

## THE MALARIAL FEVERS OF JERUSALEM AND THEIR PREVENTION.

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IN a previous paper<sup>1</sup> I referred to observations by Dr E. W. G. Masterman, on the prevalence of malaria in Jerusalem. Since that time Dr Masterman has searched various places for *Anopheles* in and near the city, and has found numerous larvae in the Birket Mamilla (or "Upper Pool of Gihon") in winter, the water of which is conducted by covered conduits to Turkish baths in the city. The pool is dry in summer.

The Pool of Hezekiah, near the Jaffa gate, contained no *Anopheles* larvae in the spring of 1903, but in various rain-water cisterns inside the walls larvae were almost invariably found and imagines in the London Jews' Society's Hospital. Last year Dr Wheeler found *Anopheles* in six Jewish houses in the city, and I found them in five, but only in dark rooms, in the hospital above mentioned, and also in many cisterns in and outside the city.

Having carried on part of Dr Masterman's work during his absence from September, 1904, to January, 1905, inclusive, at the London Jews' Society's Dispensary inside the city, and practising in the neighbouring village of Ramallah on the other days of the week, I have had exceptional opportunities of observing the malarial fevers, not only of Jerusalem, but also of the surrounding country. During the period stated I examined the blood of about 500 cases of fever microscopically.

Jerusalem, from its natural position, 2500 feet above the level of the sea and 3300 feet above the Jordan valley, surrounded on three sides N., E., and S. by deep limestone valleys, without streams of water, with

<sup>1</sup> Cropper, J. (1902), *Journ. of Hygiene*, vol. II, pp. 47—57. "The Geographical Distribution of Malarial Fever and *Anopheles* in Upper Palestine." (See p. 56.)

almost no springs, and absolutely no marshes within a radius of 20 miles, should, if any city, be beyond a suspicion of malaria<sup>1</sup>. The exact contrary of this is the case, as will appear below: few spots, even on the West Coast of Africa boasting a higher endemic index, than some at least of the Jewish colonies of Jerusalem.

A very large number of Jews live in or near the city. No census is possible, but 40,000 is probably a reasonable estimate of their numbers at the present day. Though most of the facts adduced below refer to these people, I have good evidence of the occurrence of malaria amongst the Arabs, Europeans, and others living in the city.

The Jews inside the city are mostly Sephardim or Spanish Jews, at once the poorest and most despised, but far the cleanest in their habits; they inhabit for the most part the Jewish quarter which occupies the S.-E. corner of the city, and extends from the Haram or Temple area to the Syrian and Armenian Convents.

The so-called Jewish "colonies" outside the city, over 40 in number, occupy every possible position from the lowest named colony Silwân (Siloam) to the highest Abu Bussal on the Jaffa road, and the Bokhara colony near by, 2650 feet above sea-level. Some have an eastern aspect, others face due north, and in fact every direction conceivable. Some are in hollows, some on steep hill sides, or in exposed positions. Nearly all have equally dirty surroundings, scavenging being nearly unknown, the Bokhara colony being a notable exception. The "colonies" have for the most part been erected by small limited companies, and the houses are generally one or at the most two storeys high, overcrowding is well-nigh universal.

One factor alone, out of many, which seems to have any real influence on the incidence of malaria, is the presence of cisterns of water. I mention this because the only colony where I found splenic enlargement quite rare amongst the children was (at the time of my visit) without a single cistern, water being brought from a distance. This defect is now being remedied, but I did not know of the fact until after my visit. At the present time the population of Jerusalem depends for its water supply almost entirely on rain water stored in cisterns cut out of solid rock; *Anopheles* breed almost entirely in these cisterns.

The average rainfall of the past 22 years was  $28\frac{1}{3}$  inches (see

<sup>1</sup> So scarce is water that at the end of summer from £5 to £10 can be readily obtained for a cistern of water.

*Quarterly Statements of the Palestine Exploration Fund*). The hot months being May—October, and the wet months November—April.

The following statistics will give some idea of the prevalence of malaria among the Jews, who form quite  $\frac{2}{3}$  of the total population. Of 937 new out-patients seen at the Dispensary (of the L. J. S.) in the city from Sept. 13 to the end of the year 1904, no less than 424 were diagnosed as suffering from malaria. Of these cases 228 had enlarged spleens, and in 80 malarial parasites were found microscopically. The spleen was not examined in every case, and on no occasion were more than 11 slides examined, owing to lack of time and other causes. As a rule fresh films were used, but in a considerable number of instances slides were stained by Leishman's method, and the results thus checked.

On Oct. 11 of 60 patients seen in the city 30 were diagnosed as malarial. Owing to the large number who had previously taken quinine the positive findings were more numerous than might have been expected. During the same period 179 cases were examined at Ramallah with positive results.

