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A T H E S I S

On the PROPHYLAXIS of MALARIA, according to
MODERN VIEWS, with Special Reference to the Disease
and its prevention in EGYPT,

by

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C O N T E N T S .

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On the PROPHYLAXIS of MALARIAL FEVER
according to MODERN VIEWS with special reference
to the disease and its prevention in EGYPT.

The study of Malaria has made such enormous progress within the last few years that we can now speak with more accuracy on the prophylaxis of the disease. The many thousands of experimentors in the field of research have come to some definite conclusions after years of labour, and the results obtained at Hong Kong, Lagos, Sierra Leone, Klang, and at Ismailia show us conclusively what the medical officers can do in a malarious district, especially if they be supported by a municipality, or better still, by a Government.

The amount of scepticism about the cause of Malaria is still so great, even among the better educated people that it would be wrong to go any farther in a paper such as this, without pointing out how great a social danger such scepticism may prove.

Ross⁽¹⁾ writes :- "I believe I am right in saying that out of even the educated persons living in malarious districts not one in twenty really believes that fever is acquired from mosquitoes,

(1) Journal of the Northumberland and Durham Medical Society, April, 1904.

N.B. At the meeting of the Colonial Institute on November 11th, 1903, Sir F. Swettenham, Governor of the Straits Settlements declared his disbelief in the finality of the mosquito Malaria theory.

while among the natives I doubt whether one in a thousand ever heard of the theory."

The popular ideas with regard to the origin of the disease are many. I need hardly say that the miasmatic theory still holds ground among thousands of persons living abroad.

The close relation between marshes and Malaria was pointed out long ago, and the belief that the fever is due to exhalations from soil, whence the term Malaria (bad air) and *fievre tellurique*, especially freshly turned up soil, exists up to this day.

The same state of ignorance obtains in Egypt as in many other tropical and subtropical countries. To the majority of the European population there, the mosquito theory of Malaria infection is one of the latest scientific fads.

Giles says ⁽²⁾ "It is quite a mistake to suppose that the highly educated Englishman is capable of looking after his own sanitary salvation. For one thing he has usually very little time to devote to the task; but added to this there are few people more obstinately prejudiced and more difficult to move in such matters. Often indeed, he will be found to take a sort of pride in his foolhardiness where his health is concerned, to expose

(2) Journal of Tropical Medicine, March 15, 1904, Article by Lieut. Col. G. M. Giles, M.B., & c. I.M.S.

himself to the sun in a small hat, drink water from uncertain sources and prefer the bliss of ignorance in the matter of how his food is prepared and where it comes from. Under these circumstances it is hardly surprising that outside the medical profession I have not as yet met with a single European in India, willing to put himself to the trouble involved in protecting himself against the attacks of mosquitoes."

Some medical men, on the other hand, allow themselves to be so carried away by a spirit of discovery or originality, as to suggest measures which are as eccentric as they are likely to prove unsatisfactory, and thereby make themselves and their earnest medical brethren the laughing stock of the laity.

Here is a case in point. A colonel of the Royal Army Medical Corps writing to the British Medical Journal⁽³⁾ says "Many of your readers must be aware of how destructive of mosquitoes spiders are." He says that spiders should be encouraged to spin their web, not only in dark corners, but elsewhere. He suggests that by fitting the doors and the windows with loose netting of twine or trellis

(3) British Medical Journal, October 22, 1904, p. 1048.

work, by encouraging the spider to spin her web across it, we would have at once a mosquito proof house. The old fashioned mosquito net surrounding the bed, might be replaced by a similar frame, supporting a screen of cobwebs . . . They (the cobwebs) are obviously a better protection against mosquitoes, than wire gauze. They would not interfere with the cooling and ventilating of the houses as wire gauze does, and they cost nothing.

He goes on to say, "Among the enemies of mosquitoes, to be found in or near the Indian houses are lizards, frogs, and birds, and in the gardens or verandah insectivorous plants. From these could be arranged a "mosquito brigade", far more effective than that which is at present known by this title."

Let us hope that the Colonel does not mean to be serious in suggesting this filthy and most insanitary "new method" of Prophylaxis.

In order to prevent the occurrence of Malaria by artificial means, several points have had to be elicited in connection with the cause and spread of the disease. We have now not only a minute and unanimously accepted description of the parasites which cause the disease in its different phases, but also of the method by which the disease is transmitted to man, one should perhaps say from man to man. Most authorities hold that if there were no infected

persons, say on an island, no amount of mosquitoes, be they Anopheles or not, could give the population Malaria. I may mention some good illustrations of this truth. In a leading article in the Journal of Tropical Medicine (May 16th) 1904, we read, "The introduction of Malaria by infected persons into regions where the disease was previously unknown, has again and again occurred within recent times. The appearance of the disease in Mauritius in 1866 is a noted and historical instance of the kind, and more recently a similar experience has been brought to light in the island of Turi (Italy). Up to 1901 Malaria was unknown in the island, but in June of that year a man returned to his home in Turi, suffering from Malaria. Within two months 195 persons, out of a total population of 534, were infected by Malaria of which 5 died."

It is hardly likely that the lower animals are affected by the same parasite which attacks man, although parasites closely allied to that of Malaria, have been found in monkeys, rats, birds, (4) and also in cattle and horses. Some animals, however, may be able to harbour the true malarial parasite and infect mosquitoes.

Dr Dalgetty recently published a case (5) of which this is a resumé.

(4) Malaria Fever, its Causes, Prevention and Treatment, by Ronald Ross, 1902.

(5) Canine Malaria by A.B. Dalgetty, M.D., D.P.H. South Sylhet, India. Journal of Tropical Medicine,

A dog, a fox-terrier, developed anaemia - high temperature and hoemoglobinuria. Blood was examined and the parasite was found. In diameter it was a quarter of that of the red blood corpuscle, but (6)"nearly all the parasites were extra corpuscular". Quinine made the symptoms disappear. When the quinine was stopped the symptoms, fever, etc. returned.

This may have been a case of real Malaria, but I am inclined to think it was not. It would be hard to venture an opinion on or try to classify the extra cellular parasite that was observed in the dog's blood. Parasites resembling that of Malaria have been found in many of the lower animals as already stated. The fact that quinine relieved the symptoms bears little weight as far as the diagnosis of Malaria is concerned.

From the point of view of Prophylaxis it is highly important that we should know definitely what animals, if any, may become infected with Malaria, so that adequate measures may be taken to avoid their company in malarious districts. It seems to me, looking at it from a general point of view, that a mosquito will prefer to bite man than to attack the more resistant skin of a dog or a cat. We must not overlook the fact, however, that birds,

(6) The inverted comas are mine.

have a skin very much like the human skin in texture.⁽⁷⁾ Even in the covering of our canine or feline friends, there are parts which may be easily vulnerable to the sharp proboscis of the mosquito. Very little has been decided in this respect and we can only hope that in the near future the many seekers of the Truth, to borrow Dr Osler's expression, at present engaged in settling this matter, will come to some definite and unanimous conclusions.

We realize that in methods of Prophylaxis which consist in the destruction of anopheles, the fact of the lower animals being immune to Malaria or not becomes one of scientific, but of no practical importance. There are cases, however where the mosquitoes cannot be destroyed, and where as I shall point out later on, other methods have to be employed to guard a country from Malaria, then, the same fact at once springs to the foreground in bold relief, and assumes great importance.

There is still some doubt as to whether Anopheles are the only insects capable of transmitting Malaria. A case of Malaria occurred recently in the Clarence Barracks, (Portsmouth), in a man who had never been out of the country. There was an old case of Malaria in the same barracks at the

(7) Andrew Balfour in his 1st Report of the Wellcome Research Laboratories, Khartoum, mentions the possibility of Malaria being introduced into Khartoum by birds of passage.

time. Majors Copeland and Smith, R.A.M.C., deny the existence of any mosquitoes in that part of the town, and suggest the possibility of the disease having been caused by some other suctorial insect such as a flea or bug⁽⁸⁾. Similar cases have occurred in other countries where mosquitoes, especially Anopheles are known not to exist. Ross says,⁽⁹⁾ "People sometimes ask whether other insects besides mosquitoes, such as sandflies, carry Malaria. Ziemann's experiments with sandflies were negative and there is little to be said in favour of other flies possessing such a function."

We may also hope soon to have a tabulated list of the known Anopheles distinguishing those which carry Malaria from the harmless ones.

Why certain districts remain islands of health in a sea of Malaria is still, as Manson⁽¹⁰⁾ points out, a phenomenon which we cannot explain. These circumscribed areas of immunity are common in India, Italy, Mauritius, etc. The absence of mosquitoes or at least of some particular variety of them in these regions, may be due to some deficiency in the soil to offer them a suitable nidus, or to supply them with food, or it may be due to some

(8) Journal of Tropical Medicine, October 15th, 1906.

(9) Malaria Fever, its Cause, Prevention and Treatment, by Ronald Ross, 1902, p.19.

(10) Journal of Tropical Medicine, May 1st, 1905, p.134.

very active element or elements in the fauna of the locality.

In this paper I shall discuss the preventive measures against Malaria that have been suggested in recent years. I shall also try to show what the state of Egypt is with regard to Malaria, and its prevention, by discussing statistics which have just appeared by authority of the Egyptian Sanitary Department.

I shall also endeavour to show what prophylactic measures are in daily use in Egypt and what other measures could be adopted with great advantage to the native and European population in that country. That Egypt should have lead the way as she did at Ismailia in showing the world what a little Sanitary administration can do in checking Malarial disease, is nothing very remarkable when we remember that it was in that country that Medicine saw her first pioneers. Prof. Boyce⁽¹¹⁾ referring to the diminution of Malaria in Ismailia said that "he looked upon that experiment in Egypt as having done more to impress the world with the use of scientific co-ordinated measures than anything else." Ross adds⁽¹²⁾ "the results of the work in this town (Ismailia) have demonstrated two things. 1st That it was possible to rid a town of mosquitoes. 2nd

(11) Leading Article Journal of Tropical Med. May, 16th, 1904.

(12) Leading Article Journal of Tropical Med. May, 16th, 1904.

That it was equally possible to eradicate Malaria."

In treating of the measures of Malarial Prophylaxis it is well to adopt a systematic method, in order that no important item be left out. No system seems to me better suited for the purpose of this work than the one suggested by Strachan⁽¹³⁾, and it is that plan I intend to follow, although I have taken the liberty to modify it somewhat.

A. Destruction of the Breeding Places of Mosquitoes.

This method of Prophylaxis was suggested by Ross⁽¹⁴⁾ to the Government of India immediately after his great discovery of 1895-1898. Doing away with eggs, larvae and nymphs is of very great importance. In many instances this procedure has given extremely good, not to say marvellous results. Thus, and practically by this means only, Hong-Kong⁽¹⁵⁾, Havana⁽¹⁶⁾ and Ismailia⁽¹⁷⁾ formerly all of them perfect hot beds of Malaria are now free of the disease, only a few sporadic cases occurring occasionally. Confining ourselves to the latter town

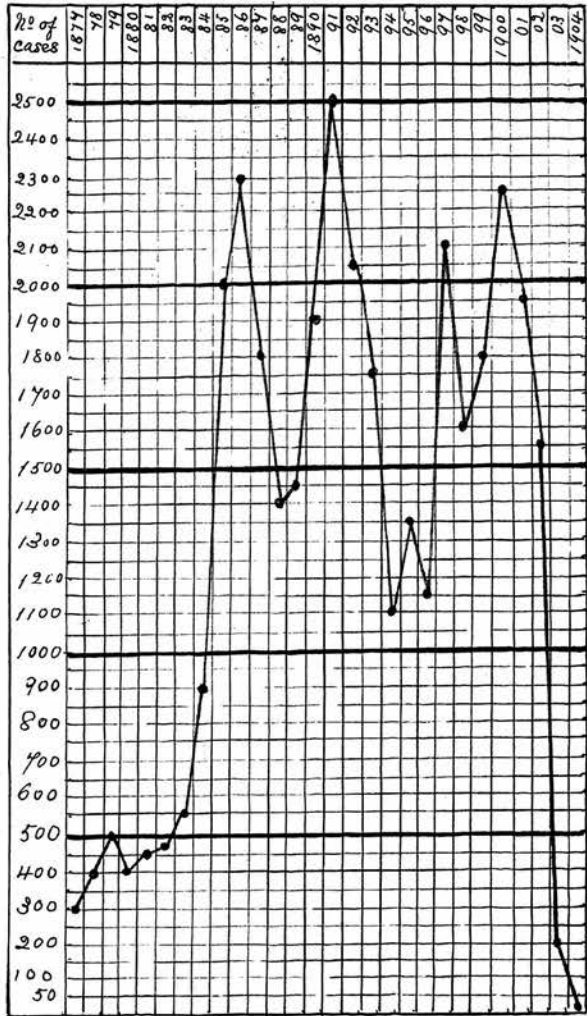
(13) Paper read before the British Medical Association at their 72nd meeting by Henry Strachan, C.M.G., P.M.O. of Lagos, see British Medical Journal Sep. 17 04

(14) First Progress Report of the Campaign against Mosquitoes in Sierra Leone by R. Ross, 1901, page 3. Also Indian Medical Gazette, July 1899. Also Lancet, 1900, Vol. II, page 1400.

(15) British Medical Journal 1901, Vol. II, p. 683.

(16) Monthly Reports of Vital Statistics of Havana, Office of the Chief Sanitary Officer of Havana.

(17) Le Paludisme et les Moustiques, by Dr Pressat, 1905, Masson & Co.



E. F. Yelverton

Malaria in Ismailia from 1874 to 1904

nothing is more striking than to glance over some statistics.⁽¹⁷⁾

In the year 1900 when the antimalarial measures were begun, 2591 cases of Malaria were registered in Ismailia (then with a population of 7,000 to 8,000 inhabitants). In the middle of the year 1903 only 206 cases were recorded and this number was reduced to 1 at the end of March 1904. This one case was a relapse and not a fresh infection. Ismailia shows us not only the way in which Malaria can be exterminated from any place enjoying the same climatic and telluric conditions, but also the factors which might originate the disease in any such place not previously contaminated. Up to 1877 Ismailia enjoyed perfect freedom from Malaria, but ~~when~~ in that year, owing to the scanty water supply to the rapidly growing village, a canal some forty feet wide was dug, bringing an ample supply of water from Cairo,

Ismailia very soon changed in appearance and within a very short time the vegetation became very abundant in that virgin soil.

Malaria now made its appearance and the epidemic made such ravages that at the end of 1900 the town was practically deserted.

The Suez Canal Company Offices and law courts

(17) Le Paludisme et les Moustiques, by Dr Pressat, 1905, Masson & Co. P. 136.

were transferred to other towns. We see, therefore, how this sudden increase of water supply with the unavoidable floods characteristic of the Nile and its branches, and the resulting formation of marshes, at once introduced favourable conditions for the breeding of gnats. These made their appearance immediately and so did Malaria.

The Chart (on the opposite side of the page), which I have taken from Dr Pressat's beautiful work, shows at a glance the progress of the disease from the first year in which it appeared, to its disappearance.

An abundance of water, therefore, in the tropics means Malaria, unless the ground be well drained. This water need not necessarily come from rivers or any other water channel. The torrential rains, so often met with in tropics associated with a somewhat impervious clayey soil often suffice to give mosquitoes a chance of laying their eggs and hatching out of them. In a well drained town collections of water may hardly be noticed, and yet Malaria may be prevalent. This was well illustrated in Ismailia. There the rainfall is practically nil, but large lagoons, formed by infiltration through the sandy soil from the canal mentioned above, as well as from irrigation channels which abound just outside the town proper, are a constant feature in the locality. It is in such

places and in small collections of water in private gardens etc., that mosquito larvae were destroyed with such good results. We have several ways in which such collections of water capable of harbouring the eggs, larvae or pupae of mosquitoes, can be dealt with.

(a) The planting of water-absorbing plants and trees in areas where water is apt to stagnate, may be useful.

There are, however, many objections to trees in general in Malarious districts as these are said to be the place of refuge of the adult mosquitoes in the day time. Leaves also during the rainy season may become receptacles in which oviposition may take place. Some advocate the planting of certain trees which have the reputation of driving mosquitoes away, such as various species of Eucalyptus of which Eucalyptus Globulus is the most common. Sunflower, Chrysanthemum and kerikeri are said to possess the same qualities in a minor degree.

Dr Wellman carried out several experiments to find out the effect of the leaves of certain plants on mosquitoes. The experiments were carried out in a cage containing a large number of Anopheles and culeces.

