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LIVERPOOL SCHOOL  
OF TROPICAL  
MEDICINE



REPORT

ON THE  
MALARIA

AT

ISMAILIA AND

SUEZ

BY

RONALD ROSE

PART II.

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*Note by the Committee of the School*

Prince d'Arenberg, Chairman of the Suez Canal Company, in a letter to Sir Alfred Jones, on behalf of the Company, made a special request for the services of Major Ross to investigate Malaria at Ismailia. The Committee had much pleasure in authorizing Major Ross to proceed to Ismailia. The accompanying is Major Ross' report to the School on his expedition.

*January, 1903.*

LIVERPOOL SCHOOL OF TROPICAL MEDICINE

MEMOIR IX

# REPORT ON MALARIA AT ISMAILIA AND SUEZ

BY  
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# REPORT

## PRELIMINARY

EARLY in the present year I was invited by Prince Auguste d'Arenburg, President of the *Compagnie Universelle du Canal Maritime de Suez*, through the Chairman (Sir Alfred L. Jones, K.C.M.G.) and Committee of the Liverpool School of Tropical Medicine, to visit Ismailia on the Suez Canal, and to recommend measures for ridding the town of malaria, which had been present there for many years. The Liverpool School of Tropical Medicine, having decided to place my services at the disposal of the Prince-President as requested, I left London for Ismailia on the 12th September, 1902. At Brindisi, I was joined by His Excellency Sir William MacGregor, M.D., K.C.M.G., C.B., Governor of Lagos, who wished to study the malaria at Ismailia for his own information. We arrived at Port Said on the 17th September, and proceeded the same day to Ismailia. There we found that Drs. Dampeirou and Pressat, the Medical Officers of the Company, had already signalled the presence of the malaria-bearing mosquitoes (*Anopheles*) in many of the infected houses, and had, moreover, determined the principal sources of these insects. There was, therefore, little left for me to do but to repeat their observations

for my own satisfaction, and to consider the best practical measures for adoption—a work in which I received all possible assistance from the officers of the Company. On the completion of my survey, and after paying short visits to Suez and Cairo, we left Port Said for Europe (29th September); and, finally, I arrived in Liverpool again on the 6th October.

### TOPOGRAPHY OF ISMAILIA

Ismailia, a town of about seven thousand inhabitants, was founded in 1862 by the genius of M. de Lesseps. It is built in the midst of the desert, on the shore of the brackish Lake Timsah, and half-way along the course of the great Ship Canal—from which, however, it is separated by a distance of two kilometres. It is reached from Port Said either by boat along the Canal (which opens into Lake Timsah), or by the Cairo railway. The famous fresh-water canal, out from the Nile to Port Said, supplies the town with an abundance of fresh water, both for domestic and for irrigation purposes. The result is that, though originally a city of the desert, Ismailia is now surrounded by gardens and groves of trees, watered by a branch of the canal referred to. The principal houses are very well built and commodious; the roads finely laid out. Every part of the town seen by me appeared to be kept scrupulously clean.

The population consists principally of the officers and employés of the Company, numbering with their families about one thousand persons; of a mixed population of other Europeans; and of Arabs.

The domestic water supply is generally furnished by pipes, but is not filtered. The pit system is adopted for the disposal of sewage.

The climate is hot but dry, the annual rain-fall being insignificant.

We are principally concerned, as regards our present purpose, with the surface-water and sub-soil water in and around Ismailia. It should be noted that we have to deal with two systems of waters—the artificial and the natural. The rain-fall is too small to be of moment. The artificial water is introduced by the branch of the fresh water canal mentioned above—a deep stream of about twenty metres in breadth, with a current of about half a kilometre an hour, which traverses the town. From this, numerous branches lead off in various directions for the irrigation of the gardens and avenues. A few of these branches are deep, permanent channels; but most of them are shallow gutters, into which the water is sluiced periodically. The canal and the permanent streams contain reeds and grass; and are all crowded with fish, large and small, which, as will be seen later, play an important sanitary role. In the small irrigation channels the water is absorbed so rapidly by the thirsty soil, that, except at a few spots, no permanent stagnant pools are produced.

