Historical Aspects of Malaria.¹

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MALARIA AS A DESTROYER.

DESPITE all the knowledge gained by able and devoted men, despite the application of that knowledge in certain places, despite heavy expenditure, malaria remains one of the great killing and crippling diseases of the world. Let us consider some of the ancient records and see what they have to tell us. First of all, however, it seems fitting, in the centenary year of Byron's death, to recall the last lines from his "Destruction of Sennacherib"—

And the might of the Gentile, unsmeared by the sword,
Hath melted like snow in the glance of the Lord.

It is of interest to note that Genovese, an Italian author who recently wrote an informative paper on "La malaria castrense"—that is to say, malaria in camps and incidentally in armies—is inclined to attribute the destruction of the Assyrian host to malaria. It is of course impossible to be certain, but Palestine, then as now, was an intensely malarious country, and it is conceivable that a severe outbreak of malaria decimated the Assyrian army. If so the poet unwittingly approached the truth when he wrote:

For the Angel of Death spread his wings on the blast—

though, as only the female mosquito attacks man, *her* wings would have been nearer the mark. The rapidity with which the destruction was accomplished as recorded in the Book of Kings is against malaria, but we need not take too *literally* the single night in which it is said that a hundred fourscore and five thousand perished.

Although it is impossible to speak with certainty, there is little doubt that ancient Egypt was heavily plagued by malaria. We know that it was a country full of great marshes, the remains of some of which persist to the present day, and the following passage from Deuteronomy has been cited as evidence of the existence of paludism: "The Lord shall smite thee with a consumption and with a fever and with an inflammation and *with an extreme burning* and with the sword and with blasting and with mildew; and they shall pursue thee until thou perish."

It is not, however, until we turn to ancient Greece that we obtain anything like a true picture of malaria and its ravages. In "Malaria and Greek History," which Mr. W. H. S. Jones, of Cambridge, inspired by Sir Ronald Ross, wrote and published in 1909, it is claimed that malaria was the cause of Grecian decadence. Mr. Jones speaks of the malaria blight which fell upon many fertile districts of Greece about the fifth century B.C. He quotes the Wasps of Aristophanes to show that malaria, the "nightmare" disease as it was called, had invaded Attica, and that fevers and agues throttled the sires and grandsires of the Athenian people. He cites the treatise of Hippocrates on Airs, Waters and Places as proof that the father of medicine was very familiar with the dire results of malaria cachexia, with that chronic malaria which even to-day is wellnigh as hard to cure as it is to endure. Those who drink the water of marshes, said Hippocrates, have

large spleens, but thin faces and shoulders. Again, after referring to the lowering of the birth-rate, owing to the physical condition of the women and the shortening of the span of life, he describes in a famous passage the people who dwell in low meadowy and hot districts, where the winds and waters are warm, as neither tall nor well-built, but short, fleshy, dark-haired, dark-coloured and bilious. They are neither courageous, nor of great powers of endurance. The stoutness to which reference is made is doubtless perplexing, for the malarial cachectic is usually emaciated, but it may imply that the sufferers were oedematous or in an unwholesome condition. There can be no doubt that in 400 B.C. large tracts of Greece were in a miserable state owing to malaria, while 200 years later the assertions of Polybius as regards the rapid depopulation of the country owing partly to emigration, partly to a heavy mortality, point, in some measure, to its malign influence.

In the olden days marshes surrounded Athens. The Stadium was a swamp, and armies fighting round the capital suffered enormous losses. It is recorded by Polyænus that Clearchus the tyrant, with the view of getting rid of a number of riotous and disaffected citizens, conscripted them to invest a town "in the dog days"—that is to say, in the summer—and made them encamp in a marshy plain "ill-ventilated and full of marshy pools," while he and his mercenaries occupied the surrounding hills. The effect was rapid and terrible, for the wretched men were wiped out by malaria. It is true that Dr. Cardamatis, of Athens, a well-known malariologist, does not agree with the conclusion reached by Mr. Jones, for he thinks the English author has overlooked the remarkable reclamation works carried out by the ancient Greeks, notably by the Minyans on Lake Kopais. He attributes the decay of the nation to other causes than malaria, but, be that as it may, the destructive agency of the mosquito-borne disease is well exemplified in ancient Greece, where towns were actually given names signifying "heavy sickness." Some of these names, such as Kounoupia, Konopina, and Kounopitsa, exist to-day.

There are some who would attribute the decline and fall of Rome to the evil influence of malaria, and certainly in olden days the environs of the imperial city were described by classic authors, such as Cicero and Livy, as "Pestilentia." Tacitus states that Gallic and Germanic troops suffered severely by camping in the insalubrious neighbourhood of the Vatican, where the lands were covered with stagnant water and the air was unwholesome. Even at the present day a suburb of Rome is called "The Vale of Hell," and three-quarters of its inhabitants are saturated with malaria.