Castor Oil plant (*Ricinis communis*) had no effect whatever. Both Anopheles and culicines

alighted on these leaves quite as often as on banana leaves used for comparison.

Gum Trees (*Eucalyptus Globulus*) had no effect unless the leaves were bruised, in which case the gnats seemed to avoid them. Pawpaw (*Papaja vulgaris*) had no effect. The results from the cultivation of such trees have been naturally disappointing, although there is little doubt as Manson⁽¹⁸⁾ says when speaking about the *Eucalyptus* tree "that the effect of this rapidly growing tree in drying the soil is of use in some localities."

The planting of trees therefore, used alone as a means of prophylaxis can be discarded at once as futile. When other means are being adopted the water absorbing power of vegetation may be made use of with circumspection.

In lower Egypt vegetation is abundant and it is in this part of the country that Malaria still flourishes. Instead of encouraging shady, wooded gardens, grassy slopes should surround the house. In certain wooded gardens along the canal at Alexandria the air is thick with winged insects in full day time. Visitors in the summer often retire to these public gardens in search of a cool shaded place, but their stay in these secluded spots is never very prolonged. We are glad to

(18) *Tropical Diseases*, by Sir Patrick Manson, C.M.G. 1903, Ed. p.171.

see in Egypt that within the last few years the Government Gardens (as they are called) or recreation grounds erected have been of the meadow type and not of the "Botanical Garden type".

(b) Filling up of depressions in the surface and of swamps which cannot be properly drained.

This is a means eminently well suited for small hollows in streets and country roads, gardens etc., which are often met with everywhere, but are extremely dangerous in the tropical and subtropical countries because of the fact that Anopheles, the Malaria carriers, are fond of laying their eggs in these smallish collections of water.

This work, as far as it concerns streets, etc., should be undertaken by municipalities, but some difficulties may be encountered when landlords are asked to make such repairs in their own property. It would seem advisable, therefore, for each municipality in Malarious districts to frame bye-laws in this respect.

The "filling up" work will vastly diminish the task of the "Mosquito Brigades" to which I shall refer later on.

Ross found these small collections of water abundant at Ismailia, and in his report (19) on that town he says; "It will be seen that at Ismailia the waters which 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".

Small unpaved courts near houses likely to become a source of mosquitoes in the rainy season may be asphalted. (20) Trenches which have ceased to be of use must be filled up. They are met with everywhere abroad and almost invariably contain collections of water, filth and rank vegetation, and are a nuisance apart from the possible source of Malaria.

The system of trenching filth is objectionable from every point of view, but unfortunately in many localities abroad it is the only means available.

If trenches are used as latrines they should be made deep and should be under municipal control where possible.

This method of "filling up" may be extended to

(19) Report on Malaria at Ismailia and Suez by Prof. Ronald Ross.
Liverpool University Press, 1903, Page 11.

(20) Dr. Andrew Davidson's "Diseases of Warm Climates - Prophylaxis of Malaria".

small marshes in a clayey soil, which are difficult to drain and impossible to dry up. If soil or sand is available from any excavation or levelling works such swamps can be filled at a very moderate cost. Or, the plan suggested by Dr. Forde ⁽²¹⁾ may be adopted. This consists in the installation in each town of a Refuse Destructor from which Clinker will be obtained and used to fill up irregularities of the surface. This plan is excellent in more ways than one. The amount of rubbish to be disposed of in towns is considerable, especially in the tropics, and no other plan could at once prove more economical in the long run and more hygienic than Dr. Forde's. I am only surprised that the suggestion has not been taken up and carried out by most Sanitary Authorities in the tropics.

By this plan of levelling the ground the cases of the disease may, in a very malarious district, be very much reduced. It is owing to this method principally that in Selanger, according to Dr. Travers, ⁽²²⁾ Malaria has been so effectually diminished. Cesspits of all sorts when they cannot be done away with should be protected from the entrance of mosquitoes.

(c) Drainage of all areas where filling up is impracticable but drainage is possible.

(21) Memoir XIV on Bathurst, Conakry and Freetown by Boyce, Evans and Herbert Clarke.
Liverpool University Press, 1905, Page 4.

(22) An Account of Anti-Malarial Work carried out with success in Selangor, etc., by E. A. O. Travers
"Journal of Tropical Medicine" Sept. 15th, 1903.

(c) Drainage of all areas where filling up is impracticable but drainage is possible.

This question of draining a very large area of swamp or stagnant water of any kind is one usually entailing such a large sum of money that before it is put into execution, careful consideration is required. This drainage scheme is really out of the reach of most medical men as so many things have to be taken into consideration. The "fall" of the ground and the proximity of a river or the sea to receive the drained water are matters of first importance.

Many other technicalities of which I am unable to speak with any confidence come into play.

Any plans of drainage should be submitted to engineers. This will be useful in many ways.

- (1) Large sums of money will probably be saved.
- (2) The ~~local~~ local authorities and the inhabitants in general will be more favourably impressed with any such scheme backed up by engineers.
- (3) The responsibility will be shared in the event of a failure.

The agricultural expert must also be consulted as to how far the drainage scheme, if carried out, will prove detrimental or otherwise to the growth of any crops which are in the habit of being raised in such a place. Here, I am, referring particularly to rice and cotton fields which exist more or less all through the tropical and subtropical regions,

particularly in India, Egypt and China. Rice fields under present methods of cultivation employ swamps, and swamps mean Malaria. The abolition of rice fields in most localities means famine. Thus, brief as it is, this truth is overwhelming and no amount of Malaria seems to justify the bringing about of such a calamity. Some parts of India, therefore, will probably always contain places in which Anopheles can breed, and there some other method must be adopted to guard the inhabitants against the ravages of Malaria. Laveran⁽²³⁾ suggests that rice should not be grown on swamps, but on well drained land, thus keeping the water always in motion. This really hygienic measure is possible in a small irrigation district, but is totally inadequate for countries like India and China, where rice fields are of such great magnitude. The evils of irrigation are so marked in Northern India that as Giles⁽²⁴⁾ remarks the area where irrigation is carried out can be arrived at deductively from looking at the number of cases of Malaria in each district. It is needless to say that where rice fields exist provision should be made that the houses of the men working the fields may be at some distance from the cultivated area

(23) Report of the transactions of the Académie de Médecine, October 4th, 04.

(24) Cold weather mosquito notes from India etc. Journal of Tropical Medicine, March 15. 04, p.108.

and on elevated ground if possible. No person should work in these fields after sundown. Rice fields should not be in the immediate vicinity of any town, village, or collection of houses. The Italian Government has been so much concerned with the rice fields as active propagators of the mosquito, that rice cultivation within four miles of any human habitation has been prohibited by statute. This, I understand, has also been adopted in Lahore. Many of our military stations in India have been established in extremely malarious districts. The Mian Mir cantonment is an instance. Nothing that has been tried so far in that locality has made the place any healthier, and I have no doubt in saying that if, from the first, the barracks had been abandoned and the same erected in another and less paludinous district, everybody would have been the better of the change, and the expense would have been, everything considered, much smaller.

Giles⁽²⁵⁾ gives the fact its full importance when he says "the retention of canal irrigation within the limits of any military cantonment a day longer than it can be avoided is little short of criminal". Irrigation, however, will take long to die out, even in those parts of India where it is essential it should. The Government as well as

(25) Lieut. Col. Giles - Cold weather mosquitoes etc. Journal of Tropical Medicine, 1904. p.108.

the European and native populations will take long to realize the necessity of doing away with such large quantities of water. The government would be slow in compensating the cantonment fund for land which, had irrigation been maintained, would have been hired as pasture land. The population generally would resent being deprived of their public and private gardens, flowers etc., which make many a dreary place just inhabitable. The expense of instituting a water system by pipes would amount to a good deal, and for this reason is impracticable. Were the irrigation water cut off and wells substituted in order to restrict the amount of water, the people would object to be compelled to use well water, not only for its possible impurity but also for the trouble of obtaining it. Where an efficient subsoil drainage exists irrigation is quite practicable. Nothing shows this better than the experiments carried out by Professor Celli in the Roman Campagna. To do this satisfactorily Professor Celli had many conditions in his favour, conditions which are but seldom met with in India, and other rice cultivating countries. What I have said about rice fields applies also to cotton fields which are so abundant in Egypt and which form a great source of wealth to that country. These fields

might be amenable to proper drainage. The large collections of water forming veritable marshes, covering hundreds of acres in the immediate neighbourhood of such a densely populated town as Alexandria could be drained at comparatively small expense. Many schemes have from time to time been talked about, but so far the Government have remained passive on a matter which if attended to, would make a great difference in the death rate of Alexandria and would render that town a winter and summer health resort of no mean order.

(d) Elimination of small collections of water in gardens, private premises etc.

1. Small collections of water should be strictly avoided. Giles says "In northern India for example, there is no good reason why we should be worried with mosquitoes during the "hot weather" as during those months there are practically no natural breeding places remaining and the enormous swarms that invade our bungalows have been almost exclusively bred in small domestic collections of water in the gardens, offices, etc., all of which might easily be rendered innocuous by half an hour's personal attention once in each week by the occupiers."

Broken bottles, calabashes, empty sardine tins, should be removed from the vicinity of the house and buried. Urban authorities should employ special

gangs to rid the town and its neighbourhood of broken bottles, empty tins, etc. The habit prevalent in Egypt of placing Zeers (porous earthenware filters) outside the house is distinctly a bad one from the Malaria point of view. I have often had occasion to find larvae of mosquitoes in both the receptacle of filtered water (which is seldom touched) and in the receptacle of unfiltered water (from which the water is drunk by the thirsty passers-by). These filters if they are to be used at all should be placed inside the house, and there should be a lid to the unfiltered water vessel. The filtered water, assuming its being removed at least once daily, should not hold the eggs for long and therefore, is not a source of much harm. Tanks, cisterns etc. opening to the exterior should be guarded by wire gauze. Traps and gullies have long been a cause of great annoyance, as any wire netting, sufficiently fine to prevent mosquitoes passing through, would seriously interfere with their action. Such gullies should be supplied with automatic lids, and concave in shape which would open when half full of water. Flower pots should be attended to in order that they may not contain water for too long a period. The pots should be, if possible, allowed to dry completely before being watered or exposed to rain again because if the

earth they contain be kept continually moist eggs and larvae which are capable of living in a moist pabulum are only retarded in their growth but not destroyed. With the next rain development would go on to the maturity of the insect.

2. Puddles in compounds and streets should be filled up as already mentioned, or if that be not practicable during the rainy season, they should be swept out daily with an ordinary broom or treated with any of the known culicides such as Kerosene oil or paraffin. An ordinary watering can may be used for oiling these small water collections.

3. In the garden, plants whose leaves are so constructed that water may gather in them during the rains, also dead leaves capable of containing water for some time should be avoided. Banana trees, bromeliads, pine apple plants, yucca and the like, should, therefore, be away from the house. Hollows in trees should be inspected for the presence of larvae or eggs.

4. In the house, flower vases should have their water renewed daily. Apart from the fact that they are often the favourite place for the breeding of mosquitoes,⁽²⁶⁾ every one who has lived in a warm

(26) Henry Strachan C.M.G. - in the British Medical Journal, September 17, 04 at the 72nd annual meeting of the British Medical Association at Oxford mentions that in many instances in which no breeding ground for Anopheles could be found after weeks of search in the immediate neighbourhood, the source of supply of the insects was eventually traced to the flower vases decorating the dining table.

climate is aware of the disagreeable odour which often proceeds from flower vases, the water of which has not been changed by the careless housewife or servant. Fire buckets which must be kept full, unless carefully covered up should, as suggested by Sir Richard Temple have a handful of lime added to their contents or they may be treated with petroleum or kerosene.

(e). Wells. The management of wells is of immense importance in the tropics, from the sanitarian's point of view. Wells abound ^(they are usually shallow wells) in hot countries, and ^{apart from their geological formation they} are of a variety of kinds. There is the domestic house well provided with a pulley and a bucket, the well provided with a pump, and the agricultural well. The latter is very frequently met with in Egypt, and is locally known as "Sakieh". Underground rain water reservoirs, wrongly called wells, are often underneath the house, and beside the underground chamber they consist of a tunnel in the wall with an opening into each flat, so that water can be drawn by bucket direct from the reservoir into each flat. Such water reservoirs are universal in Malta, and similar ones but of a superior type are met with in Venice. From the Malaria point of view we cannot object very strongly to indoor reservoirs because if kept covered, they are perfectly safe as far as mosquito oviposition is concerned. Unfortunately

they are in the great minority in tropical countries. The garden well, which is not supplied with a pump, is very objectionable unless properly attended to. Every domestic well should be provided with a pump, the pipe of which passes through a hole in the lid of the well. The lid should be well fitting. To prevent other contamination, a wall about three feet high should surround the well and the base of this wall should be cemented and should slope a distance of three feet to a wire fence. The inside of the well should be cemented as far down as the water level.

To destroy any larvae in a well one should not hesitate to use kerosene or paraffin. If a pump be used the water being drawn from a certain depth does not taste of the oil. If the bucket be used some oil may be seen as a film on the surface, but this can be easily skimmed off. The water may taste slightly of the culicide, but it has by no means a disagreeable taste. I once paraffined a well with ordinary lamp oil, and after twelve hours drew a bucket of water. Very few traces of the oil were to be seen on the surface, and these were easily removed with a spoon. The water had a slightly tarry flavour by no means disagreeable even to the uninitiated. After some time one may even get to like this aroma. Thus Dr Balfour says ⁽²⁷⁾

(27) Balfour's 2nd Report of Wellcome's research Laboratories, Khartum, p.25.

"It is interesting to find that the natives have developed a great liking for petroleum . . . they seem to regard it as a panacea for every kind of winged pest and use it to keep away flies and midges. This is a curious testimony to the efficacy of Major Ross's method." With regard to shallow, private wells used by natives, Professor Boyce and his collaborators⁽²⁸⁾ say, "It is obviously very difficult to get the natives to realize the necessity of covering them, and we think the only remedy . . . is abolition."

As to the agricultural wells of Egypt and elsewhere they consist of a large well supplied with a vertical wheel to which buckets are fixed along its circumference. A buffalo, a cow, a mule, a horse, a donkey or a camel, or any combination of these animals ^{is} ~~is~~ used to drive the wheel. When the buckets come above the ground they empty their contents into a trough and this leads into irrigation channels. In a district where mosquitoes are abundant the objection to these wells is great, and more so when such wells are not "worked" and are left uncovered. I have seen such wells (which must be about six times the size of a garden well) full of insects in all stages of development. In none of these wells of which I must have seen scores, is

(28) Memoir XIV on Bathurst, Conakry, and Freetown, by Boyce, Evans and Herbert Clarke, Liverpool University Press 1905. p.9.

there ever any attempt made at covering them. It would not be an easy matter to do so without taking the whole mechanism to bits and even if this had to be done only once a year, during the rainy season, the Arab is too lazy to undertake so much labour for the good of his health. Not only are these wells so objectionable in themselves, but the water usually found in their immediate vicinity gives rise to a perfect swamping of the ground. This is not to be wondered at when one looks into the primitive construction of the agricultural implements used by natives in Egypt. Troughs and shallow channels made of wood (three boards nailed together) may be seen everywhere in the country. Of leakages they are absolutely callous, even if their work has to take double the time on that account. In lower Egypt where Malaria is yet very rife, no attempt has been made by the Government to check this great source of the disease. Indeed the country immediately outside the large towns is in the state it must have been a couple of centuries ago in every respect. All wells within a mile of a town or village should be treated with paraffin. Half a pint per well is ample according to Balfour,⁽²⁹⁾ and such work could be carried out by mosquito brigades as recommended by Ross in his work on the subject.

(29) Balfour's 2nd Report, Wellcome's Research Laboratories, Khartoum.