With reference to the natural waters, we must first note that the sub-soil water is very near the surface, and, as we were informed, fluctuates with the rise and fall of the distant Nile. In some spots near Ismailia, where the surface of the desert sand is much depressed, this sub-soil water produces considerable lakes and ponds; but, owing to the extreme salinity of the sand, most of these pools are brackish, their shores being encrusted with salt, and supporting but little vegetation. There are several spots, however, where the water is nearly if not quite fresh; and here we observe a considerable amount of cultivation—grass and vegetation. There are even places where the fresh, natural waters produce

shallow marshes of small extent ; where small pools form among reeds and grass. And these can be found, not only close to Ismailia, but, as I was informed, in many parts of the desert, and can be seen along the railway to Cairo. But it must be understood that such areas are very small in extent when compared with the large surface of perfectly arid sand which surrounds the town.

### MALARIAL FEVER AT ISMAILIA

Drs. Dampeirou and Pressat furnished us with a complete history of this subject, accompanied with a chart showing the number of cases occurring every month from the commencement of the epidemic. A copy of this chart is attached to this report. Malarial fever appeared first at Ismailia in 1877, when the fresh-water canal was enlarged. During that year, according to the chart, over three hundred cases occurred from August to December. Next year there were about four hundred cases ; and the annual sick-rate remained at about this figure until 1885, when, owing possibly to the increase of the town, the fever-rate rose considerably. Since then the worst years recorded are 1886, 1890, 1891, 1897, and 1901. In 1891, nearly 2,500 cases are recorded ; and there were almost as many in 1901. The monthly fluctuations show that the four last months of the year are generally the worst as regards the fever, and the early months the best. The largest monthly rate is that of November, 1891, when four hundred and sixty-nine cases were reported.

It is necessary to remember that these numbers do not necessarily refer only to fresh infections. Malarial fever is a disease in which relapses occur time after time

—often long after apparent cure. Consequently many of the cases given in the chart were only cases of recurrence of fever. Others were probably cases of re-infection ; while some must of course have been due to a first infection.

The excess of cases in the autumn maximum of the fever curve over the spring minimum is probably due to first infections and re-infections. The spring minimum (amounting to between fifty and a hundred cases per month) probably represents, I think, the average number of cases which can reasonably be attributed to recurrence, and not to fresh infection or re-infection. Subtracting this number from the autumn maximum, we obtain a figure which can reasonably be attributed to fresh infections, or re-infections recurring in June to October. This figure is seen to vary from about 100 to about 300.

We can place complete confidence in the statement of the Medical Officers that the fever is true malarial fever and not Malta fever or other illness. In several cases examined by me the parasites of malaria were easily detected ; and were found to belong to two varieties, the benign tertian parasite and the so-called aestivo-autumnal parasite.

In spite of the prevalence of the latter parasite, which is morphologically the same as the organisms most commonly found in West Africa and other highly malarious localities, pernicious attacks are very rare in Ismailia. We were assured that only three or four had been known to occur there since the commencement of the epidemic.

It is unnecessary to describe the clinical details, which are the same as those usually found associated with this malady. The illness does not appear to be of such a severe type as I have met with in parts of India

and Africa; and no deaths have been reported. Nevertheless, the malady is sufficiently common and troublesome to be not only a source of great annoyance in Ismailia, but one of considerable expense in connexion with invaliding, and a serious detriment to labour. Without it, Ismailia would be a settlement almost free from infectious disease.

### THE MODE OF PROPAGATION OF MALARIAL FEVER

It will not be necessary to discuss this point in detail. The great discovery of Dr. Laveran has enabled us to ascertain with certainty the life-history of the parasites which cause the disease, and we know that certain kinds of mosquitoes (*Anopheles*) inoculate them into the human blood.

One point alone has remained doubtful to those who have not completely studied the literature of the subject. While admitting that the disease is conveyed by these insects, they think that other sources of infection are possible—especially freshly turned soil. There is, however, no trustworthy evidence in favour of this conception, which is, in fact, merely a superstition dependent upon the fact that the *Anopheles* breed in small pools of water lying upon the ground. By a general consensus of all authorities, the parasites of malaria are in all probability conveyed solely by the bites of mosquitoes.

It was a point of some interest to explain how in a desert such as surrounds Ismailia, these insects could find the swamps necessary for their existence. As already mentioned, however, this had been already done by Drs. Dampeirou and Pressat.

These gentlemen showed us on our arrival a collection of mosquitoes caught in the houses of Ismailia. Many of the insects were at once seen to be *Anopheles*. During our stay, mosquitoes were again collected from many of the houses in the town, and *Anopheles* were found in large numbers among them.