Genovese, already quoted, refers again and again to the havoc wrought by malaria amongst armed hosts. Many large Carthaginian armies faded "like mists before the wind" because of it, and the losses amongst the Roman armies in the wars against Hannibal must have been incalculable.

It is Banister the American, however, who brings things nearer home, for he declares that Brennus would undoubtedly have taken the Capitol at Rome had he

¹ From a discourse delivered at the Royal Institution on Friday, May 23.

not, in A.D. 208, lost in "Caledonia stern and wild" 50,000 out of 80,000 men from malaria.

So much for Europe long ago. A single example may be culled from the tropics, from the fate which overtook the people who built the lost cities of Ceylon, those wonderful ruins in its north central areas. Lucius Nicholl, of Colombo, believes, with some reason, that their ruin was occasioned by malaria. He points out that the ancient cities really owed their existence to the field labourers, who, by constructing tanks and by rice cultivation, made the country prosperous and self-supporting. It is reasonable to assume that the stress of devitalising diseases would fall upon them, and as the climate and the rainfall have not altered, there is every probability that malaria was imported from India with dire results.

However interesting and suggestive these records and experiences from ancient times may be, they scarcely appeal so forcibly as those from later periods. Take the extermination in the Roman Campagna in 1167 of the finest army ever commanded by Frederick Barbarossa. So rapid and awful was the destruction that the writers of the time have represented the disease as a "black cloud which covered all the valley near the Monte Mario, where the army was situated, and poisoned the air." A heavy rain had fallen in August and converted the place into a boundless swamp; then followed an enervating spell of hot weather, and an irresistible invasion of the wretched troops by fever. "Obscure soldiers, nobles and illustrious prelates laid down their lives there," says Genovese. The flower of a nation was exterminated, while in the same outbreak Rome lost some 20,000 inhabitants. Throughout the Middle Ages there were many deadly epidemics of the disease, like that of 1557-58 in England.

Let us fare to the tropics once again, and see how malaria wrecked high hopes and a well-found expedition when the ill-fated Scottish Darien scheme came to nought. The settlers landed on a pestiferous spot of land in 1698 and speedily came to grief, mainly, if not wholly, by reason of disease. There can be little doubt that malaria was the chief malady which overcame them, though yellow fever may possibly have been operative. At any rate, the "Memoirs" of the Rev. Francis Borland, who was one of the chaplains to the second portion of the expedition, leave one in no doubt that mosquito-borne fevers wrecked the enterprise. Two hundred years later a similar want of skill, due chiefly to lack of knowledge, occasioned, not far from Darien, a similar melancholy tragedy when the French failed in their great endeavour at Panama. It must be remembered that, though yellow fever proved their main adversary, malaria wrought much havoc in their ranks. It was left to the Americans, the heirs to learning gained partly by others, partly by themselves, to triumph over malign local conditions.

I have spoken of camps and armies, but navies have also felt the weight of malaria; the British Navy has suffered from it time and again. Perhaps the most dolorous account of its ravages is to be found in the records of the forgotten Batavian endemic, as it was called, which occurred in June 1800, when we were fighting the Dutch in Java. The ships concerned were the *Centurion* and the *Daedalus*—historic names. Seamen, marines, and soldiers alike suffered. The place of

tragedy was the small island of Edam, nine miles offshore from the low swampy grounds of Batavia, and the remarks of Shields, the naval surgeon who is the chronicler of the disaster, are highly suggestive. He speaks first of Onrust, a small island only three miles from the main, well cleared of trees, underwood and jungle, nearly flat and free from swamps and marshes. Speaking of the sick brought here from the ships blockading Batavia, he says:

"From the foetid exhalations, which were conveyed by the land winds from the neighbourhood of Batavia, the sick were easily secured, by closing certain apertures in their apartments, till the sun dispersed the vapours in the morning; after which there did not appear to be any danger from the miasmata disengaged during the day. Edam, on the other hand, though farther out of the reach of Batavian exhalations, is covered with trees, long grass, and jungle, having a part of the island itself in a stagnant, marshy state. The buildings here were indifferent, and only one long ward could be found for the sick and convalescents; in consequence of which the latter class of patients experienced all those dire effects produced by the depressing passions, forever nurtured by the melancholy scenes of death, which this fatal spot too constantly presented to their view! Thus, in running from a doubtful danger, they precipitated themselves on certain destruction. In leaving Onrust (a cleared space) to avoid the effluvium of Batavia, weakened and diluted by a three miles passage from its source, they settled on the jungly and marshy island of Edam, where pestilent miasmata, in a concentrated form, issued from every foot of ground around them! The fatal effects which followed were predicted by an intelligent surgeon on the spot, but his suggestions were disregarded or overruled; distance from the main being held paramount to all other considerations."