(f) Ornamental Fountains. No garden is much thought of in the tropics, unless it contain a fountain. The water is turned on in a beautiful jet rising high in the air on special occasions during the winter and daily during the hot summer days to "cool the air". During a whole week or more afterwards, such fountains may contain water which forms an admirable site for mosquito breeding. Such fountains usually communicate with flower beds and it may merely be necessary to pull the plug and let the water empty itself out in the flower beds to avoid hundreds of insects infesting the house. The introduction of fish in such fountains and wells has been suggested but it is questionable whether that is a sure means of getting rid of eggs and larvae. The question would rise as to what kind of fish one should employ, and how many of them. To these questions no certain answers can be given. In running streams larvae and fish may be seen swimming side by side in perfect harmony.⁽³⁰⁾ I have often demonstrated larvae and eggs of culex to friends, in fountains where gold fish were kept. These larvae were, I must say, usually small and only visible when a white saucer was placed under the surface of the water. My friends suggested

(30) First Progress Report of the Campaign against mosquitoes in Sierra Leone. Letter of Dr C.W. Daniel to Professor Ross. p.20.

that these larvae could only have hatched out a short time before and had not yet had time to be destroyed. Larger larvae I could also see although not in such large numbers. It seems to me that they escape destruction by hiding in the centre of the fountain among the water plants that are generally there, and in such situations they avoid their voracious enemies. It is a well known fact that wherever fish are introduced in any collection of water rich in larvae of mosquitoes a large number of the fish die⁽³¹⁾. What the cause of death is we do not yet know. Major Bray⁽³²⁾ records the fact that mosquito larvae destroy the young fry of fish. Murray⁽³²⁾ has shewn that the adult mosquito can do the same. Ornamental fountains are better done away with in all malarious districts. A lot of mosquitoes will be thereby abolished. I may mention here that in a house which I inhabited at one time in Alexandria, "the front" overlooked a busy thoroughfare while the back windows were in close proximity to a garden in which such a fountain existed. Mosquitoes were found daily in the back rooms while the front ones were free of winged insects. Some time after making this observation, the owners of the fountain left the house and there was no more water in the fountain.

This happened at the time when mosquitoes are most

(31) First Report of the Campaign against Mosquitoes in Sierra Leone. Letter of Dr C. W. Daniel to Professor Ross, p.19.

(32) 2nd Report Wellcome Research Laboratories, p.27.

abundant in Egypt and yet, our house became entirely free from mosquitoes.

(g) Attention to Roof gutters. If of faulty structure these may retain water in which mosquitoes may breed. Any such faults should be corrected. Strachan⁽³³⁾ points out that iron in water is not inimical to larvae as was at one time advanced. In Egypt flat roofs have been the rule up to now (some modern houses are now adopting sloping roofs). Each roof is surrounded by a wall some four feet high. These roofs are generally used for drying the washing and are often ornamented by various flower pots and other receptacles. Standing collections of water are, therefore, frequent and yet not once did I find any larvae or eggs at such moderate heights as 40 feet or so. Mosquitoes never rise to any great height. In many localities in Alexandria where "flatted" houses are common, it is often the case that while the first and second floors may be infested with mosquitoes, the flats above are absolutely free from them. When possible therefore, upper flats should be used in preference to lower flats, and in self contained houses bedrooms should be as high up in the house as possible.

(h) Destruction of Larvae by Kerosene, Petroleum etc.

Any collection of water which cannot be got rid of

(33) Henry Strachan C.M.G., British Medical Journal, September 17, 04.

for any reason, should be treated with Kerosene or some substitute such as paraffin oil, etc. There is no doubt that Kerosene and Petroleum as well as many other allied substances, are excellent in destroying larvae. They do not, however, destroy eggs, although they are said to retard their development, and for this reason and also because of their volatility, such substances have to be reapplied every fortnight or oftener if the place be one exposed to much wind. A mixture of Ghi, (native butter) and Kerosene has been advocated by Major Wyville Thomson, F.M.S. as a more stable compound.

At Ismailia Dr Pressat⁽³⁴⁾ used crude petroleum and fine burning oil mixed in the proportion of one part of the former to two of the latter during the winter months. In the summer owing to rapid evaporation, equal parts of the two substances were used. The results obtained were excellent.

Tar is recommended by Simpson. The applications should take place summer and winter as it has been proved that in some countries at any rate the eggs and even the larvae of mosquitoes can hibernate.⁽³⁵⁾

Howard, Christophers and Stephens hold that adult females are also killed by the paraffin on the surface of the pool where they come to lay their eggs.

(34) Dr Pressat's "Le Paludisme et les Moustiques", page 92.

(35) New observations on the larvae of Anopheles and Culex in winter by Prof. Bruno Galli-Valerio, and Dr Rochaz. Journal of Tropical Medicine, September 15, 83.

Dr. St. George Gray⁽³⁶⁾ is inclined to think that this does not occur to any very great extent. Out of 18 female mosquitoes he watched, only 3 were killed. Instead of using paraffin, Dr Dolz⁽³⁷⁾ of New York, has been using a solution called "Bordeaux", which is mainly composed of Sulphate of Copper and Lime. He obtains good results with this preparation. Major Fink, I.M.S., recommends peppermint oil with which he obtained good results in India. He also tried with equal success, an emulsion of peppermint oil, castor oil and liquor potassae. Dr Logan Taylor⁽³⁸⁾ tried formalin, corrosive sublimate, copper sulphate and carbolacene, but found them inferior to oil culicicides.

Dr Balfour of Khartoum tried the effect of solutions of chrysoïdine, the hydrochloride of di-amido-azobenzene, on larvae and pupae, but his results were somewhat indefinite.⁽³⁹⁾

We have heard no more about *Agamomermis culicis*⁽⁴⁰⁾ (Stiles), the American Sporoz^{oon} parasite.

(36) Notes on the use of Kerosene as a culicide by St. George Gray, B.A., M.B. &c. Medical Officer Sierra Leone Journal of Tropical Medicine 1903, p.313.

(37) Journal of Tropical Medicine, September 1st, 1904.

(38) Dr Logan Taylor's Report on the Campaign against Mosquitoes in Sierra Leone. Liverpool University Press 1902, page 9.

(39) First Report, Wellcome Research Laboratories, Khartoum, (under Mosquito work).

(40) Johnson - Journal of Medical Research, Vol.VII, 1902. No.2, p.213.

Oiling has been objected to on the grounds that it might cause extensive fires, but the film produced at the surface of the water is so thin that no danger is to be feared from that quarter. In the municipal systematic oiling of ponds and stagnant waters of every description the work is best done by establishing mosquito brigades as suggested by Ross. Three men and an inspector are sufficient to form a small but serviceable brigade. Each squad is supplied with a barrel mounted on wheels (after the style of the Military Water cart). This barrel, of course, contains the larvicide. It is with a brigade (only one) such as this that Ismailia was practically freed from mosquitoes during such a comparatively short time. The inspector of the brigade had orders to pour petroleum wherever there was stagnant water, whether on the ground or in barrels, tanks etc. The householders in each district were warned that on a certain appointed day the brigade would call at their premises and as most of them objected to having their grounds and garden tubs smeared with oil, they simply took the precaution of emptying out any collection of water. This was indeed a most excellent result, being both effective and economical. Mosquito-brigade work has also been objected to on the grounds that immigration from neighbouring districts would always make up for the number of mosquitoes destroyed and that

such work, therefore, is if not useless at least unsatisfactory and costly. The failure of the Mian Mir experiment has been attributed by Christophers and Stephens⁽⁴¹⁾ to immigration from neighbouring districts. Ross⁽⁴²⁾ holds that this is not the case but that the experiment failed because it was badly carried out and on lines so economical that they were incompatible with good results. Lately Major Ross dealt with the question of mosquito immigration in a very elaborate paper read at the International Congress of Arts and Science in St. Louis.⁽⁴³⁾ His conclusions are as follows:-

- (1) The mosquito density will be always reduced not only within the area of operation but to a distance equal to the ideal limit of migration beyond it.
- (2) On the boundary of operations the mosquito density should always be reduced about one half of the normal density.
- (3) The curve of density will rise rapidly outside the boundary and will fall rapidly inside it.
- (4) As immigration into an area of operation must always be at the expense of the mosquito population immediately outside it, the average density of the whole area affected by the operation must be the same as if no immigration at all had taken place.

(41) Prophylaxis of Malaria, by J.W. Stephens, B.A. Abstract of proceedings in the section of Tropical Medicine. British Medical Association. July 28, 04.

(42) At same meeting as above (see abstract in British Medical Journal).

(43) The Logical Basis of the Sanitary Policy of Mosquito Reduction. British Medical Journal, May 13th 05.

5. As a general rule for practical purposes if the area of operation is of any considerable size immigration will not very materially affect the result.

Finally it must be repeated that the whole subject of mosquito reduction cannot be scientifically examined without mathematical analysis. The subject really is part of the mathematical theory of migration - a theory says Ross which so far as I know has not yet been discussed. Ross⁽⁴⁴⁾ sums up the effect of mosquito destruction on the diminution of disease as follows - "I estimate for several reasons that the amount of a mosquito borne disease in a locality should vary roughly as the square of the number of mosquitoes capable of carrying the disease found there.

Hence, if the Anopheles are reduced to one half, the Malaria should finally be reduced to a quarter; if the Anopheles are reduced to one tenth as should generally be practicable the Malaria should be reduced to one hundredth.⁽⁴⁵⁾ But this is an estimate founded merely on a priori considerations; and it will always be a matter of great difficulty, especially in native towns, to obtain reliable statistics of the variation of the amount of Malaria!"

(44) First Progress Report of the Campaign against Mosquitoes in Sierra Leone by Ronald Ross, p.13 (1901) Liverpool University Press, also Report on Malaria at Ismailia and Suez by Ross, p.18, 1903, Liverpool University Press.

(45) Logan Taylor also says "In towns the number of Mosquitoes can be reduced at least 80 or 90%". Report on Campaign against Mosquitoes in Sierra Leone

(i) Destruction of Larvae by Salt Water.

This method was advocated for large and small pools but has now been abandoned, although excellent results were obtained at Amsterdam⁽⁴⁶⁾ by allowing sea water to mix freely with canal water. Dr Mori also tells us that larvae of mosquitoes were killed by sea water on the littoral of Pekin. Since then we have learned that many mosquitoes such as *Culex sollicitans*, *Acartomya* ^Z~~Sammitii~~ *Sammitii* (of Malta)⁽⁴⁷⁾ *Guibhamia mariaⁿe*⁽⁴⁸⁾ lay their eggs in water containing as much salt as sea water and it is possible that mosquitoes may, when forced to it, lay their eggs in salt water and that the larvae and pupae may acquire the habits of salt water insects. At Ismailia larvae of *Anopheles* were found in water containing 9 grammes of Sodium Chloride per litre.

Lower Egypt, especially that part of the country which stretches between Alexandria and Mansourah, abounds in small lakes and swamps, the water of which contains a high percentage of salt; in some instances as much as 15% of solids were found in such water. Yet, in spite of such a high percent-

(46) The disappearance of Mosquitoes from Amsterdam, etc. 1872, British Medical Journal, 18.4.03.

(47) Theobald.

(48) Thomson, Yates and Johnston, Lab. Reports, T. VI, Part 2, p. 139, Article by Sargent.

age of salts, mosquito larvae and pupae may be found in great numbers.

(k) Destruction of Larvae by Fish.

This subject has been referred to already in connection with ornamental fountains. I only wish to point out here that on account of the smallness of the collections of water in which anopheles are found it is impossible to utilize fish to any great extent even if much could be expected of them. Tadpoles and water beetles also feed on larvae whenever the chance presents itself. Finally I must mention that Dr Dempwolff⁽⁴⁹⁾ who succeeded Professor Köch as head of the German expedition for the investigation of Malaria in German New Guinea has, according to the Standard, discovered a water insect which destroys mosquito larvae. By artificially cultivating this insect he hopes to exterminate the mosquito of Malaria.

Stephens⁽⁵⁰⁾ points out the importance of knowing definitely what species of mosquitoes one has to deal with before undertaking any elaborate system for their destruction. In India he found that *A. Rossi* which does not transmit Malaria preferred to breed in pools and dirty puddles, whilst *A. culicifacies* prefers clear running water. It will be seen how

(49) British Medical Journal, February 21st, 1905.

(50) paper read before the British Medical Association.

a lot of money could be utterly wasted in attempting to destroy the larvae of Anopheles Rossi in this case.

B. Means to Prevent the Mosquitoes from biting Man.

(1) Mosquito Net.

The use of mosquito nets in tropical countries must be of extreme antiquity. Whether the people in bye-gone days used mosquito nets principally to prevent the attacks of fever or mainly to keep out the annoying insects is not quite sure. I wish to quote the following extracts from writings which date from a period when the theories of Ross and Laveran had not yet enlightened the world. G. P. Sanderson⁽⁵¹⁾ in a book published in 1878 says - "I believe that with a small fire kept up in or near the tents all night, and, of course mosquito curtains, and a cot at least 3 feet from the ground, a person may sleep in the most malarious swamps or jungle with safety," and again " . . . I was out of bed in a twinkling not even waiting to untuck the mosquito netting which I always use as a precaution against Malaria as much as against troublesome insects." Captain T. L. Trotter⁽⁵²⁾ in his book, "The Bayard of India" says - " . . . M. Brocchi about the same time (1830) both

(51) ^{was fully adopted by the British Government} Thirteen years among the wild beasts of India, by G. P. Anderson, 1878.

(52) The Bayard of India by Captain Trotter, 1903, Chapter IV, p.38.

successfully adopted de l'Isle's suggestion⁽¹²³⁾ and also recommended the sleeping under a fine mosquito net in all places where intermittents were epidemic. It might also be interesting to note that Captain T. H. M. Clarke, R.A.M.C., in a letter published in the British Medical Journal for December 5th 1903, describes how surprised he was to find that the Turks in Crete used mosquito nets and he learnt later on that this use had been practised for years, perhaps centuries. When asked why they used mosquito nets they told him that they found by experience that if they did not use nets they could not withstand the fever and ague.

In Italy, I understand the custom of sleeping under a mosquito net is extremely old, possibly it dates back centuries, judging from information gathered locally. In Egypt in malarious districts the habit is also very old among Europeans, it being probably imported from Italy, as the natives hardly ever use a mosquito net. Arabs, however, are in the habit of sleeping wrapped up in a blanket, and their face covered with a handkerchief or even a newspaper. This habit may or may not have originated as a preventive measure against the bites of insects.

(123) Dr Mason Good's Study of Medicine, 4th Edition, 1834. Vol. I, page 631. Mr Rigaud de l'Isle recommended so long ago as 1817 the wearing of a fine silk gauze over the mouth and nose in malarial regions (a precaution which Sir James Outram actually successfully adopted in India in 1830.)

It is certainly not efficient as a means of protection against Malaria.

The importance of mosquito nets in the tropics cannot be too strongly emphasised. It is as essential to health in such regions as food is to the nutrition of the body. Ross writes⁽⁵³⁾ "I cannot say enough for the mosquito net. I believe if all Europeans in the tropics could be induced to use it as carefully as some of us do, malarial infection would be reduced among them to less than a quarter." Many objections are raised against the use of mosquito curtains. Here are a few. 1. The cost. 2. The fact that a net prevents to some degree the free circulation of air. 3. Danger of setting fire to the house when light other than electric light is used. 4. Last but not least people of a "scientific" turn of mind argue that since the natives do not use mosquito nets, these cannot be a sine qua non in the tropics. To the first objection very little need be said. The cost of mosquito nets is a moderate one and the upkeep is also moderate if ordinary care be taken.

A mosquito net lasts indefinitely if repaired from time to time. The average European going abroad to tropical countries is generally in a position to supply himself with one. In cases

(53) Malaria Fever, its cause, prevention and treatment by Ronald Ross, 1902, p.37.

where European labourers have to take their residence in malarious districts and where the cost of mosquito netting for themselves and family might prove a somewhat severe tax on their resources it should be the duty of every intelligent employer to supply such necessary articles. The second objection, the question of ventilation, is a very serious one and has been the cause of a good deal of trouble in public institutions where the use of nets has been enforced. It is a truth nevertheless that mosquito nets do make the air within the net more still than it otherwise would be and therefore, the sleeper suffers from the heat to a greater extent. To the wealthy classes the objection can be somewhat mitigated by the use of punkaks or electric fans, but even these are not always available. Electric fans are an expensive commodity and they imply electro-motive power, which is not a constant feature in the tropics. Moreover, electric fans have a knack of giving one a stiff neck. Punkaks are perhaps more suited for the purpose of agitating the air in a room. With a low mosquito net, and a punkah swinging within a few inches of the top of it, one can enjoy a very cool sleep. This, I believe, is a very common practice in India in the houses of the well-to-do people but on the West African coast, in Egypt and many other countries, punkah boys are very seldom available. To the man



The Swatow Lamp
as suggested by Mr J. Cantlie

of moderate means only one means is possible to relieve the oppressing effect of the mosquito net, and that is the opening of all windows and doors in the room. This, of course, is not an ideal scheme, but is undoubtedly the cheapest. Balfour writes: "Some people say that they are stifled in a mosquito net. This is only because they do not have the net properly stretched. . . . The net should be stretched as tightly as possible in all directions, so as to permit every breath of air to blow through!"