The insects were submitted by me to the British Museum for identification, and were examined by Mr. F. V. Theobald, whose great work on the subject of the mosquitoes of all parts of the world is well known. Unfortunately the specimens were damaged in the post ; but he was able to ascertain definitely that the *Anopheles* of Ismailia belong to two species, namely, (1) *Anopheles pharoensis*, Theobald ; and probably (2) *Anopheles chandoyei* (nov. sp. Theobald).

The first species has been already discovered at Cairo and in Central Africa ; and Mr. Theobald remarks in his letter to me that it is evidently the common Egyptian species of the genus.

Of the second variety he says that the specimens sent by me were too damaged for an absolutely certain identification, but that he thinks they are of the new species named above—a species already taken in the department of Constantine in Algeria.

It is possible that there may be still other species of *Anopheles* at Ismailia and Suez ; and I hope that Dr. Pressat will be able to transmit more specimens for identification.

The evidence inculcating mosquitoes of the genus *Anopheles* as carriers of malaria is already so definite that I did not feel called upon to undertake exhaustive formal experiments with the two particular species found at Ismailia—more especially as such experiments would have occupied a long time, and will easily be undertaken in the future by Dr. Pressat at his own laboratory.

SOURCE OF THE *Anopheles* AT ISMAILIA

This subject claimed our attention most particularly, as it was absolutely necessary to obtain an exact knowledge of the breeding-places of the insects in Ismailia before attempting to formulate measures against the malaria.

As a general rule, the larvae of *Anopheles* exist in stagnant pools of water—a fact which gave rise to the old idea that malarial fever is caused by emanations from marshes. But considerable differences have been found in different countries in regard to the habits of these larvae. In some countries, the larvae confine themselves only to the smallest and most stagnant puddles; in others, they occur also amongst the reeds and grass growing at the margin of lakes, ponds, canals, streams, and even rivers.

It was possible that at Ismailia the larvae might exist either in the fresh-water canal and its branches, or in the small marshes described above. In the former case, it would have been a difficult matter to extirpate them; in the latter case, it would be an easy matter. The question was, therefore, one of great practical interest.

We made a very careful examination of the fresh-water canal and its branches, and searched especially among the reeds and vegetation growing at their margins. We did not succeed in finding a single larva in these situations. This is undoubtedly due to the fact that *wherever the water is deep enough to admit fish, these animals effectually destroy the larvae.*

In only one locality connected with the irrigation system, namely in several small and very shallow pools situated close to the *Abattoir* and used for the cultivation of water-cresses, did we succeed in finding the

larvae in any considerable numbers. A few were observed in an artificial fountain in the middle of the European quarter ; and it is possible that some similar situations may, hereafter, occasionally be found to contain the insects ; but, as a general rule, I feel justified in saying that *almost the whole of the irrigation system of Ismailia is free from larvae, and is not favourable for their propagation*. Consequently I think that this system may be acquitted from the blame of causing the malaria—a very fortunate circumstance.

It is otherwise, however, with the marshes connected with the natural waters which exist round Ismailia. Wherever we examined these we succeeded in finding very numerous larvae of *Anopheles*, and also of *Culex*. The insects existed especially among the short grass and other vegetation growing on soil covered with a very thin layer of water. In such situations the larvae could obtain shelter from their enemies, the fish ; but where the water collected itself into deeper channels we found that small fish were able to live, thus rendering such places quite uninhabitable for the larvae. Where, following the slopes of the surface of the earth, the channels formed themselves into streams which seek discharge into the lakes, fish began to be as numerous as they were found to be in the canal, and, of course, rendered such streams quite unsuitable for the mosquitoes.

It will thus be seen that at Ismailia *the waters which really occasion malaria are the most shallow and insignificant surface pools, which could be filled up or drained away without difficulty, and without detriment to cultivation or irrigation*.

In one series of such pools situated to the east of the town, we found innumerable larvae, both of *Anopheles* and *Culex*, existing in water which was so brackish as to

contain nine grammes of salt per litre. It is, therefore, clear that the insects do not demand entirely sweet water for their existence. On the other hand, they are not found in entirely salt water, such as that of the sea (which contains about twenty grammes per litre).