The percentages of the various forms of malaria found out of a total of 259 positive examinations work out approximately as follows:

Tertian	= 20 %	
Quartan	= 4 %	
Remittent or Tropical	= 68 %	Double Infection = 8 %
Doubtful (Pigmented leucocytes —broken parasites, etc.)	= 8 %	
	100	

Every effort was made not to count any patients' names twice. Several were examined 2 to 3, or even 4 times. The number of the double infections would probably have been increased had more time been available.

Crescents were seen in 13 cases, and exflagellation in all forms of fever, including quartan. This is hardly the place for discussion of the various forms of the "tropical" parasite, but by far the commonest form was not that of pale rings so often described and so easily seen and stained, though these occurred in over 10 %, but the very minute oval, rod, or pear-shaped bodies, occasionally showing active though slow (hardly amoeboid) movement<sup>1</sup>.

<sup>1</sup> See J. Cropper (l. v, 1905). "Note on a form of malarial parasite found in and around Jerusalem. *Journ. Tropical Med.* vol. VIII, pp. 132—133. One figure."

This form is very common in children (50 %), and is accompanied by a considerable amount of splenic enlargement, being often very resistant to quinine, though it yields in the end. It is occasionally found in persons evidently suffering from malarial poisoning without actual fever.

Crescents are rare in this infection. This was the only form of malarial parasite found in the case of an Armenian boy who died in the hospital in November from pernicious fever, with well-marked tetanic symptoms. In the past 10 years, as I am informed by Dr Wheeler, there have been three deaths from pernicious attacks. Almost all the cases showing typical pale rings have come from Jerusalem, the Jordan valley, or villages to the east of Ramallah, whose people often visit the valley. Several cases have also occurred amongst men who went to work on the new Haifa Damascus railway near Tiberias.

I think from what I have seen that it will be proved that those who are quite immune to the fever occurring in the hills at once fall victims to the fever of the Jordan valley. *Anopheles* is present in sufficient numbers in both places.

In three cases of remittent fever of a severe type I observed the parasites sporulating in the peripheral blood (of the ear).

The youngest patient whose blood I have examined was 20 days old ; in this case the spleen was considerably enlarged. I have seen several patients aged 3 and 4 months in whose blood the parasite of tertian or remittent fever was found. Evidence of the occurrence of malaria amongst the non-Jewish population has chiefly come to me from those who have come to Ramallah for their health after suffering from malaria in Jerusalem, these cases fully bore out what I found obtaining amongst the Jews, and presented nothing of special interest.

Want of time has alone prevented me from making a much more extensive examination of the Jewish colonies, and the following facts are only given as a fair sample of what may be found.

In October, 1904, I examined a corner of the Damascus Gate colony containing 8 houses. Of 15 children every one had notable splenic enlargement. The older people had every appearance of chronic malaria.

The children's ages ranged from 3 months to 15 years. In one house where *Anopheles* was quite abundant, the father and mother, and five children aged 3 months to 15 years, all had enlarged spleens, and on this and on subsequent occasions I found malarial parasites (tertian and remittent) in two of the family aged 5 years and 3 months, and a clear history of quartan malaria in the father.

I moreover visited the colonies of Mia Shârim and Oel Mosché. At Mia Shârim of 33 children examined aged 2–14 years, 20 had enlarged spleens. At Oel Mosché I visited several schools of children aged 3–14 years; of 104 children, 36 had enlarged spleens, but the children in these schools came undoubtedly from the most healthy and breezy suburbs of Jerusalem, and moreover those at the time suffering from fever were probably not at school. On one occasion (Oct. 11th) I treated at the Dispensary in the city 8 girls from the same school suffering from fever—in all of these the spleen was notably enlarged, and from what I can judge there is more malarial saturation as a rule inside the walls. It is perhaps worthy of note that in every house where *Anopheles* was found, there were patients down with fever (with only one exception). A few dissections of mosquitoes were made, but not enough to be of any real value. Judging by previous records the months of the greatest incidence of malaria are September, October, and November—when the proportion of malarial to other cases is  $\frac{1}{3}$  to  $\frac{1}{2}$ . After the rains and cold weather have set in the number gradually diminishes; and in February, March, and April the proportion is  $\frac{1}{8}$  to  $\frac{1}{5}$  of the whole, after which the number increases until September. The rains cease in April, hence malaria coincides with the hot weather and not with the rainy season as in other parts.