The danger from fire is also one of great importance. Anybody who has lived in warm climates knows how many fires are caused through mosquito nets, because of the prevalent habit of reading in bed. Another practice, although a good one, in some respects, is a common cause of severe conflagration. I refer here to the habit of burning mosquitoes found inside the mosquito net in the morning. This is usually done by means of a candle or a match, which is placed for a moment below the resting mosquito. The mosquito is destroyed and so is the net, and the rest of the house sometimes.

Quite recently ⁽⁵⁴⁾ Mr J. Cantlie advocated for this purpose and in order to destroy mosquitoes found resting on walls, the use of a lamp called "the Swatow Mosquito Lamp" (illustration ^{opposite} page).

(54) Journal of Tropical Medicine, June 15, 1905. Page 186.

This lamp resembles an ordinary cycle lamp in which the front glass has been removed. When the funnel shaped "mouth" of the lamp is brought sufficiently near the insect to startle it, the insect flies straight into the flame where it invariably perishes. Any burning oil may be used in this lamp. By means of it the danger of fire is much minimized. I understand this lamp is widely used in the South of China where it was originated, but it will be long, I think, before its use will become universal. A bicycle lamp with the lens removed may be used instead of the Swatow Lamp with enormous success, as I had occasion to find out quite recently.

It often happens that once inside the mosquito net one hears the "buz" of a mosquito and instead of making a search for it at once in order to destroy it, one often waits for it to alight on one's face and then kills it (sometimes) with a slap. This procedure is extremely dangerous.. One may fall asleep and forget about the mosquito before it is destroyed or if the mosquito has succeeded in piercing the skin, the act of killing the mosquito on that spot is, according to Fink⁽⁵⁵⁾ like that of inoculation after scarification.

That natives do not generally use mosquito nets and that they are, as compared with Europeans, less frequently the subjects of Malaria is also a fact

(55) Journal of Tropical Medicine, August 15, 1905, page 257, British Medical Association meeting (Leicester.)

worthy of comment. This relative immunity of adult natives has been attributed to a thousand and one causes. This alone proves that whatever cause or causes are responsible factors, no two authorities seem to be of the same opinion. It would be sufficient, I think, with the statistics we have at hand to prove that natives are the contrary of immune to Malaria when taken as a whole. Malaria attacks the young among the coloured races, and of them it kills a large percentage. Boyce⁽⁵⁶⁾ and his colleagues, in their report on Malaria in West African towns, say, speaking of Conakry - "Although we were unable to obtain definite figures of the proportion of Malaria in the young native population, cases do occur and observations similar to those conducted at Bathurst, Freetown and other West African towns, would no doubt reveal its presence in the proportion of 80 per cent.

[Koch and Daniel say about 50 (E.F.V.)] It is, however, a matter of great importance to have this point settled". When the children reach puberty the parasites tend to die out in them, by some natural but unknown process.⁽⁵⁷⁾ Those who do not perish in their infancy are the "fittest" among a multitude, a small percentage of what should have

(56) Memoir XIV on Bathurst, Conakry and Freetown by Boyce, Evans and Herbert Clarke, Liverpool University Press, p.21 (year 1905.)

(57) Malarial Fever, its cause, prevention and treatment, by Ronald Ross, 1902, page 7.

been the population were it not for Malaria. Even among the presumably healthy adults a great majority have enlarged spleens an almost pathognomonic sign of previous attacks of Malaria.

Most of the natives which I examined in the Deaconess' Hospital at Alexandria had large spleens. All the large spleens came from lower Egypt (except one) where Malaria is common. Cases of rupture of the spleen are also frequent in lower Egypt. Pressat gives the percentage of affected children in Ismailia as 31%⁽⁵⁸⁾.

Having now dealt with the objections which are usually put forward against the use of the mosquito net and having come to the conclusion that it is an essential item in the outfit of the European going to tropical climates (where the houses to be inhabited are not otherwise protected), I shall now consider the important points connected with the structure of the mosquito net. In the choice of the netting material attention should be paid to the closeness of its meshes. There should be at least 20 of these to the inch (Simpson). In Egypt particularly, this is of great importance, because there exists there a certain dipterous insect called locally "Akl u Scoot" (silent eater) of very small size which penetrates through an ordinary mosquito net. This insect according to Pressat of Ismailia

(58) Pressat's "Le Paludisme et les Moustiques" p.104. This percentage is now much reduced.

may be the carrier of the parasite causing Nile Boils. As its name implies this insect does not hum and on that account is more difficult to discover. It is remarkable how, even the full sized mosquito can squeeze through an aperture which seems at first impenetrable to its body. When the mosquito is in search of blood, the abdomen of the animal is extremely thin. I have watched a mosquito, a female culex (I have never found a male mosquito inside a net) take about five minutes to get through my mosquito net, the meshes of which were of usual size. The first pair of legs were introduced first, and then the head with the appendages bent back by flexion of the head on the chest. By pushing with the front legs against the net more of the insect passed through, the wings being carefully adapted to the trunk and the middle and posterior pairs of legs being, as it were, dragged behind until the animal was entirely through. Some "giving" of the meshes assisted in the passage of the little animal, as I noticed that after the insect had passed, the hole in the curtain, between the meshes was larger than the others. I would recommend, therefore, that the material of which the net is made should be stiffish and if not naturally so it can be rendered sufficiently firm by starching. Professor Simpson⁽⁵⁹⁾ says "Fine muslin is even more

(59) The maintenance of Health in the Tropics, by Professor W. T. Simpson, p.17.

protective than mosquito netting as it excludes sand flies as well, but on sultry nights its use is felt by some to be more oppressive than mosquito netting; when, however, there is good ventilation in the room, the muslin is to be preferred." It is almost unnecessary to state that there should be no holes in the net and that these, when accidentally produced should be repaired at once. The net should be in the shape of a right angled parallelopiped and not bell-shaped. The bell-shaped nets are more stuffy than the others although from the aesthetic point of view they are superior. The roof of the net if high, may be made of opaque material, but if low or underlying a punkah it should be made of netting. The sides should hang down curtain like to the floor, the lower edge being weighted down by lead, shot, or sand. The net should hang at some distance from the mattress all round so that no part of the sleeper's body should come accidentally in contact with it. Every morning the net should be lifted up for thorough ventilation, and it should be replaced in position before sunset. The floor beneath the bed should be swept daily. A framework of wood or thin bar iron to support such a net can easily be made by native workmen everywhere. In Egypt the four posted bed is in general use, and such beds are supplied with a mosquito net carrier.

The arrangement is usually faulty inasmuch as the net hangs right over the edge of the mattress, thus there is risk of the sleeper lying in contact with it. The curtain which is not usually weighted has to be tucked in under the mattress, a precaution which is often neglected and which when carried out is very often the cause of rents in the delicate meshes of the curtain. When this type of net has to be maintained it should be lined with calico for a foot above the level of the mattress as suggested by Professor Simpson.⁽⁶⁰⁾ In this way if any part of the sleeper be in contact with the calico there is no great danger of the person being stung, and thus infected. The use of mosquito nets although admirably adapted for houses, is not suitable for public institutions such as barracks, hospitals, etc. Too great a staff would be required to see that the mosquito net is properly used and the cost of repairing and renewing the nets may prove a great draw-back. Other means of keeping out the nefarious insects, means which will presently be described, are more suited for public institutions.

A great variety of nets for out-door use are supplied by many makers and are extremely useful for travellers. Of the precautions to be taken when travelling in the open country in the tropics I shall treat later on.

(60) The maintenance of Health in the Tropics, by W. T. Simpson, p.17.

(II) Use of Mosquito Proof Rooms.

Dwellings are made mosquito proof by the application of fine wire netting to all the openings. This is the plan advocated by Professor Celli, and adopted very extensively in Italy. The results obtained by this method of prophylaxis alone, are so good that too much cannot be said in favour of it. This method also is old. The Romans were in the habit of having "fenestrae reticulae ne quod animal male ficum introire queat."⁽⁶¹⁾ It is the method par excellence for public institutions referred to above, and should certainly be adopted in all hospitals, barracks, schools, etc. in the tropics. Not only can rooms be made mosquito proof but verandahs can be so covered with wire netting that it becomes a possibility to remain out in the open after sun down with perfect safety. This would be a great addition to our hospitals abroad. Its adoption in private dwellings would make life very much more pleasant in a good many parts of India. This, like many other methods of prophylaxis, is open to objections:- (a) cost, (b) rooms so protected become extremely hot. To carry out Professor Celli's plan with any hope of success, each window should be fitted with a removable but well fitting frame, carrying a fine wire net of galvanized iron or other non-corrodible substance. Each door should

(61) Varron (R. R III, 7.)

be supplied with two wire net screens at some distance from one another. This even in a dwelling of small size entails considerable expense. In India the cost is proportionately greater, for the houses, according to Giles,⁽⁶²⁾ seem to have an extraordinary and unnecessary number of doors. That observer reckoned that in an average sized house in India £26 would be required to supply every door and window with sufficient protection. In Italy, at Grosseto, in order to protect 31 men the sum of 1200 Lire (£48) was spent.⁽⁶³⁾ This is a plan, which, should it be carried out to a large extent should receive Government monetary support. The heat in protected houses is undeniably greater as the air circulates more slowly. The objection is a great one, and one which it is difficult to remedy. In large institutions punkahs or electric fans improve the condition at once, but in ordinary dwelling houses, especially those of the poorer working classes these luxuries are impossible, nor is it possible to give them the large commodious houses that are bestowed on the higher officials. The problem, we may safely say, has not yet been solved. Many officials on the West Coast of Africa, I believe,

(62) Lieut. Col. Giles, Journal of Tropical Medicine, 1904, p.136. Notes on Cold Weather Mosquitoes in India, etc.

(63) Pressat's "Le Paludisme et les Moustiques". p.103.

were supplied with such protected houses, notably the railway servants at Clinetown,⁽⁶⁴⁾ but they seem to have preferred the ravages of Malaria to the discomfort of sleeping in the protected houses. On the other hand, Ross says, that houses protected in this manner are not unpleasant to live in. "I found in Lagos," says he, "contrary to my expectations that it (the wire gauze) does not shut out the breeze".⁽⁶⁵⁾ In Italy thousands of railway officials inhabit these protected houses right through their hot summer. When in Sicily I had the opportunity of entering the house of a station master. Mosquitoes were so numerous that year, that the screen had never once been dislodged from the window for several days. At the time of my visit the heat of the sun was excessive and the interior of the protected rooms was cooler than the outside air. The rooms were dark on account of the screens in the windows. At night, however, as I learned from the station master's wife the conditions are reversed, quite apart from the heating effects of artificial light in such rooms. After sunset there is a great temptation to run out of doors to enjoy the cool breeze. I found the station master to possess a good notion of the cause and prevention of Malaria. Not only did he follow the recommendations of the

(64) Memoir XIV on Bathurst, Conakry and Freetown, by Prof. Boyce, Evans and Herbert Clarke, Liverpool University, Press 1905. p.39.

(65) Malarial Fever, its cause, prevention and treatment by Ronald Ross, 1902. page 45.

railway government doctors for himself and family, but he was responsible for the health of his staff. The Italian government must be congratulated on having dealt with Malaria and its prevention in the liberal way they did. No money or pains were spared in giving their officials both mechanical and medicinal protection, and the instruction which these poor badly paid officials have received in the question of Malaria is remarkable when one is acquainted with their ignorance on other topics. That government have been rewarded greatly for their efforts by the excellent results they have attained. In localities where the mosquitoes are absent through the day, the screens should be removed for a few hours daily; this will ventilate the house. In houses protected in this manner, where presumably mosquitoes cannot gain access, some method of cooling the house by water jets may be adopted, but this requires to be very judiciously carried out, because if neglected it may become the source of the mosquitoes by forming a nidus for their reproduction. It is not a method suited for the poorer classes for obvious reasons, and has in addition, the disadvantage of increasing the humidity of the air to a harmful extent. I have not seen any house in Egypt protected by wire screens although the use of loose netting fixed to windows, is a frequent means of keeping flies out. In some districts in Lower Egypt where

Malaria is abundant, wire nets would be of great benefit. Unfortunately no authority has such a powerful grip on the Egyptian as the Italian Government have on their subjects, and I am afraid that under the present state of affairs these precautions would be wasted on this stubborn nation. Some time ago⁽⁶⁶⁾ it was stated that the Mikado intended to introduce this system of protection against Malaria into Japan. Under this heading of protection from mosquito bites something might be said in connection with the question of dress. I do not mean to take up the subject from the general hygienic point of view, but I wish to mention the precautions to be taken in the covering up of the body, so as to avoid the stings of mosquitoes. Veils should be generally worn after sunset. They must be loose, falling from a large brimmed hat, (motor fashion). Gloves should be worn and they should be of the gauntlet pattern. Puttees are excellent articles for both sexes. If these are not worn boots with long tops should be used by ladies, and gentlemen could have the military foot straps fixed to their trousers. I need not say that in malarious regions the low necked dress of ladies as well as open work blouses, stockings, etc. should be discarded.

(66) British Medical Journal. August 27th, 1904.
Page 459.

Substances Tested		Time in which	
		Apparent Death occurred	Real Death
<u>I Essences</u>			
1	Essence of Nourineg	10'	2h
2	" " Camphor	4-5'	4h-5h
3	" " garlic	5-10'	5h
4	" " powdered Pepper	20'	6h
5	" " Caphtaline	10'-35'	8h
6	" " Sage	4h-6h	survived
7	" " Rosemary	-	-
8	" " dry Basil	-	-
9	" " Cinnamon	-	-
<u>II Smoke</u>			
1	Smoke of Tobacco	Immediate	1'-3'
2	" " Chrysanthemum and	"	5'
3	" " Valerian		
3	" " Quassia Wood	16'	5h
4	" " Pyrethrum powder	5'	8h
5	" " Mint leaves	5'	8h
6	" " dry Basil leaves	2'-6'	24h
7	" " Rosemary	7'-12'	24h
8	" " Camomile flowers	4'	36h
9	" " Sage leaves	8'-10'	36h
10	" " Wood	5'-7'	12h-48h
11	" " Guaiacum Resin	12'	survived
12	" " Myrrh	15'	"
13	" " Elemi Gum	15'	"
14	" " Incense	15'	"
<u>III Gases</u>			
1	Sulphurous Anhydride	Immediate	1'
2	Sulphide of Hydrogen	"	1'
3	Lighting Gas	1'	2'
4	Formaldehyde (Trillat's appar ^{ns})	2'	10'-15'
5	Sulphide of Carbon	15'-30'	survived
6	Acetylene	-	-
Halensia.			

(III) Burning and other use of certain Substances as prophylactics.

The substances which when burned, or otherwise used are said to kill or ward off the attacks of mosquitoes are extremely numerous. Some of these remedies belong to the fetich variety, others have been handed down from generation to generation, and although enjoying great repute have proved to be useless in their action. A certain number of substances are still used to destroy the adult mosquito when it has entered a house, and substances now exist which, modern experimenters say, when applied to the skin are a sufficient protection against the bites of mosquitoes. Dealing with the destruction of the adult mosquito, I will give here a table (see opposite page), from Dr Pressat's work, ("Le Paludisme et les Moustiques",) and taken from the experiments by Celli and Casagrandi.⁽⁶⁷⁾ This table shows the effect of various volatile oils, of smoke from the combustion of various substances and of chemical gases of daily use. It shows that none of the volatile oils kill mosquitoes under two hours while some do not kill them at all. Of the smoke experiments, tobacco smoke gave the best results. Ross says⁽⁶⁸⁾ "I have heard that coarse, damp, brown paper placed in a large tin and mixed

(67) Per la distruzione delle Zanzare. Ann. d'Igiene sperimentali, 1899.