It is to be assumed that small pools of this nature, capable of harbouring the larvae of mosquitoes, can be found for many miles round Ismailia, wherever the sub-soil water appears above the surface of the ground in the deeper depressions of the sand. We need not, however, concern ourselves with marshes which exist at any considerable distance from the town, because it is quite unlikely that any considerable number of the adult mosquitoes could ever fly more than a few hundred metres from their breeding-places in the desert. In order to produce malaria, it is necessary not only that the *Anopheles* exist, but that they are numerous. It is just possible that a few insects may find their way from considerable distances, but such wanderers are not likely to be sufficiently numerous to maintain an epidemic of malaria. We may, therefore, rest assured that the vast majority of the *Anopheles* which cause malaria in Ismailia come from the marshes which are in immediate proximity to the town. These marshes are (1) *the small marshes lying in the midst of the cultivation to the east of the town*; and (2) *the still smaller marsh existing close to the Abattoir*.

It is not necessary to specify in greater detail the points at which the insects breed most plentifully in these marshes. Drs. Dampeirou and Pressat and other officials of the Company joined us in our investigations on this subject, and are as familiar as we are with all the breeding-places which we found together. The only point which requires emphasis is that the most dangerous collections of water are precisely those which can be most easily got

rid of. Even where, as occurred in several places in the marshes, the larvae exist in somewhat deeper channels than usual, owing to the protection which they receive from reeds, grass, and other vegetation, it would be easy to extirpate them by clearing out this vegetation, and thus opening up the channels for the entry of small fish.

In many countries where there is a large rainfall, *Anopheles* can be discovered almost all over the ground in the rainy season. Happily this condition of affairs does not exist at Ismailia, where, owing to the extreme paucity of suitable breeding-grounds, these pernicious insects are obliged to confine themselves to very limited areas ; and, as I have pointed out, these limited areas are fortunately not associated with the valuable irrigation waters of the town, but rather with the brackish and useless marshes which can be dealt with without loss and at very little expense.

I may also add that no *Anopheles* larvae were found in the drainage cisterns and cesspools attached to the houses, although these contained innumerable larvae of *Culex*.

#### PREVIOUS EFFORTS AGAINST MALARIA AT ISMAILIA

I was informed that many efforts to combat malaria had already been made in this town. For instance, the marshes to the east of it had already been partially drained. Several other marshes had indeed been completely filled up. Moreover, nearly all the patients suffering from the disease have continually been treated by the medical officers of the Company with quinine ; and, as I observed myself, the employes of the Company are provided with excellent mosquito nets.

It is most interesting to note that these measures have not proved entirely efficient, although they must have had the effect of diminishing the epidemic, which, but for them, would probably have reached, by this time, very serious dimensions. I fancy that the measures of drainage adopted have not proved quite effective, because, before the days of the mosquito theory, people did not recognize that it is the small pools rather than the big ones that are dangerous, and, moreover, were unable to specify exactly the dangerous waters, as we are now able to do. At any rate, the continued existence of the marshes at the present day proves that the drainage was not complete. The fact that the malaria has continued in spite of the use of mosquito nets by the patients, and also in spite of assiduous treatment by quinine, shows, as I have often suspected, that such measures are not of themselves sufficient so long as the propagation of the carriers of the disease is not arrested. The use both of quinine and of mosquito nets can be looked upon only as a partial protection.

#### MEASURES RECOMMENDED FOR THE PURPOSE OF DEALING WITH MOSQUITOES AT ISMAILIA

It is worth while to review briefly the measures frequently recommended for dealing with malaria in other parts of the world.

(1) Professor Koch is much in favour of giving *quinine* compulsorily to all persons suffering from the disease within the area of operations, arguing that if the parasites are destroyed within the patients, the mosquitoes cannot become infected, and cannot infect others. I attach great value to this method, which has

been recommended by so distinguished an authority, but, in my opinion, it should be made subsidiary to a scheme directed against the mosquitoes themselves, at least wherever such a scheme is possible.

(2) Another method, warmly recommended by others, is that every house should be carefully protected by *screens and wire gauze fixed to the doors and windows*. This also would doubtless be useful, but the expense would be very large, and would amount, at a rough estimate, to about five hundred francs for every house, besides the annual cost of repair, which would be considerable. Moreover, I doubt whether a scheme of this kind, however efficiently carried out, would amount to anything more than a partial protection.

