo, where an American Archeological party who were excavating near the marsh, had suffered heavily from malaria. The Joint Distribution Committee of New York had granted £E,100 for the clearance of the swamp and work would soon be started.