(68) Malaria Fever, its Cause, Prevention and Treatment, 1902, page 30.

with a little tobacco and burnt, is a very effective culicid. Next in the list of efficacy comes the smoke of Chrysanthemum and Valerian. Pyrethrum smoke kills after eight hours when sufficiently well concentrated, a condition hardly ever obtainable in a room. Recently Messrs Hooper & Co., 7 Pall Mall, London, have issued a preparation which they name Aromatic Pyrethrum. It is a liquid substance which according to the makers is capable, when sprinkled about a room, to keep mosquitoes and other insects at bay. Of the gases, sulphurous acid and sulphide of hydrogen gave the best results, the next best being ordinary coal gas and formaldehyde. The quantity of the substance used in each experiment and the cubic space of the chamber in which the experiment was carried out are not given. For practical purposes the importance of knowing these two factors cannot be over-estimated. Essential oils we may say are per se of no practical use in the destruction of the adult mosquito. We have no means of producing vapours of such oils in sufficiently concentrated form, and for a sufficiently long time to kill mosquitoes. These oils are also expensive when unsophisticated. Their prophylactic action, however is taken advantage of in the preparation of substances which when spread on the skin are said to protect that part from the bite of insects. Everybody who has lived in Africa knows how fond

the negro is of anointing his body with all sorts of oils and fats. Whether or not this widespread habit originated with the desire of protection against the bites of insects, I am not ready to assert. The apparent immunity of the adult negro to Malaria has been attributed by many to this habit; others have proved that very few of the fats used by negroes when tried experimentally in the laboratory afforded any protection, and in the case of those which gave positive results the protection only lasted for a very limited time. It is not a strong argument to advance that because the native cosmetics are of strong odour that their use is mainly a measure against the attack of insects, for we know that the negro delights in anything that possesses a strong odour. Their judgment of what is an agreeable odour or otherwise is probably different from ours. Dr Ferni⁽⁶⁹⁾ endeavoured to find a substance which would keep mosquitoes at a distance if sprinkled on the clothes or applied to the skin and the action of which lasted from 10 to 16 hours without having any harmful effects to the epidermis. For this purpose 400 substances were tried, including various animal and vegetable fats, all essences, the various vegetable infusions and powders, various waters, secretions, animal excretions and extracts. Only

(69) July 15th, 1904. Journal of Tropical Medicine. "Prophylaxis of Malaria", by Dr Antonio Mori.

a few of these substances kept mosquitoes away for one or two hours. That the habit of smearing the body with oily substances was much thought of formerly, is shown by the fact that a good many Europeans abroad used to practice it, as shown by the following extract from Mary Kingley's works ⁽⁷⁰⁾ -

"He does not mind them, that is mosquitoes - himself oh dear no! being a sort of savage he is totally indifferent to the impression he creates on the fair sex, so, if you please, he smears himself over with butter, which preserves him from the mosquito's impertinent sting." This habit which was apparently dropped by Europeans is being revived now. A circular published in English, Singalese and Tamil is being circulated ⁽⁷¹⁾ by the Ceylon Agricultural Society in Ceylon, drawing attention to the use of a composite oil for anointing the body to prevent mosquito bites. The circular bears the names of E. E. Green, F.E.S., and M. Kelway Bamber, F.C.S. The material suggested is composed of the following ingredients. Citronella, Kerosene, and Cocoanut oils with a certain proportion of carbolic acid. As an alternative for cocoanut oil, vaseline may be used but is more expensive. The resulting mixture is said to be a limpid liquid without any smell of kerosene or cocoanut oils but having the

(70) W. Sykes, M.D. etc. British Medical Journal, December 31st, 1904, page 1777.

(71) Journal of Tropical Medicine, September 15th, 1906, Page 283.

pleasant smell of citronella. It is also harmless to the skin. That agricultural society recommend all employers of labour in malarious countries to supply their coolies with a small quantity of this preparation to be used every evening at dusk. Quite lately a London firm⁽⁷²⁾ have taken to advertising a preparation (mentioned in the Journal of Tropical Medicine) which according to the makers "sets the fatal mosquito as well as flies, gnats and all flying insects at defiance. One application to the exposed parts affords protection for hours". I have not yet had occasion to experiment with the last two products and I cannot therefore vouch for their efficacy. It is only right to suppose that they have been found useful in keeping mosquitoes away and must be mentioned among our prophylactic agents. This method by enunciation would be invaluable to travellers, troops etc. having to pass one or several nights without any other protection from the attacks of insects. The habit of applying oily substances to the skin of the whole body has practically died out among the Arabs of Egypt, although I believe it still exists to some extent among the native women of the better classes, the idea of course being to preserve the skin in its pristine condition by means of massage which always accompanies such applications.

(72) The Antikito Syndicate Ltd., 6 Great Portland Street, London.

Smoke. Smoke of any kind tends to drive mosquitoes and other insects away. Unfortunately the amount of smoke that would be unpleasant to insects would also be injurious to the average European. In Northern India, owing to the faulty construction of the houses, it is said that during the winter the inhabited rooms are usually black with smoke, and that the natives seem to delight in a smoky atmosphere. It has been suggested that wherever natives are congregated the plan of smoking the rooms should be adopted.⁽⁷³⁾ Giles tells us that this was done in an Indian jail by Jennings.⁽⁷⁴⁾

"The smoke was pouring out of the windows in such large volumes that many people ran to witness what they thought was a fire. The fuel used was cow-dung, and a fire of this was kept up in each ward of the jail. The advantage claimed for cow-dung is that it can cause large volumes of smoke without sensibly elevating the temperature of the room." While admitting that a course of this kind may be feasible as a last resource in case of emergency I do not agree with those who advocate this measure as a permanent means of prophylaxis. It seems to me that the plan is against the principles of sanitation from more points than one. The air inhaled becomes

(73) Lieut. Col. G. M. Giles, I.M.S., Cold Weather Mosquito Notes from India. Journal of Tropical Medicine, 1904, page 123.

(74) Major Jennings I.M.S., Superintendent of the Central Jail, India.

markedly altered, being especially deficient in oxygen and rich in carbonic acid. The solid particles in the air are greatly increased in quantity and are bound to act injuriously in the long run. We must not forget also that this plan would only be suited to natives and that politically many people might rightly find fault with it. As far as possible any means of prophylaxis, especially if carried out by the government in any of their official capacities, must apply to both Europeans and natives. While this plan of protection is so open to criticism when it is to serve man, its application to the protection of the lower animals may be of great value. Quite recently Power investigating the cause and prevention of horse sickness in Zululand, obtained good results by "Smoking" the stables, thus driving away the Anopheles mosquitoes, which seemed to be instrumental in the propagation of the disease. Power, I believe, had not heard of Major Jennings' experiments when the idea of utilising smoke occurred to him. I cannot say that the Egyptian is very much used to smoke. The climate of Egypt makes fires for heating purposes unnecessary. The town Arab uses charcoal for cooking his food. This does not give rise to much smoke. The country Arabs, be they Fellahins or Bedouins, often cook their food outside their huts or tents. I have often seen small fires

of cow-dung burning of a night outside a Bedouin tent, but these, I was told by a native, were to keep the Evil Spirit away on certain nights of the year on which he was more likely to pay them a visit. The smoke of specific substances especially Pyrethrum, Chrysanthemum and Tobacco, has been used to destroy the adult mosquitoes as already stated. This plan is useful as a preliminary to other methods of protection. Before protecting a house by wire gauze in a place where mosquitoes are suspected to be hiding, it is important to make sure that no living mosquitoes are left within the house, as these would bite the people, and having no means of escape, would lay their eggs in domestic utensils and propagate rapidly if not noticed at once. Pyrethrum or Chrysanthemum in such cases is very useful. The former is strongly recommended by Major Gorgas as it causes no injury to fabrics and is rapid in its action. One pound is sufficient for a room of 1000 cubic feet. Professor Simpson in his book on Maintenance of Health in the Tropics (page 67) mentions powdered cineraria one tablespoonful of which should be mixed with nitre and burnt. The mosquitoes and any other insect are not always killed but often lie unconscious on the floor. The floor should, therefore, be carefully swept, particularly in dark corners, and the sweepings should be burnt.

Sulphur may also be used with advantage. If sufficiently concentrated it acts fatally, not only on insects, but also on micro-organisms. The killing of adult mosquitoes in small numbers has little, if any, effect on making the place less malarious, and, therefore, as suggested above, should invariably be accompanied by other methods of prophylaxis. It had been said⁽⁷⁵⁾ that certain flies, notably the dragon fly, are very fond of mosquitoes, and according to Capt. C. E. Williams, I.M.S., in some parts of the tropics these flies are kept in the rooms to reduce the number of mosquitoes. Before passing to the prevention of malaria by means of drugs, I would like to mention

C. Some accessory measures which every man should adopt in the tropics to prevent not only malaria, but all the other ills that flesh is heir to in hot climates. (a) Avoiding the heat of the sun during the hours when its power is greatest. I agree with Strachan when he says "One cannot but regret that young military officers are exposed during these hours (10 a.m. to 4 p.m.) on the very hot rifle range or at parade." In Egypt, British soldiers and their officers can be seen daily, about noon, in the height of summer, at the ranges of Sidi-Gaber in a burning sun. They lie there for

(75) p. O. Malabre, M.D., Paper read at the British Medical Association. Journal of Tropical Medicine, February 15th, 1904.

hours on sand so hot that natives themselves can hardly walk on it barefooted. It is not surprising therefore, that these men often have their health so undermined by what might be termed unnecessary exposure that they become an easy prey to disease. They often complain of attacks of fever, which may, as they seem to, predispose the subject to severe attacks when infected with Malaria or bring about a state of activity in the dormant malarial parasite when the patient is already infected. It seems to me that it is often necessary to bring before the commanding officers of our regiments abroad (who often act on matters concerning hygiene without consulting their medical officers) the fact that the amount of outdoor work should be influenced by the temperature in which such work is done. Marches, parades, range shooting, should all take place before ten o'clock in the morning, and after five in the afternoon. In a country like Egypt, especially lower Egypt, where there is such a marked contrast between the temperature of the early morning and that of mid-day, most of the soldiers' daily outdoor work should undoubtedly be accomplished before 8 a.m., and what is left over could be done between 5 and 7 p.m. The cool early morning breezes are highly appreciated in Egypt. It is the only time in

which, as experience has taught generations of Europeans, it is safe to take outdoor exercise during the summer months.

Cricket, foot-ball, golf, tennis, horse riding and other games and pass-times are indulged in daily as early as five o'clock, just at daybreak, by thousands of civilians. Why could not the example be followed by our military authorities. It has become evident, I think, that it is bad financial speculation to overwork our soldiers at any time, but when this takes place in tropical and subtropical regions, we soon begin to realise what a serious drain invaliding expenses are upon the country's exchequer. (b) Exposure to chills is extremely important in bringing about relapses of Malaria, and also in causing various other diseases. It sounds rather paradoxical to say that one is more liable to suffer from chill in a hot than in a temperate country. This is why Europeans abroad will not take even the precautions they would take at home. It is of the maximal importance to point out to new comers in a warm climate how necessary it is to guard against chill. A severe illness acquired through negligence is often the best lesson in tropical hygiene. It is common enough abroad to see people who have perspired a good deal, and whose clothes may be literally

soaked, exposing themselves to currents of air and "enjoying" the cooling effect of rapid evaporation. This is often followed by very serious results.

(c) The maxim of "Temperance in all things" is also one that should be particularly adhered to in the tropics. It is often diverged from in the case of drink and food. The dehydration of the tissues by the excessive removal of moisture through the respiratory channels in hot, dry climates, is undoubtedly the cause of much drinking. I do not refer here only to the use of alcoholic beverages. The amount of water which can be consumed daily by some Europeans and some natives, is nothing short of marvellous. Much of the fluid is lost by the means already mentioned, but the blood is, in spite of that, in a hydraemic condition, especially if the water drinker be living in a hot, moist climate and if he be of sedentary habits. These persons are usually much depressed, flabby, obese or extremely emaciated, and may suffer from diarrhoea for which no other cause may be found.

Whether or not a hydraemic condition of the blood is more favourable for the multiplication of the parasite has not yet been definitely decided, but some authorities, notably Dr Cadwallar, hold that it is in those who are in the habit of drinking large quantities of water, that malarial fever shows its

most pernicious forms,⁽⁷⁶⁾ and, therefore, recommend very free purgation as soon as the symptoms of the disease make themselves manifest.

Dr Cadwaller founds his opinion upon the following facts - (1) Persons who drink large quantities of water have the severest forms of malarial attacks. (2) Persons who consume large quantities of water melon (i.e. water) have fever most severely. (3) Malarial attacks are relieved by getting rid of excess of fluid in the system by the profuse sweating and increased urination that follow the rigor. (4) Cool weather by stopping sweating is the period of the year when malarial attacks mostly prevail. (5) All specifics for Malaria, such as quinine, arsenic (?) all sudorifics such as anti-pyrin, phenacetin and all purgatives, tend to the elimination of the excess of fluid from the body, this reducing hydroemia. Whether or not the malarial parasite can be transmitted to the alimentary canal with water as a vehicle is another point about which there is still some doubt. Major Fink thinks water to be the chief carrier of Malaria.⁽⁷⁷⁾ There seems to be some evidence that persons who are in the habit of boiling the water which they drink are less liable to Malaria.

(76) Journal of Tropical Medicine, October 15, 1904, p.332. A paper read before the Northern District California Society by Dr Cadwaller.

(77) Paper by Major G.H. Fink, I.M.S. (retired) at the meeting of the British Medical Association at Leicester 1905. Journal of Tropical Medicine August 15, 1905. p. 255.

The consumption of alcoholic beverages in excess in the tropics is undoubtedly one of the commonest causes of ill health among both civilians and the military. This subject as well as that of tropical diet, is treated fully in books on general hygiene in the tropics, and in the series of lectures by Professor Simpson published in the Journal of Tropical Medicine for the Year 1903. With regard to diet, I would like to mention only one fact, which has some bearings on my subject. It appears, from a leading medical paper, that in China, the natives eat large quantities of Garlic, the essential oil of which being discharged by the skin emits a peculiar pungent odour which helps to keep the mosquitoes away.⁽⁷⁸⁾ This fact also needs confirmation. The odour of garlic, however, is so nauseous to most people, that, were the prophylactic properties of garlic corroborated, very few people would not rather risk malaria than indulge in the highly obnoxious vegetable. In Egypt Europeans eat and drink as if they were living in their own country. On account of the heat they drink perhaps more. The native food consists of a large quantity of beans, which they have to every meal. This vegetable ~~being~~^{which is} rich in proteids and

(78) Journal of Tropical Medicine, July 1904.
A paper on Prophylaxis of Malaria, by Dr Antonio Mori.

carbo-hydrates is extremely nutritious and its cost moderate. Large quantities of raw onions are also used by natives, which may act in the same way as the garlic on the Chinese.

D. Prophylaxis by the Employment of Drugs.

The use of drugs as a prophylactic of malaria is by no means new in the Tropics. In the complex pharmacopoea of every African or Asiatic tribe, we find a stock of animal and vegetable juices or mineral compounds which have the reputation of preventing or curing attacks of fever.

Quinine and its preparations. Among Europeans abroad the drug which is rightly the antifebrile par excellence is Quinine. This alkaloid and its various salts derived from the Cinchona Bark, is too well known to require further description. The tonic and antifebrile properties of cinchona must have been known for centuries. The name of the drug has changed with the improved methods of preparation, and even now other derivatives and compounds of quinine are being created in order to arrive at a drug, which, while containing all the qualities of the alkaloid quinine is free from its disagreeable properties. As long ago as 1679 we find mentioned in Burnet's History of His own Times (Volume II) the following paragraph, "The King (i.e. Charles II) was taken ill at Windsor of an intermittent fever; the fits were so long and so

severe. that the physicians apprehended he was in danger . . . The fits did not return after the King took quinquina, called in England the "Jesuit's Powder!" The drug was known in South America and India long before the year mentioned above. The specific action of quinine in malaria was also known a long time ago, but the mode in which it acted was only ascertained subsequently to the discovery of the malarial parasite and therefore, comparatively recently.

Ross⁽⁷⁹⁾ holds that quinine is not a prophylactic in the true sense of the word, since it does not prevent the parasite from entering the circulation, but only kills the organism when it has entered the blood stream. This is a somewhat delicate point in definition, and one of no practical value. Every European going out to malarious districts in the tropics supplies himself usually with quinine, and yet a great number of them acquire the disease. This is to be explained in two ways, (1) Negligence or forgetfulness. (2) The taking of too small doses or of fair sized doses at too long intervals.

It is even now a doubtful point among authorities as to which is the best way of taking quinine

(79) Major Ross's paper on Malaria read at a meeting of the Colonial Institute Journal of Tropical Medicine, November 16th, 1903, page 387.

for prophylactic purposes; what salt to take and in what doses. Salts of quinine now in use are numerous, and some of them very popular. I will mention here, those which are in common daily use:-

1. Sulphate of Quinine.
2. Bisulphate " "
3. Hydrochloride of Quinine.
4. Bihydrochloride " "
5. Hydrochloro-sulphate of Quinine.
6. Hydrobromide " " "
7. Bihydrobromide " " "
8. Phosphate " " "
9. Arseniate " " "
10. Salicylate " " "
11. Valerianate " " "
12. Bichloride of quinine and urea.
13. Tannate of quinine.
14. Lactate " "
15. Euquinine or euchinine.
16. Salsol^ochinine.