(3) A third measure frequently recommended is to *segregate Europeans from the natives*, in the hope that the mosquitoes which bite the former will not, in this case, be infected by the latter. This scheme is a selfish one, which leaves the natives to their fate. It should be noted also that, as just mentioned, some of the schemes have already been partially, if not fully, tried at Ismailia. Quinine has been very largely given, though perhaps not to such an extent as would satisfy Professor Koch. Though the houses are not protected with wire gauze, their inmates are very effectively protected by mosquito nets over their beds. Lastly, the Europeans are already segregated from the natives to a very large extent. Nevertheless, in spite of these precautions, it is certain that the malaria continues to exist.

(4) The measure then which I feel called upon to recommend is that of *extirpation of mosquitoes*. I recommend this with the greater confidence because, in my opinion, mosquitoes can be extirpated with great facility at Ismailia—in fact, with much greater facility than in any other town I have seen. As already explained, the

*Anopheles* confine themselves to certain small areas of marshes which can be drained away or otherwise dealt with without trouble.

The efficacy of the measure is certain. It has already been observed that at certain parts of Ismailia, where the disease was formerly virulent, it has already disappeared as a result of the drainage of the neighbouring pools. We may note also that at Port Said and at Port Tewfik there is *no malaria because there are no Anopheles*, and we may be quite confident that if we put Ismailia in the same state as Port Said and Port Tewfik, as regards mosquitoes, we will succeed in banishing the malaria there also.

We should also carefully note that measures directed against mosquitoes have many great advantages over the other methods proposed for dealing with malaria, and mentioned above. For instance, measures against mosquitoes are carried out by the local authorities, and, therefore, can be subjected to proper supervision. They do not depend for their success upon the efforts or good sense of private individuals. They do not subject anyone to the disagreeable and costly treatment by quinine. They affect for good the natives and Europeans alike, without showing favour to any one class of the community. They remove a source not only of disease, but also of great annoyance to all the inhabitants of the town. Lastly, at least as regards Ismailia, the cost of exterminating the mosquitoes will, I am convinced, be far less than that of protection of the houses by wire gauze, or even that of carrying out the method recommended by Professor Koch, which requires, for a large town, a considerable staff of special medical men to be properly and constantly maintained.

It is, therefore, without hesitation that I recommend that for Ismailia the *extermination of mosquitoes* should

be adopted in preference to the other methods mentioned above. At the same time, I beg to recommend that some of the other methods also should, if possible, receive attention. Thus, even though the mosquitoes may be very largely reduced in numbers, I should not for that reason advise that the use of mosquito nets should be stopped. Again, I think that the energetic treatment of all persons suffering from malaria should be persisted in. This is a most important matter, because it is well-known that when a person is once infected, he may continue to suffer from attack after attack of fever for several years. Even if the carrying agents of the disease be swept out of existence to-morrow, relapses of fever, amongst those already infected, are sure to continue to occur for many months, unless all such patients receive continuous treatment with quinine.

(5) There is also one other method to which I have not yet referred, but which is a very valuable one. I refer to the *education of the people upon this subject*. It is most essential that everyone at Ismailia should know exactly how the malarial infection is produced. In order to effect this education of the people, it is necessary only that several public lectures on the subject should be delivered from time to time, and also that small pamphlets should be scattered amongst those who can read.

I should state that in considering the best measures for adoption at Ismailia I have received much assistance from Sir William MacGregor, who authorizes me to say that he concurs with my views. Sir William MacGregor, in his own government of Lagos, has had an unique experience of the various measures which can be adopted against malaria, all of which he has actually tried for his own people. Regarding the prophylaxis against malaria on a large scale, that is, as a political scheme, his opinion is, I think, more valuable than that of anyone living.

METHODS FOR COMBATING *Anopheles* AT ISMAILIA

It should be understood at first that it will be rarely possible to exterminate mosquitoes of any kind from any town *completely*. It will be generally possible only to reduce their numbers so largely that they will cease to be a menace to the public health. I am of opinion that this can be done almost in every town. I estimate by a process of reasoning, which need not be examined here at length, that the reduction of malaria in a town will vary as the square of the reduction of the number of the *Anopheles*. Thus, if we reduce *Anopheles* to one-half, the malaria should be ultimately reduced to about one-quarter; and if we reduce the *Anopheles* to one-quarter the malaria should be ultimately reduced to about one-sixteenth of its former prevalence. We may thus expect that a small reduction in the number of *Anopheles* will cause a great reduction in the amount of malaria.