Concerning the habits of *Anopheles*, one thing has been most prominently brought to my notice, and that is that *Anopheles* during the daytime will select the coolest, darkest and dampest spot available, especially avoiding well-lighted, whitewashed rooms. Where the houses are the coolest and the darkest hiding-place to be had they will be found in these, but not otherwise; they may always be found by day in the cisterns.

At first we were greatly puzzled by the rarity of *Anopheles* in the houses by day, *Culex* being always much in evidence, and especially *Stegomyia fasciata*, etc. The reason for the above scarcity was not apparent to me, until, having an occasion to examine a cistern at Ramallah which was being cleaned out, I found (on descending into it by day) numerous *Anopheles* flying round. The water at the bottom of the well contained the larvae in abundance, but none of *Culex*. Osler's statement therefore that *Anopheles* is a country insect is hardly true, for in Jerusalem, where the only species is *A. maculipennis*, this is at least equally as common as in the country, and probably more so. The comparative immunity enjoyed by the peasants I attribute to:

(1) The scarcity of cisterns, all water being sometimes carried two or three miles, at any rate in summer. In Ramallah there are 50 cisterns for 5000 people.

(2) Less overcrowding.

(3) Healthier open-air life.

(4) Exposure to breezes at night, which prevents mosquitoes flying.

(5) A relative condition of acquired immunity.

The last statement needs to be qualified, for peasants from the hills on visiting the Jordan valley, as already stated, often acquire a most virulent form of fever, which the Arabs call "plague" (or "wakhm"), which reduces them to a condition of great prostration if untreated: this frequently is bilious remittent in type<sup>1</sup>.

At Jericho there is evidently much endemic malaria, and enlarged spleens are common.

*Prophylaxis.* Could any real pressure be brought to bear on the authorities the prevention of malaria in Jerusalem would be an easier matter than in any part of the globe. There are no marshes to be reclaimed, no streams to be diverted, no puddles to fill up, and few open collections of water, and these easily dealt with. Hitherto efforts to influence the Government have been in vain. The following methods have been suggested by Dr Masterman<sup>2</sup>:

(1) To close the wells.

(2) To use pumps instead of buckets.

(3) The systematic use of quinine throughout the city.

The first measure is of course impossible of achievement where several families use the same well. The best closed well I have seen

<sup>1</sup> Early in July, 1904, five healthy men went down from this village (Ramallah) to work on the Haifa-Damascus Railway in the Jordan valley near Beisan. In 17 days (almost exactly) they returned all ill with fever, bilious vomiting, etc., the illness having lasted about a week. Three of them were well enough to come to the dispensary here for medicine, the other two were seen in bed in their houses. The native doctor here pronounced them all to be cases of enteric fever. The blood of one of them (temperature 102° F.) on examination showed a fair number of crescents. All the cases were therefore diagnosed as bilious remittent fever and all recovered in a few days under quinine, at least 20 grains daily, and, so far as I know, only one case relapsed later. In all probability all of these men had had the form of malaria so prevalent here in infants; amongst the latter crescents are practically unknown, though splenic enlargement is common. This corresponds with what A. Plehn found in Africa as quoted by Manson (*Tropical Diseases*, ed. 1900, p. 66).

<sup>2</sup> In his lecture on the sanitation of Jerusalem, *Pal. Expl. Fund Quarterly Statement*, Jan. 7th, 1905.

when opened revealed *Anopheles* inside. The second measure is impracticable, for the poorest classes of Jews *cannot*, and the landlords *will not*, go to the expense of pumps, and these would soon be out of order. The third measure has been tried as thoroughly as possible for many years. In the last 10 months at one hospital no less than 600 ounces of quinine have been used, entailing a cost roughly of £50. There are at least four or five other hospitals probably spending as much, and yet from the statistics available I can find no appreciable diminution in the number of cases of malaria. Moreover young children will not take quinine, when once their fever has gone.

The only feasible method of dealing with the matter in practice appears to me to consist in the *sulphur fumigation of the cisterns*. This is both cheap and easily carried out, and is found not at all to affect the water for drinking purposes<sup>1</sup>.

Lastly, I may mention the suggestion of the British Consul in Jerusalem, Mr John Dickson, that of putting an eel into the cistern, as is done, he informs me, in Tunis in N. Africa.

In order to draw the attention of the Jewish authorities to the above, a paper in Yiddish and Judæo-Spanish is being printed, setting forth the method of the conveyance of malaria and its prevention. We have been treating the wells of private residents by sulphur fumigation. Some of the wells of the German colony at Jaffa were petrolized last summer with very gratifying results, namely, the almost total disappearance of mosquitoes. I was able to convince myself of this when I was there in October.

<sup>1</sup> A bucket containing some live charcoal and a few handfuls of sulphur is lowered into the cistern, which is then tightly shut up and left all night.