Each one of these salts is said to have advantages over the others, yet we cannot say that any one of them when administered in large doses does not produce the symptoms of cinchonism or quinine poisoning. Marburg's tincture is a favourite prophylactic and curative mixture in India; it is

also known as *Tinctura Antiperiodica*. The ingredients of which it is composed are as follows:- Alcohol (57%), Quinine Sulphate 1 in 50, Socotrine Aloes 1 in 40, Opium 1 in 4,000, Rhubarb 1 in 125, Camphor 1 in 500, with angelica seed, elecampane, saffron, fennel, gentian, zedoary, cubeb, myrrh and white agaric as aromatics, (it is often prescribed to be made without aloes).⁽⁸⁰⁾ The form in which quinine is taken varies considerably; some people dissolve the powder and thus take it in solution, others take it suspended in various vehicles, some prefer the dry powder made into cachets, pills or compressed tablets. The best results are obtained when quinine is taken in solution, but the bitter taste of the drug is greatly objected to by many people. We must not overlook the fact that pills or compressed tablets, if not freshly prepared or if the excipient used be not easily acted upon by the gastric juices, are apt to pass through the intestinal canal in statu quo. Euquinine or euchinine is free from the bitter taste of other quinine salts.

This preparation is the ethyl carbonate of quinine and the makers claim also the following advantage for this drug, i.e., that the symptoms of

(80) W. Hale White, M.D., F.R.C.P., *Materia Medica*, etc. 7th Edition, 1902, page 451.

cinchonism occur but rarely and are in a mild degree when they do occur. Many authors among which Manson,⁽⁸¹⁾ Mori, Noorden, Panegrossi Conti, Plehen, Friedrich, Gray, Lewowicz, Levi, de Carlo, Sylvan and Andry⁽⁸²⁾ to name only a few, confirmed the value of euquinine and its advantages over ordinary quinine salts. These advantages are due according to Mori⁽⁸³⁾ to the ethyl radical which is a component of the euquinine molecule and this is supposed to neutralize, as it were, the effects of quinine.

Euquinine may be given in flakes (the natural commercial preparation) generally suspended in Syrup, milk or coffee, or it may be given in tablets.

Mori⁽⁸⁴⁾ obtained excellent results by administering daily doses of 25 centigrammes to persons below twelve years of age, and 500 centigrammes to persons above that age. The only disadvantage of euquinine is its price which is very high. When euquinine is not available and only some bitter salt of quinine is at hand, Manson recommends the following procedure⁽⁸⁵⁾ "Give the powder in a tablespoonful of milk after the patient has previously lubricated the mouth with a morsel of bread and butter. Given in

(81) Manson's Tropical Diseases 1903 Edition, p.157.

(82) " " " " " " " "

(83) Journal of Tropical Medicine 1904, p.215. Dr Antonio Mori on the Prophylaxis of Malaria.

(84) Paper by Dr Antonio Mori on the Prophylaxis of Malaria, Journal of Tropical Medicine, Feb.15, 04, p.215.

(85) Manson's Tropical Diseases 1903 Edition, p.157.

this way the bitter taste of the drug is not perceived. This is by far the best way of getting children to take quinine."

Others have found that the addition of 1 grain of tannic acid to every three grains of quinine with syrup of Tolu as a vehicle will sufficiently cover the bitterness of the quinine to make the drug quite acceptable to young and old.

When the ordinary sulphate is given dissolved in hydrobromic acid instead of diluted sulphuric acid, the buzzing in the ears attending the free use of the drug is greatly diminished. I have tried this and found it very satisfactory. I took fifteen grains of quinine in hydrobromic acid without experiencing any buzzing, but on taking five more grains the noise in the ears soon appeared. Under ordinary circumstances ten grains of quinine are sufficient, in my case, to cause the ringing in the ears.

Ergotin is also said to have the same action as Hydrobromic acid. ⁽⁸⁶⁾

Dr Cadwaller ⁽⁸⁷⁾ of New York recommends that quinine should be mixed with 1 grain of pulvis capsici and four grains of bromide of soda to allay

(86) W. Hale White, M.D., etc. *Materia Medica*, etc. 7th Edition, page 451.

(87) *Medical Record* September 14, 1904, New York.

unpleasant ear symptoms, Manson⁽⁸⁸⁾ says that if an ordinary salt of quinine is to be used the hydrochlorate should be given the preference as it contains the highest percentage of the alkaloid. Having decided on what preparation of quinine to use the new comer in a tropical country will ask his medical adviser or his friends what doses he should take and how often he should repeat them. In no other region of therapeutics is there greater difference of opinion. It can almost be said that every one in the tropics has his own way of taking quinine. Broadly speaking the Medical Profession, in this respect, divide themselves into two classes; one class urge the taking of small doses of quinine daily, this we may call the Italian School and is headed by Professor Celli,⁽⁸⁹⁾ the second class, the German School, follow Koch's⁽⁹⁰⁾ plan of prophylaxis and recommend the taking of large doses at intervals of a few days. Those who take quinine daily are pretty sure to avoid infection, although they are liable to take too small a dose. Persons who have taken 3 grains daily have fallen victims to the disease. According to some authorities cinchonism is more apt to prevail when quinine

(88) Sir Patrick Manson's Tropical Diseases, 1903 Edition, page 156.

(89) Atti della Societa per gli studi della Malaria 1904.

(90) Deutsche Medicinische Wochenschrift, 1899 - 1900.

is given at intervals of some days than when exhibited daily.⁽⁹¹⁾ Five to eight grains daily are recommended by Celli. Ross tells⁽⁹²⁾ us "Five grains of quinine daily is not sufficient to prevent fever entirely, and it is doubtful whether even ten grains daily would suffice . . . "

The disadvantage of the method of daily administration of quinine is the large amount of the drug taken (35 grains a week, almost four ounces a year). Very few people according to St. George Gray⁽⁹³⁾ can stand such large quantities of quinine without showing evidence of poisonous effects, but Dr Mori⁽⁹⁴⁾ says "I am of opinion that small doses (daily) are to be preferred (to large doses at intervals) not only because all symptoms of intolerance are completely avoided, but also as the daily administration introduces a quantity of quinine into the organism in which it circulates similarly as if a large quantity had been given in one dose as Mariani expresses it. This is due to the law regulating the elimination of the quinine salts according to the treatise by Kerner, Personne and others; of a certain quantity of quinine introduced

(91) Archiv fur Schiffs und Tropen Hygiene, VolX, No.2.

(92) Malarial Fever, its Cause, Prevention and Treatment by Ronald Ross, 1902, p.39.

(93) Notes on the method of taking quinine in the prophylaxis of Malaria by St. George Gray, M.B. B.Ch. Sierra Leone, British Medical Journal 1905 Vol.II, p.1289

(94) Prophylaxis of Malaria by Dr Antonio Mori, Journal of Tropical Medicine, July 15, 1904, page 215.

in the body, only part, between 10 and 30% will be excreted within 24 hours whilst the excretion of the balance takes place fairly slowly during the following days". It is hard to follow this argument without seeing that the person who is under daily quinine administration must be poisoned in a very short time if he perseveres. Supposing him to take his three grains daily (hardly a sufficient dose as I pointed out before) according to this law of elimination, at the end of a month, he will have such a tremendous quantity of quinine in his blood that we would, to say the least, expect him to go a whole month discharging this large quantity of accumulated material without running any risk of infection. This, however, does not seem to be the case, for, as already stated, these persons who do take three grains of quinine daily acquire malaria sometimes, and those persons who take five grains every second day also seem to take the disease occasionally.⁽⁹⁵⁾ In this question of quinine elimination we must, I think, conclude from clinical experience, that a larger quantity of quinine must pass by the bowel unchanged, than it is thought.

The amount of quinine eliminated in the first twenty four hours is never, I hold, a steady per-

(95) British Medical Journal 1905 Vol. II, p. 1289, Notes on the Method of taking Quinine in the prophylaxis of Malaria by Dr St. George Gray.

centage of the quinine in the organism but is a large percentage when large doses are taken and vice versa. The fact that people who take three grains daily or five grains every second day are still liable to take the disease after say a month of such treatment clearly proves, I think, that the amount of quinine which would kill the parasites in the blood (8 - 15 grains according to clinical evidence) is not present in the circulation at any given time.

The followers of Koch whose plan of prophylaxis consists in taking large doses at intervals claim that their method is more scientific. It is based on the fact that quinine acts more rapidly on the parasite at the moment of spore formation⁽⁹⁶⁾ i.e. when the "spores" are free in the liquor sanguinis than at any other stage of its life cycle. Now this occurs generally every 48 hours. Further, that fever occurs eight or ten days after the introduction of the parasites into the system if quinine be not taken. Suppose a man to have taken his 10 grains of quinine on Monday, by the Wednesday most of that quinine is eliminated, he is on that day infected with malaria and the parasites in the blood are not killed by the small quantity of quinine then present in the system. Next Monday he takes another dose of quinine (10 grains) and all the parasites are d

(96) Dr St. George Gray, British Medical Journal, 1905, Vol. II, p. 2006

destroyed in whatever stage of their cycle they may happen to be. Dr Gray from the above facts concludes that "if a full dose of quinine (10 or 15 grains) be taken on two successive days with an interval of 8 or 9 days before the next two consecutive doses are taken, the parasites will always be destroyed before they can cause fever."

Many advantages are claimed for this method.

Firstly, the quantity of quinine is in the long run much smaller. Roughly $1\frac{1}{2}$ oz. a year which contrasts markedly with the 4 oz. a year the result of 5 grain-daily doses. Secondly, there is a period of 8 to 9 days during which no drug is taken. This is a boon to persons easily affected by the drug who would not stand quinine were they to take it daily. Thirdly, the expense is reduced by about two thirds. Fourthly, being based on scientific principles, this plan is more likely to meet with public approval than any other. For some persons this method has a distinct drawback. While a man may remember to take his quinine every day, he may forget to take it regularly once or on two consecutive days exactly every 8 or 9 days. Dr Gray makes the following suggestion of the procedure he has himself adopted. "On my Calendar I mark certain days, namely, the 1st and 2nd, the 11th and 12th, and the 21st and 22nd of each month. When I see the date marked in this way I know that

it is my day for taking quinine, and after taking it I make an additional mark to indicate that this has been done. This additional mark is necessary as a reminder for those who have short memories, because they sometimes forget whether they have taken their quinine or not. The method of prophylaxis by quinine does not apply to private individuals only. Large communities of people of all classes may be protected by this means. Italy has given the lead in this method of prophylaxis as applied to towns and villages. Professor Protempski⁽⁹⁷⁾ of Rome, Chief Medical Officer of the Italian Red Cross Society gives us a brilliant record of the results he obtained by quinine prophylaxis in the Roman Campagna. He shows us that in 1900 no medicinal prophylaxis was used and the proportion of cases among the population was 31%. In 1901 when quinine was given prophylactically the proportion fell to 26%. In 1902 it was 20%. In 1903, 11% and in 1905 it came down to 5.1%. This is a remarkable result in a country like Italy and when dealing with such large masses of population. The persons supplied with quinine at the various dispensaries and from whom statistics were made up amounted to about 14,000. We must congratulate the Italian Government and Professor Protempski on

(97) British Medical Journal, p.753, (1906). Malaria in the Roman Campagna.

the immense success their efforts have been crowned with. The Italian peasants with few exceptions (which easily account for 5.1% of the population still, in 1905, afflicted with the disease) are realizing the benefits to be derived from following medical advice. Not only does the Italian Government at present supply quinine free to all the residents in malarious districts, but in 1903 they issued ordinances to the effect that all employers of labour in malarious regions more than 2 Kilometers distant from the residence of a doctor, or in a district where there is no pharmacy must, under penalty, always keep by them a quantity of quinine sulphate or hydrochlorate sufficient for the needs of all his employé's if attacked by malarial fever. With such good legislation and so much help generally from the State, it is not surprising that the Roman Campagna has flourished so much within recent years. In India also, the Government, by selling quinine at cost price, have come to the rescue of those afflicted with malaria or who are in danger of acquiring the disease. The drug can be obtained at any post-office throughout the country.⁽⁹⁸⁾ Another scheme of protection by quinine was tried in Italy in the town of Nona.⁽⁹⁹⁾ All the inhabitants were treated on the assumption that they had malaria.

(98) The Maintenance of Health in the Tropics by Professor Simpson, p.75.

(99) Rivista Medica 1903. Comm. 15, La profilassi della Malaria.

Each adult received 6 pills every morning of which he took 2 at 5 o'clock, 2 at 8 o'clock, 2 at 11 o'clock. Pregnant women took their pills regularly at longer intervals and did not seem to receive so much benefit as others. Children were also given pills, the number of which varied in proportion to their age. Each pill contained Bichlorate of quinine 0.1 gramme; Citrate of Iron 0.03 gramme; Arsenious Acid 0.001 gramme, and bitter extract 0.15 gramme. This treatment was prescribed for 15 days in every case. At the end of that time the cure was considered complete and the prophylactic treatment was begun which consisted in the administration of 2 pills a day to adults. Speaking roughly the results of the initial treatment were very good and the prophylactic course was extremely useful but not completely successful because it was not universally taken. Sceptical persons will be found in every multitude. If antivaccinationists exist in Great Britain it is not surprising that some people will refuse to take quinine in Italy. These people can quote cases where quinine failed. These cases unfortunately exist in the large amount of literature which exists concerning malaria. Among recent publications we find a paper by Fritz I. A. Beringer M.R.C.S. ⁽¹⁰⁰⁾ of the colonial service. He tells us he was in Hong Kong doing duty with

(100) 72nd Annual Meeting of the British Medical Association at Oxford. See British Medical Journal.

troops 1900-1902. Quinine sulphate 5 grains in solution, was given to European troops every morning at quinine parades, beginning in 1900, at the time when the malarial season usually commenced; later 10 grains per day on three consecutive days per week were given. During that year a greater percentage of cases than during previous years was noted. The general opinion was that the cases of fever were perhaps a little less severe. The results undoubtedly showed that in this case quinine had no effect on the actual number of cases and that the systematic taking of quinine did not act as a prophylactic. There is no explanation offered to account for such cases and this fact alone strengthens the case for the anti-quinine people. Many people moreover, labour under the impression that the systematic taking of quinine is the cause of certain ailments such as loss of memory, neuritis, dyspepsia, black-water fever. This idea is said to be to a certain extent fostered by some medical men in England occasionally attributing a West African ill health to the taking of too much quinine. We cannot deny, however, that some persons cannot take quinine or its preparations without suffering severe gastric and nervous symptoms. These people are not now very numerous, thanks to such preparations, as euquinine, which affect the nervous system only very slightly, and

Malaria in Foreigners' Hospitals

	1899		1890		1891		1892		1893		1904		1905	
	A	D	A	D	A	D	A	D	A	D	A	D	A	D
Cairo	3	-	7	-	2	-	1	-	1	-	4	-	1	-
Alexandria	175	1	131	1	194	-	191	-	172	-	182	2	190	-
Port Said	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Ismailia	-	-	-	-	50	-	78	-	5	-	13	1	3	-
<u>Suez</u>	-	-	-	-	19	-	25	-	16	-	11	1	5	-

A = Admitted
D = deaths

~~Halving~~

thanks also to the plan suggested by Dr Granjux.⁽¹⁰¹⁾

This eminent physician suggests that to obviate the gastric derangements caused by quinine, especially when its prolonged use is necessary as in prophylactic medication, it would be well to convey a soluble salt of the drug such as the hydrochlorate directly into the intestines.

This can be done by encasing the salt with gluten, which is not attacked by the acid gastric juice but is dissolved in the alkaline intestinal secretions. Moreover, these glutenised globules of hydrochlorate of quinine, not being influenced by heat or damp, are extremely well suited for tropical climates. The other synthetic preparations of quinine are Salochinin, Neochinin and Aristochinin. According to Muehlens,⁽¹⁰²⁾ Salochinin is a very poor substitute for quinine; although tasteless it is not well absorbed. In some cases where it was tried for effecting a cure, parasites were still found in the blood after large doses. The dose of this drug for curative purposes is given as 15 to 20 grains.⁽¹⁰³⁾ Neochinin is in every respect similar to the precedent preparation. Aristochinin is also tasteless. In ordinary 10

(101) Journal of Tropical Medicine, February 15th, 1905, page 63.

(102) Muehlens; (Dent. Med. Woche) August 27th, 03.