As regards Ismailia, however, I am very sanguine that the *Anopheles* can be almost entirely exterminated at a very small cost (that is, of course, within the town itself), owing to the small extent of the breeding-grounds. *I think, therefore, that we may reasonably expect that the malaria of Ismailia can be practically exterminated entirely.*

Another point to be remembered is that whatever measures against the mosquitoes are adopted, they must be persisted in indefinitely. It does not suffice merely to drain their breeding-grounds on one occasion, and then omit all care regarding the subject in the future. The officer responsible for the health of the town must make periodical examinations to satisfy himself that pools of water do not continue to collect, and that the insects do not continue to breed in places which have not hitherto been detected. All this demands a certain degree of persistent effort and of conscientious work.

In order to give effect to these recommendations, the following rules should be observed :—

(1) One of the medical officers of the Company should be appointed to have charge of the operations against malaria. I do not think for Ismailia it will be necessary to appoint a special officer for this purpose, at least until the medical officers of the Company already present at Ismailia find that the work is too much for them, a thing which I do not anticipate.

(2) The Superintendent of the operations should have placed under his orders a squad of men for the purpose of draining the marshes. As the marshes should be drained as quickly as possible, I advise that this squad be a large one at first. For instance, twelve men would not be too numerous. They should set to work at once to remove all the small puddles and pools in which the *Anopheles* breed, either by filling them up with sand, or by draining them away into the deeper channels in which fish can live. Or, where this is necessary, they should remove the weeds and vegetation in the deeper channels, if the larvae are found existing in the midst of such weeds and vegetation. As this work draws to completion, it will, I think, be possible to reduce this squad of men very largely, and, when all the marshes have been dealt with, that two or three men will suffice to prevent accumulations of water forming in the future.

(3) Another squad of men should be placed under the orders of the Superintendent for the purpose of sprinkling oil upon such collections of water as the former squad cannot quickly deal with. This second squad need number only about three men at present.

(4) I think it highly desirable that at Ismailia not only the *Anopheles* should be attacked, but that efforts should be made to reduce the *Culex* mosquitoes. We

made a careful search for the larvae of this variety, especially round the Residency. Owing to the absence of rainfall, these insects do not breed at Ismailia in small vessels and tubs left scattered in the backyards of houses, as is so frequently the case in other towns. We find that they breed almost exclusively in the drainage-cisterns and cesspools attached to the houses, even when these are supposed to be hermetically sealed. For example, we found that the Residency was swarming with the mosquitoes called *Culex pipiens* and *Stegomyia fasciata*, and we ascertained that these mosquitoes breed in the cisterns in the houses, finding an entrance to them by way of the ventilating shafts. It is easy to destroy the larvae in all such places by adding every week a few ounces of crude petroleum, mixed with refined oil. But, in order that all of the cisterns in the town be dealt with once a week, as is necessary, a sufficient number of men must be employed for this work. I estimate roughly that a third squad of six men should be placed under the orders of the Superintendent for this purpose. It will be the business of the squad to search out every place in which the *Culex* larvae exist in the town, and where such places cannot be filled up or done away with, to treat them with oil as described. I think it right to make this recommendation, because, though these kinds of mosquitoes do not carry malarial fever, they do carry other maladies, such as elephantiasis and yellow fever ; and, at all events, they are extremely annoying to all the inhabitants of the town. It will be distinctly worth a small annual expenditure, such as is involved in the payment of a few men, to evict all kinds of mosquitoes simultaneously.

I refrain from giving further details upon these points because the officials of the Company at Ismailia are fully acquainted with this subject, and know exactly

how to deal with *Culex* and *Anopheles*, under all the varying conditions found in that town. Of course, as the work develops, and as the medical officers acquire further experience regarding the carrying out of these measures, it may be advisable to make alterations in the number of men employed in each squad. Thus, as already mentioned, the first squad (for draining the marshes) may be soon reduced; and, possibly, it may be found necessary or advisable to augment or reduce the number of men employed in the other squads. The officials of the Company may be trusted to make such modifications in my proposals as are necessary.