(103) Appendix to Squire's pocket companion, published by Messrs Squire & Son, 430 Oxford Street, London.

grain doses the effect on the parasites is nil. If taken in much larger doses or for a prolonged period it kills the parasite but at the same time causes all the uncomfortable symptoms of large doses of quinine. All these preparations have further the disadvantages of being of unstable composition, difficult to obtain and very expensive. For those who are not able to take quinine in its various preparations because of some idiosyncrasy, for pregnant women and infants who cannot take any large doses of the drug, many so called substitutes have been recommended. Many of them have been proved to be futile, but some have done good. Nursing women should be protected by quinine if exposed to infection. The child must then be hand fed as quinine is said to be excreted by the milk, and might cause some disturbances in the child. Infants under one year of age should not get any drugs⁽¹⁰⁶⁾ but they should be otherwise protected, as it is easy to do so in their case. Methylene Blue is after quinine the best known anti-malarial. It is an aniline crystalline derivative giving an intensely blue solution in water. Chemically it is the hydrochloride of Tetramethylthionine. According to Muehlens⁽¹⁰⁴⁾ and Moore⁽¹⁰⁵⁾ when used as a curative agent the drug made the fever disappear and removed

(104) Dent. Med. Woche, August 27th, 03.

(105) Journal of the American Medical Association, July 2nd 04.

(106) Archiv. für Schiffs und Tropen Hygiene. Vol VII

the parasites from the blood. Methylene Blue has certainly no advantages over quinine, except perhaps that pregnant women take it better. It is certain that no person who can tolerate quinine in any of its various forms should take up Methylene Blue. The action of this drug is very slow compared with quinine and the effects of the drug, although different from those of quinine, are generally speaking much more unpleasant. The fœces and the urine are coloured a deep blue, symptoms of cystitis may be set up with extreme discomfort on micturition. Nausea and headache may become extremely distressing. Methylene Blue has been used much more for curative than prophylactic purposes and it is more suited according to Moore for cases of hæmaturic and hæmoglobinuric fever on account of its diuretic action; also in cases of neuralgia and neuritis of malarial origin. When the drug is administered, the pure crystals should be given, and according to the same authority it should be combined with powdered nutmeg. Methylene Blue has not been much in vogue in our colonies but according to Manson^(106a) it enjoys a certain reputation in America and Germany.

Dr Mori⁽¹⁰⁷⁾ tells us "the therapeutic value of Methylene Blue was recently investigated by De Blasi in 100 cases of malarial infection and this

(106a) Sir Patrick Manson's Tropical Diseases 1902, page 166.

(107) Dr Mori. Prophylaxis of Malaria, Journal of Tropical Medicine, July 15th, 1904.

is the verdict which he pronounces:- It is my conviction that in many cases Methylene Blue cures malarial fever and also prevents relapses, but I am far from desiring to affirm this in an absolute manner. De Blasi also points out that Methylene Blue is not a tonic and is therefore, inferior to quinine, also in that respect." A very much similar compound, namely, Methylene Azure is said by Muehlens to have no effect whatever on the malarial parasite.

Thiocol. This drug is recommended by many authorities. Strachan⁽¹⁰⁸⁾ says "Thiocol has been advocated and I am inclined to think with some reason, but the number of cases in which I have used it apparently, with good effects is at present too small for me to have on it any useful opinion. I however, think it would be well if the drug were widely tested with a view to settling the question. It has the advantage of being easily taken and of not disturbing the well being of the taker". It can be given even in doses of 10 to 30 grains thrice daily as a powder. It is soluble in water and when given in solution it should be mixed with syrup of oranges. These two drugs (Methylene Blue and Thiocol) are the only two, apart from quinine and its synthetic compounds, from which anything like good and trustworthy results have been obtained.

(108) 72nd Annual Meeting of the British Medical Association at Oxford. Paper by Henry Strachan, C.M.G., P.M.O., of Lagos. B.M.J. September 17th, 1904.

Lately Dr George Tauret⁽¹⁰⁹⁾ has isolated two glucosides from the fresh root of Gentian, termed Gentiopicrine and Gentiomarine. Singly or in combination these drugs, the discoverer maintains, are useful in warding off attacks of malaria. Arsenic has for a long time been considered second to quinine as a specific for malaria. It was thought very much of not only for its curative but also for its prophylactic powers. It is said to have given excellent results in the hands of T. Crudeli and Ricchi⁽¹¹⁰⁾ in Italy, Downie in India, and Leslie in Africa. Ricchi's experiments at Bovino⁽¹¹¹⁾ in 1883 seemed to prove conclusively that this drug was a specific against malaria when administered in the form of arsenious acid. The drug has a tendency to produce gastro-intestinal irritation in hot climates. Recently, however, a good many observers have again tried arsenic, and with the exception of one or two, they came to the conclusion that arsenic alone is useless in the treatment of malaria or its prophylaxis, as it has no action on the parasite of the disease. Undoubtedly both arsenious acid and the cacodilate form of the metal when added to quinine, form an admirably tonic mixture (Celli). There is no doubt

(109) Bulletin générale de Thérapeutique, Nov. 23, 1905.

(110) Andrew Duncan M.D. Paper read at the 72nd meeting of the B.M. Association at Oxford, also paper by Antonio Mori on Prophylaxis of Malaria, Journal of Tropical Medicine, July, 15, 04, p.215.

(111) Lancet, December, 10th, 1892, p.206.

that the tonic effects of arsenic in non-malarial fevers must have misled many observers in the days when the microscope was not in such daily use as it is now. Manson says "the place of arsenic is not as a substitute for quinine but as a blood restorer after fever."

Other Remedies. A strong infusion of the "hairs that grow between the grain and the outer leaves of the mealie cob"⁽¹²⁴⁾ is said to have cured many cases of malaria. This is probably a native remedy which may do good in cases of some fevers of non-malarial origin. Anarcotine seems to have been extensively used in India by Sir Wm. Roberts, but the results are doubtful. Dr Duncan⁽¹¹²⁾ found that next to quinine, powdered pine bark was most successful as a prophylactic for malaria; this, however, has not been confirmed. Sulphur and hyposulphite of soda recommended by Dr Schmidt were tried by the same experimenter in the Mauritius Epidemic of 1866-67, but found to be of no use. Phenocol hydrochloride has according to Manson, been used with advantage in Italy, and is said to have succeeded in some instances in which quinine had failed. Tannic Acid also is said to have cured cases of malaria. Recently salicylate of soda, salicylic acid and salicin have been tried in West

(112) Paper read before the 72nd Annual Meeting of the British Medical Association at Oxford, September 1904, see B.M.J.

(124) Manson's Tropical Medicine under "Prophylaxis of Malaria."

Africa. They are said to have given some good results, but the effects of continued doses of these preparations closely resemble the effects of large doses of quinine. Their action is in no case comparable with that of quinine. Some of the other drugs which have been said at different times to be beneficial are the following:- Kola, Simaba, Gentian, Eucalyptus, Parthemum, Oilanthus, Chiretta, Iodine, Bromine, Enolgen, Carbolic Acid, Formalin, and Formaldehyde, Permanganate of Potash, Oxalate of Iron, Mercury. How far any of these drugs has any action on the malarial parasite it is difficult to say. Many of them can be easily discarded as being useless; others need more investigation. Beside the drugs which have been enumerated, every country in Africa, to mention only one continent, boasts of a pharmacopoea of its own, each drug of which has powers either pharmacological or belonging to the domain of supernatural magic. With the latter we are not at present concerned, but in the former group of drugs many there are which seem to have acquired, and justly so in many cases, a very high reputation in the therapeutics of tropical diseases. Walking through any Egyptian bazaar one will often come upon the native druggist or "Attar" seated cross-legged on his high platform and surrounded by a

perfect museum of drugs. Most of his merchandise is exhibited in large partitioned boxes, other more precious drugs are hidden away in remote recesses of his sanctum, wrapped up in pieces of rag or paper. Not one of these various substances is labelled. There, at the Attar's you may get "medical advice" and a "certain cure" for any trouble under the sun, for half a small piastre or about a halfpenny. According to Sandwith⁽¹¹³⁾ in the Ebers papyrus which is the oldest book on medicine existing, with the exception of the Kahûn papyrus, as many as 60 vegetable drugs are mentioned. "The Materia Medica of ancient Egypt" says Sandwith, "includes the following drugs still of daily use, sulphate of copper, nitrate of potash, castor oil, opium, gentian, mustard, aloes, linseed, squills, colchicum, hyoscyamus, magnesia, lime, soda, iron, and others. Castor oil has been grown in Egypt for about 4,000 years, and always employed as a favourite purgative, hair restorer for women and a sedative liniment for some skin diseases." We see therefore that Egypt has been a pioneer in the art of healing and we are not surprised, therefore, that apart from the well known cinchona they should have drugs many of which have been lately said to be beneficial in malaria.

(113) The Medical Diseases of Egypt by F. M. Sandwith, M.D. etc., Vol. I, page 3, (1905.)

Deaths from Malaria
Deathrate per 100 Deaths & per 1000 inhabitants

<u>Egyptians</u>	1886/90		1891/95		1896/1900		1901/905	
	% Deaths	% Inhab.	% Deaths	% Inhab.	% Deaths	% Inhab.	% Deaths	% Inhab.
Cairo	1.1	.5	.5	.2	.5	.2	.3	.09
Alexandria	3.3	1.3	1.4	.6	.6	.2	.1	.02
Suez	11.0	4.2	10.4	3.6	12.4	4.3	7.8	2.8
Ismailia	6.5	3.2	1.4	.9	.3	.4	2.9	.9

<u>Foreigners</u>	Total number & % of all Deaths								1896/ 900 Inhab.
	No. Deaths	% Deaths	No. Deaths	% Deaths	No. Deaths	% Deaths	No. Deaths	% Deaths	
Cairo	47	1.7	29	.8	33	.8	21	.5	.2
Alexandria	52	1.2	33	.4	47	1.0	12	.25	.2
Suez	9	3.2	15	3.8	21	5.9	9	2.4	1.0
Ismailia	(*) 16	9.5	10	4.4	5	2.3	8	4.3	.4

1886/90 1891/95 1896/1900 1901/905

(*) 1884/90

E.F.V.

Balfour⁽¹¹⁴⁾ who has made a special study of native drugs in Egypt and the Soudan, mentions among these a substance called "Arad" which is the local name for the pods of Albizzia Amara. This drug has been found lately to be a good emetic, and an astringent also beneficial in cough and malaria. Another drug of great renown, especially in higher Egypt and Soudan, but of which unfortunately very little is known is called "Abce-Akoe". This is said by the natives to be a marvellous remedy for malaria. Another drug of great fame, originally found in the Soudan only, but which has found its way even to lower Egypt is "Kassa". It is reputed to be extremely useful in black-water fever. Balfour, who has apparently studied this plant, asks whether this may not possibly be Cassia Bearcana of recent fame. Cinchona bark may be said to stand in the fore-ground of the native unwritten pharmacopoea as an antipyretic, but the unpleasant taste of its preparations is a great drawback to its universal adoption by the Egyptian, who is particularly sensitive in this respect. Drugs for the treatment of diseases other than malaria are too numerous to mention and are of no interest from the point of view of malarial prophylaxis. As regards the Europeans in Egypt it may be said

(114) Notes on the Tropical Diseases common in the Anglo-Egyptian Soudan etc. by Andrew Balfour, M.D. Chief Medical Officer, Wellcome's Research Laboratories, Khartoum.

generally that quinine is with them the drug largely resorted to. In malarious districts it is largely taken both as a preventive and curative agent. Its tonic effect is also highly appreciated by the general European population. Many preparations containing quinine are taken daily as an "apéritif" by thousands of Europeans, but it cannot be said that the custom has yet, in Egypt at any rate, made itself evident in the homes of the British. I have no doubt that the cinchona mixture (usually composed of the bark steeped in Madeira port or sherry) taken before meals would replace with great advantage to the consumer the whisky and soda of the British. It remains for me to discuss two more questions in connection with general prophylaxis of malaria, i.e. the question of separation of European from native dwellings, and education in matters concerning malaria.

E. Segregation.

Undoubtedly in those countries where malaria is abundant, segregation of the natives must prove most beneficial to the European settlers. It has already been pointed out what a large majority of native children suffer from malaria. These innocent carriers of the parasites must be a continued source of the disease, and, therefore, the further they are kept away from the new-comer into any

malarial region, the less, taking into account the limited power of mosquito migration, is the risk of our new-comer becoming infected. The Utopian condition and the one that should be aimed at in any new town in the tropics, is to establish the native quarters $\frac{1}{2}$ to 1 mile from the European houses and to have such native quarters on the lee side of the town (during prevailing winds), that is sheltered by and not sheltering the European quarters. While this is an ideal plan its application is extremely limited in practice. Even in the towns that enjoy a certain amount of segregation, there is bound to be a good deal of intermingling. As a town increases in importance and population the space separating Europeans from natives almost necessarily becomes smaller and smaller until it is abolished altogether. There is a natural tendency for Europeans and natives to inhabit different parts of the town, yet in most localities native dwellings are very close to, if not adjacent to, European houses. It is remarkable how, in countries that are only slightly malarious, the number of mosquitoes and consequently of cases of malaria in any one place is in direct proportion to the vicinity of that place to the native habitations. This is most beautifully brought out in the town of Alexandria in Egypt.

The centre of that city is totally, one may say, composed of European houses, and enjoys perfect immunity from mosquitoes. As we proceed to the borders of the city in every direction but one (south-east) we approach native dwellings and we enter at once into a zone where mosquitoes are to be found and where the mosquito net is always employed. This is natural when one thinks of the sanitary measures taken by the two classes of the population respectively. Apart from humanitarian and political reasons, segregation alone, as a method of prophylaxis, is to be avoided because it does not tend to diminish the amount of malarial poison in the locality. Even if segregation partial or total be present, the same measures must be adopted in the European and native quarters, and particular attention should be paid to the welfare of the native population; otherwise segregation alone would be as Ross⁽¹¹⁵⁾ says, "a selfish scheme which leaves the natives to their fate."

F. Education of the people in malarious districts in matters concerning the disease.

Apart from municipal sanitary measures in the distribution of quinine, this is perhaps the most

(115) Report on Malaria at Ismailia and Suez by Ronald Ross. Liverpool University Press, 1903, page 15.

satisfactory way of dealing with the disease among natives. Lectures should be given and pamphlets giving full details about how the disease is acquired and its prevention, should be distributed to those who can read. Specific and general hygiene should be incorporated in the curriculum of all schools in the tropics. Native teachers and sanitary officials should be required to have special education in hygiene, and it should be attended to that they themselves have special faith in modern hygienic methods. This was long ago pointed out by Manson.⁽¹¹⁶⁾ The foregoing recommendations have, according to Strachan,⁽¹¹⁷⁾ found application on the West Coast of Africa at Lagos, and he has reason to believe that such special education is having its desired effect. This method by education has been largely carried out in Italy, and, as might be expected in a European country, with very satisfying results. School teachers⁽¹¹⁸⁾ were given pamphlets on the subject, as most of them were themselves ignorant about malaria and now every school boy and school girl in the Roman Campagna has a very fair notion of the cause and prevention of malaria. The railway officials

(116) Meeting of Colonial Institute, November 11th 1903. Journal of Tropical Medicine, Nov. 16, 1903, page 357.

(117) 72nd Annual Meeting of the B.M.A. at Oxford. See B.M.J., September 17th, 1904.

(118) B.M.J., February, 25th 1905, Page 420.

also received special education on the subject. In Egypt under the present system of education the majority of the natives are absolutely ignorant of even the elements of person^{al} hygiene.

In the larger government schools the subject, I believe, has been recently introduced, but only an infinitesimal proportion of natives attend these schools. In the European schools, of all grades and nationalities, I am sorry to say, the subject is absolutely neglected, perhaps on the hypothesis that hygiene should be taught at home. I hold that hygiene should be part of a school's curriculum. Children of twelve to fifteen rejoice in anything that smacks of medicine and, as shown in several schools in this country, they take to it with avidity and become healthier men and women in consequence. To any one who has lived in Egypt for some time, and who compares the mode of living in that country with what takes place in most European countries, it will seem remarkable how small the death rate among Europeans is. One would expect much higher figures, considering the unsanitary habits of a class that should know better. The average European going to Egypt, be he British, French, German or of any other nationality, makes, as a rule, no difference whatever in his modus vivendi when he sets foot on Pharaoh's Land.