It will also be useful if Dr. Pressat can make some experiments in his laboratory regarding the best oils for dealing with the mosquitoes, because oils locally procurable differ very much in their properties in this respect. I may also suggest that some permanent poisons for the larvae in the drainage-cisterns may be discovered. Such poisons will largely reduce the cost of the squad of men employed in dealing with the *Culex* mosquitoes.

Before we left Ismailia measures against mosquitoes, on lines indicated above, were already commenced, and I hope that by this time they will be far advanced.

We must again emphasize, in order to prevent all mistake, that these measures must be persisted in with sense and care, if we wish them to be a success. A mere perfunctory series of spasmodic efforts will be quite useless. The superintendent should not only see that every source of the mosquitoes is regularly dealt with, but he should also satisfy himself that the adult insects in the houses are really reduced in numbers; and, needless to say, this will be the ultimate test of the success of the campaign. Lastly, the effect of the measures upon the malaria should be carefully noted, especially with regard to the occurrence of fresh cases. He should

also see that, as advised, the public are educated in the subject ; and that the old cases of malarial infection are systematically treated with quinine.

Perhaps I may be permitted to make one more suggestion, although it does not bear upon the malaria of Ismailia. I found that everyone in the town was very anxious that the supply of water should be filtered. There appears to me to be a certain amount of danger in the present water supply, which may become readily infected by cholera or typhoid, and by the parasites called ankylostomes. Ismailia excels so much almost all the tropical towns which I have seen in cleanliness, in the construction of its houses, and in the order of its roads and gardens, that it might easily become a model town for imitation by other municipalities.

## MALARIA AT SUEZ

We were informed that malaria has existed for some time in the water-works of the Company near Suez, and we paid that town a visit to enquire into the matter. On arrival, we were assured that the disease does not exist at Port Tewfik and, apparently, in the town of Suez itself, but only at the water-works. Even here malaria has decreased a great deal, according to reports, since a circular ditch which surrounded the works was filled up.

We immediately endeavoured to find the larvae of mosquitoes in proximity to the water-works. None were discovered in the large tanks connected with the works ; and there were none in the neighbouring canal, nor in the channels, one of sweet and the other of brackish water, which flow close by. Also in the garden, no larvae were found in the waters used for irrigation. There is, however, a small marsh in the vicinity which

risers and falls with the Nile. In the centre of this marsh, which is practically a small pond, larvae do not exist owing to the presence of fish ; but we found numerous *Anopheles* larvae in some very small pools left in half-dried mud. It is probable that these insects are the cause of the malaria, if any still exists apart from the old infections. In order to remove this malaria, it appears to me necessary only to deal with the marsh referred to, in the manner already indicated for Ismailia. It would be advisable, however, to make a more prolonged search for the *Anopheles* larvae in the neighbourhood than we had time to complete.

#### MOSQUITOES AT PORT SAID

At our two visits to Port Said we observed the presence of many mosquitoes of the species *Culex pipiens* and *Stegomyia fasciata* (these species have been determined by the authorities of the British Museum from specimens furnished by me). On making a search for the larvae they were observed to breed chiefly in the cisterns attached to the houses, as at Ismailia. They were also detected in some large cisterns and tubs close to the Residency. Our knowledge of the habits of these mosquitoes assures us that when they abound much in a given house, they are likely to be breeding just outside the windows. Hence I am of opinion that the mosquitoes which cause such annoyance to the employés of the Company at Port Said are those which breed in the cisterns just referred to, and are not likely to have an origin at a greater distance, as for instance, in the town of Port Said.

As the officials of the Company examined this matter with us, it appears to me scarcely necessary to

make any recommendations. But I think that if one or two men were directed to put oil in all the cisterns once a week the mosquitoes would practically disappear from the Company's property at Port Said. I should advise, however, that if a man be employed for this work, he should receive special pay for it, so that he could be justifiably held responsible for the proper performance of his duties. It would be necessary for him to make a more detailed search for the larvae than we had time to carry out.

### CONCLUSION

In conclusion, I wish to express my thanks, both on behalf of Sir William MacGregor and of myself, to His Excellency the Prince President for having so kindly placed his residences at our disposal. I should like also to acknowledge the great assistance and hospitality given to us by the Agent Supérieur, M. Chabrou ; by Dr. Dampeirou and Dr. Pressat ; by M. Raynaud, M. Renaud, and M. Dumont ; and by all the officials of the Company with whom we came in contact.

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