Each nation carries to Egypt her characteristic customs, some of which to put it mildly, are highly unsuited for a subtropical climate such as that country has. We do not wonder, therefore, that precautions against malaria are very seldom thought of until mosquitoes make themselves objectionable by their great number and their continual buzzing and stinging at night. Even now, that the brilliant results obtained in Ismailia are well known to the general European public in Egypt, very few, if any, would show so much scientific enthusiasm as to sprinkle a little paraffin over any pool of water near their house in order to reduce the number of winged insects which may be literally swarming indoors at night. They would rather change house than fall victims to any "new fanged scientific idea". It is a fact worthy of notice that of the few Europeans who show some interest in hygiene, the British form the majority. Often their want of knowledge in tropical hygiene is apparent, but it may be said generally, that with the exception of one or two inextricable home habits, the British can adapt themselves better than any other nation, to the conditions under which they live. Let us hope that very soon the Egyptian Government will awake from this state of lethargy into vigorous activity. Not only should they

take up this subject of education as the first step towards improving the present insanitary condition of the people, but other matters of great importance to the Public Health such as water supply, drainage, sewage works, etc. should cease to be a monetary speculation by private companies or individuals, and should rest wholly in the hands of a responsible municipality or directly in the hands of the Government. The question of public dispensaries in Egypt is also a matter that should be taken up at once by the Sanitary Authority. In Alexandria and the immediate neighbourhood where malaria is still prevalent and is perhaps on the increase, there is no reason why dispensaries should not be instituted providing free medical advice and drugs, on the Italian system. The average native in Egypt may be made to submit to treatment in his own home but resents strongly going to a Hospital. The few free dispensaries that exist in most towns in Egypt are connected with missionary societies and to them the poorer Europeans flock in such great numbers that the unfortunate natives are often totally disregarded. Like every other eastern country, Egypt suffers from the presence of a large number of quacks who work great havoc on the poor natives. I have no doubt that with improved sanitary legislation and

very moderate expense not only could malaria be entirely stamped out of Egypt, but many other diseases depending on the highly unsanitary conditions of certain localities, could be reduced.

Before concluding it remains for me to say a few words in connection with three special subjects.

(a) The antimalarial measures to be adopted by travellers in malarious regions.

(b) The prophylactic measures as they affect troops in time of peace and active service.

(c) The consideration of the relation of ships to malaria and the precautions to be taken on ship-board to protect passengers calling at infected ports.

(a) By travellers under this heading I mean all those who, for some reason or another, are journeying "up country". The necessity of choosing a proper site for camping need not be dwelt on; this should be at least half a mile from any native village. The difficulties met with consist in the means of protection from mosquito bites mainly during the hours between sunset and sunrise. In marshy districts, where mosquitoes are very abundant it is not uncommon, I believe, for them to make

Malaria

Governorates & Provinces ⁽¹⁾	1903		1904		1905	
	C	D	C	D	C	D
Cairo	4	71	4	39	3	34
Alexandria	312	8	198	3	199	6
Damietta	..	2	..	4	..	4
Port Said	58	1	5	4	6	9
Suez	103	43	129	68	95	35
Ismailia	6	1	13	2	3	7
Gharbia	..	1	116	27	7	4
Mansourah	..	10	1	6	1	3
Damanhour	..	7	8	4	16	6
Zagazig	38	11	4	38	2	19
Shibin-el-Kom	..	15	4	12	5	9
Guiza	..	11	..	3	..	3
Benha	1	1	3	1	4	2
Payoum	3	62	29	115	7	63
Beni Souef	3	10	..	1	2	1
Minia	12	4	5	34	3	29
Assiout	20	5	15	2	7	1
Sohag	-	-	-	1	-	1
Kena	2	5	2	3	1	1
Assouan	7	2	8	..
Total	562	268	546	369	369	237

(1) Hospitals included

C = cases

D = deaths

E

their attack in day time. It may be necessary, therefore, to protect oneself during the day by means of a veil, fixed on as already described in a previous chapter. Gloves and Gaiters or puttees should be worn. White clothes are less attractive to mosquitoes than dark clothes. No travelling should be undertaken after sunset. Strachan recommends the use of a large umbrella with bamboo frame, over which hangs a weighted mosquito net. The umbrella is large enough to admit a table and a chair under it. Protected in this way reading, writing or microscope work may be carried out for a considerable number of the cool hours of the day when one could not remain out in the open without running grave risks. The other apparatus which is of very great importance is the portable bed mosquito net, which, as already stated, should not hang too close to the mattress. All this apparatus and a good deal more is supplied by several firms in London. The articles are purposely made light so as to be easily carried. A spare supply of netting should be carried for effecting repairs. The traveller in malarious districts would do well to take quinine in the way he has most faith in.

(b) The necessity to protect troops, especially when on the move, is becoming daily more and more apparent. Dr Duncan⁽¹¹⁹⁾ in a paper read before⁽¹¹⁹⁾ British Medical Journal, Sept. 17, 04.

the British Medical Association at Oxford mentioned the fact that during the Ashanti expedition of 1896, one half of the troops employed were placed "hors de combat" by African remittent fever. He points out also that during the Spanish American war out of 13657 men in hospital at Cuba, 2.014 were cases of malaria, whilst in our Burma, China, Abyssinia, Sooshai, Duffla, Malay and Afghan wars, among others, malarial fever either headed the list of admissions or took the second place. Thus we see that the question of protecting our soldiers from attacks of malaria is of very great importance because although a very small number of the attacked are actually killed by the disease, the majority become incapable for active service and have to be invalided home or treated in hospital for a lengthy period; probably so long that they do not recover in time to join in the expedition. From a practical point of view these men become useless, and not only so but they are at the same time extremely expensive to the State, which has to supply them with everything through their illness and a tedious convalescence. One attack of malaria makes the subject liable to relapses and to blackwater fever on returning to a malarious climate, and this also the State must take into consideration. The Royal Army Medical Corps have of late instituted classes which are largely attended by officers and men of all regiments, where

questions of general sanitation are dealt with minutely. A short time ago I had the pleasure of attending one of these meetings in the Q.R.V.B.(R.S.) Drill Hall Class Room, Forrest Hill, Edinburgh. The subject of malaria was being treated by Major McNaught, R.A.M.C. The lime light illustrations were highly appreciated by the audience. I have no doubt the army authorities are beginning to look at matters from the right point of view. Organisation may do much, but it is of greater importance that every individual of a community be it civil or military, should thoroughly understand the reason for such organisation. One danger in the new system is the tendency to make the lecture too scientific and thereby boring, rather than interesting, the non-medical hearers who may not have been trained to concentrate their attention for any length of time on matters of such great public importance. The lecturer is too apt to drift into relating any experiments which bear on the subject under consideration, which experiments, although they may be of great scientific value, are to say the least, extremely immaterial to the lay mind. Every lecturer of this kind should keep in mind, that he is to make himself and his lecture interesting to an audience which can only assimilate a limited amount of knowledge at one sitting, and that the members of this audience are very prone to turn

the whole thing into ridicule or to fall into a state of comfortable lethargy of body and mind. I hold that these lectures, especially as far as regiments on foreign service are concerned, should be held in a Hospital, where the cause of the disease and the result may be shown side by side, thereby impressing the lay mind more deeply and relieving that feeling of scepticism apt to prevail from the mere reading of books or the badly assimilated lecture of a too scientific orator.

The protection of soldiers on the march from the attacks of mosquitoes can only be carried out to a very limited extent. Mosquito nets are out of the question. Fires may sometimes be kindled near the bivouacking places; the smoke thereby produced drives the mosquitoes away. The sleepers' faces, hands and feet should be covered, and men on sentry duty should be made to wear a veil, thick gloves and leggings during their watch at night. The camping ground should of course be dry; when the stay on any one site is to be prolonged not only is it necessary to have the surface of the ground dry, but the level of the ground water should be ascertained⁽¹²⁰⁾ for if this be high, the first rain will convert that site into a veritable swamp where

(120) Dr Davidson's Hygiene and Diseases of Warm Climates, 1893, p.204.

mosquitoes will breed galore. Beyond these limited and unsatisfactory means we must fall back on quinine. Quinine should be given in either of the two methods described under quinine prophylaxis. The cases in which quinine has failed to procure immunity are so rare that they have probably crept into the history of malaria through some error in the administration of the drug or in the diagnosis of the condition for which the drug was given. We must also remember that the choice of men is of great importance. Native troupes are the least affected. Young recruits are usually an early prey to the disease and persons who have suffered previous attacks, as already pointed out, are prone to relapses. The question of food and clothing comes under general military hygiene, but it may be well to mention here that tea and coffee are said to be beneficial in combating malaria, and Andrew Duncan⁽¹²¹⁾ recommends that these beverages should be supplied freely to the men. Koch advises us to boil all the drinking water. In the Niger campaign the only white officer who remained free from malaria boiled his drinking water. Sir Henry Stanley according to Dr Duncan was of the same opinion as Koch.

Fruit seems to do good probably because of the acid it contains. According to J. J. Kinyoun, Anopheles brought up on fruit could not be made to

(121) British Medical Journal, September 17, 04.

Malaria in Government Hospitals

	1889	1890	1891	1892	1893	Total	1894	1895	1896	1897	1898	Total
Mast-el. Bini	A	1										
	D											
	A	74	59	62	3	59	4	4	2			107
	D											
Alexandria	A	165	14	70	6	59	4	107	22	462	40	56
	D											
	A	39	54	2	64	3	113	8	63	14	338	149
	D											
Port - Said	A	50	5	39	2	75	21	108	23	90	57	318
	D											
	A											
	D											
<p>A = admitted D = deaths</p>												
	1899	1900	1901	1902	1903	Total	1904	1905				
Cairo (Infectious Hosp.)	A											
	D											
	A											
	D											
Mast-el. Aini	A											
	D											
	A											
	D											
Alexandria	A											
	D											
	A											
	D											
Suez	A											
	D											
	A											
	D											
Port - Said.	A											
	D											
	A											
	D											

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convey malaria. "This", he says, "may account for the absence of malaria in districts where mosquitoes are abundant." Tobacco seems to act favourably and its use, according to Sanderson, should be allowed freely. As to what is the best time for marching there seems to be some difference of opinion. The early morning naturally suggests itself in a warm country, as being the coolest part of the day. According to Duncan; Morache, Sanderson, as well as the late Professor Parker, say that marching should be undertaken in the afternoon, but Duncan points out that he has never seen any ill effects arising from marching in the early hours of the morning. On a very hot afternoon the practice should prove more fatiguing and Duncan tells us that then cases of sunstroke are liable to occur.

(c) Prophylactic means to be taken on Ship-board.

If there be a confirmed case of malaria on board, the patient should be isolated and protected by a mosquito net. A hunt should be organised at once and all the mosquitoes and larvae found on the ship destroyed. When at sea for some days, and mosquitoes increase in numbers, it is a sign that there are breeding places on board. These should be looked for and destroyed. It is by means of mosquitoes carried on ships that diseases such as malaria and Filariasis may spread long distances,

and reinfest a place which may newly have been rendered free of the insects and the disease. These facts were brought out a few years ago by Dr Andrew Balfour of Khartoum who studied the question on the Nile boats. He found that mosquitoes bred in every part of the ship where water was to be found, even down in the engine room. Water closet tanks are particularly patronized by all mosquitoes for breeding purposes. Ships calling at infected ports should be properly guarded against infection. Passengers, who intend to return to the ship, should not be allowed to land, especially at night. This can usually be arranged if the reason is given. Passengers embarking at infected ports should be given cabins free of mosquitoes, and such passengers should be supplied with mosquito nets. During the stay of a vessel at an infected port, all water tanks on board should be carefully protected against the entrance of insects, and to both crew and passengers, quinine should be administered. Mosquito nets to protect passengers and crew have been adopted by many shipping companies, notably the Booth Line, whose ships⁽¹²²⁾ go to Iquitos, Para and Manao. This has resulted in a wonderful decrease amounting almost to abolition, of the cases of malaria and yellow fever. Thus we see that no matter how limited the

(122) British Medical Journal, p.385, February 13, 04.

number of mosquitoes is in a locality, we must not disregard importation. This unfortunately we cannot very well prevent, and the only thing we can do is to give a very cold welcome to the newly arrived mosquito by previously destroying all the places where it can lay its eggs, and by destroying the eggs or larvae when and where they are discovered. Importation of mosquitoes is a serious consideration in Egypt. Apart from their geographical and telluric relations, sea ports in the tropics, and Alexandria in particular, will be under, the present régime, continually threatened with outbreaks of malaria, so long as within two miles from the centre of the city, in the docks, there may be grouped together hundreds of persons who have acquired malaria in other countries. These patients have the blood loaded with active parasites and the ships on which they are, harbour infected mosquitoes, which are ready to disseminate the disease broadcast. We may look forward to a time when vessels coming from malarious districts will have to be free from mosquitoes before they are allowed to enter a port. The protection of water tanks by wire gauze may also be regulated by adequate legislation.

While progress in some parts of Egypt (viz. Cairo and Ismailia) has been going on at a rapid pace, the conditions in the North have remained stationary for many years. The careful drawing up of

Total Number of Deaths and Deaths from Malaria

Suez

Year	Total	Malaria	% of all Deaths
1886	413	27	6.5
1887	423	62	14.7
1888	610	47	7.7
1889	448	47	10.5
1890	394	78	19.8
1891	2289	251	10.9
1892	454	38	8.4
1893	443	44	9.9
1894	432	53	12.3
1895	384	41	10.7
1896	574	97	16.9
1897	575	76	13.2
1898	408	33	8.1
1899	509	64	12.6
1900	597	59	9.9
1901	2603	323	12.4
1902	604	47	7.8
1903	477	39	8.2
1904	753	65	8.6
1905	638	35	5.5
1906	2977	233	7.8

Year	Total	Malaria	% of all Deaths
1886	413	50	12.1
1887	423	3	0.7
1888	610	79	12.9
1889	448	59	13.2
1890	394	45	11.4
1891	2289	283	12.4
1892	454	77	17.0
1893	443	49	11.0
1894	432	68	15.7
1895	384	87	22.7
1896	574	74	12.9
1897	575	74	12.9
1898	408	62	15.2
1899	509	60	11.8
1900	597	86	14.4
1901	2603	356	13.7
1902	604	73	12.1
1903	477	43	9.0
1904	753	70	9.3
1905	638	60	9.4
1906	2977	237	8.0

Year	Total	Malaria	% of all Deaths
1886	413	27	6.5
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1889	448	47	10.5
1890	394	78	19.8
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1892	454	38	8.4
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1894	432	53	12.3
1895	384	41	10.7
1896	574	97	16.9
1897	575	76	13.2
1898	408	33	8.1
1899	509	64	12.6
1900	597	59	9.9
1901	2603	323	12.4
1902	604	47	7.8
1903	477	39	8.2
1904	753	65	8.6
1905	638	35	5.5
1906	2977	233	7.8

Ismailia

Egyptians } Total Malaria 154
 Malaria % of all Deaths } 8
 Foreigners } Total Malaria 38
 Malaria % of all Deaths } 6

statistics in a country like Egypt is a matter of great difficulty. Typhus and relapsing fever, both still endemic in many districts, are sufficient to make the cause of death uncertain when examination of the blood is not made during life. Cases of supposed sunstroke may really be a pernicious form of the disease. Hospital statistics are perhaps the best in helping one to form an accurate idea of the amount of malaria in a locality, but hospitals in Egypt are not very numerous, except in large towns. Where they do exist the number of cases in them of any one disease is of course, out of proportion to the local conditions. The patients admitted into a hospital in Egypt are usually of the pauper class, of middle age, and are, for the most part, males. We are, therefore, restricted to a very small percentage of cases, and the case distribution is to say the least, extremely fallacious, if arrived at from hospital reports. Slight cases of fever, sometimes locally, called "date fever" are often "treated" at home; while severe cases, or cases of relapse with aggravated symptoms seek admission into hospitals. Thus our case mortality must be markedly affected.

I have indicated as I went along the several modes of prophylaxis used in Egypt, and I have also pointed out what measures might be taken to reduce the number of cases of malaria in that country.

I only wish to add that, now that the microscope is of such common use and that every medical man is trained to use it, we may look forward to better diagnosis and, therefore, statistics of greater accuracy. We must hope that some day an adequate number of dispensaries will be open, providing free advice and free quinine. Legislation aiming at the Notification and subsequent isolation of confirmed cases of malaria, would do much towards ridding the country of this terrible disease.

I am much indebted to Sir Horace Pinching of the Egyptian Sanitary Board, who has very kindly supplied me with the inserted statistical tables of great interest.

By a glance at the number of cases of malaria in each district a correct estimate of the area of palludinous ground may be obtained, as they bear a direct proportion to one another. These statistical tables are the first and the latest of the kind published in Egypt, and the responsible authorities deserve great credit for a work which must have been extremely laborious in a country where sanitary organisation is so deficient.