I might trace the deadliness of malaria from the Walcheren expedition, which it ruined, to the Crimea, where it played havoc, and on to Macedonia where it, more than any other single factor, rendered the Allied Forces in the War comparatively impotent. I might tell you of great epidemics in India, of its strangling hold on the West Coast of Africa, of how the Indians in Mexico suffer and die from it; of the appalling conditions at present existing in Southern Russia; but I prefer to take one great classical example of its powers for evil within recent times—its invasion of Mauritius. It is unnecessary to consider the rights or wrongs of the story generally believed—to wit, that in the late 'sixties of last century, African malaria-carrying mosquitoes were introduced from a sailing ship, multiplied exceedingly, found infected blood already present in the bodies of Indians from India or Creoles from Africa, and commenced spreading the parasite, and incidentally the disease. I would rather give one or two passages from a book on Mauritius by Nicholas Pike, who was American Consul at Port Louis in 1867-1868, and was an eye-witness of the scenes.

"Those who inhabited Port Louis," he says, "during the terrible mortality in 1867 and 1868 will never forget the sad spectacles the city presented daily. Fever! Fever! was the only word on every lip—the only thought in every heart. Mourning and desolation everywhere. Scarcely a person visible that did not wear the garb of woe. Song and laughter had ceased.

"Port Louis was once remarkable for the number

of pianos heard in every street in an evening, from the Erard's grand and semi-grand to the humblest cottage instrument.

"At this time it was literally 'The daughters of music were brought low and the voice of mourning was heard in the streets.' Funeral trains were met at every corner. Relays of men were kept busy night and day digging the graves."

I have seen these graves, mute witnesses to the severity of the outbreak, to the dire results of ignorance. For months an average of 200 people died per day in Port Louis, and scenes such as Pike describes were common.

Think of what all this means, and what the discovery of the malaria parasite, and of the method of infection by the mosquito, has meant, and how much more it would mean if only men and governments would act energetically and enthusiastically upon the knowledge gained. When Mauritius passed through its furnace of affliction, and 31,920 persons perished, Laveran was a student at Strasbourg and Ross a schoolboy at Ryde.

We have dealt with malaria as a destroyer *en masse*, but before looking at the reverse side of the medal and noting how it has benefited mankind, let us see what it has done in the way of removing notable persons in the historical sense, some of whom at least were valuable assets either to the communities they served or to the world at large. Naturally enough it is difficult to obtain trustworthy records from the far past. In those days the word fever covered, if not a multitude of sins, a great variety of febrile disorders, and it is only in a few cases that definite clinical evidence is forthcoming which enables us to say that so-and-so undoubtedly perished from malaria. Even in comparatively recent times accurate diagnosis was difficult, for malaria is a very protean disease, and cannot be definitely predicated without the use of the microscope. Hence my examples are scanty and some are doubtful.

Alexander the Great conquered the world, but there is some reason to believe that malaria conquered him, aided by his excesses and his disregard of precautions. Vasco da Gama voyaged half round the globe, but he voyaged to another, and it is to be hoped a better, land at the bidding of the malarial plasmodium—at least so it has been said. Anyhow he died of fever at Cochín, and his fatal illness was probably malarial in origin. "The wisest fool in Christendom" was undoubtedly killed by malaria. He died of ague at Theobalds. One of his predecessor's stoutest, but not too reputable servants, the bold Sir John Hawkins, had his end hastened by, if indeed it was not actually due to, the same disorder. Oliver Cromwell also, who died of ague at Whitehall, yielded his life to the insidious attack of the malarial parasite. Whether Byron was a victim of the disease when he died in his beloved Greece is a moot point. Sir Ronald Ross is inclined to think malaria was not guilty in this instance.

Careful research might add other names to this brief list. One would expect that of the great explorers in the tropics some were wiped out by malaria, but I have not been able to find indubitable evidence in the case of the greatest of them.

MALARIA AS A BENEFACITOR.

Until very recently it would not have been possible to adduce evidence showing any *direct* benefit to man

from the disease malaria, but a surprising development took place a few years ago when Prof. Wagner-Jauregg, of Vienna, began to treat cases of general paralysis of the insane—the dreaded G.P.I.—by introducing into the blood of patients the organism causing malaria, thereby producing in these patients attacks of malarial fever. He had noticed, as had others, the beneficial effects of febrile attacks in cases of general paralysis, and conceived the idea of inducing high temperature repeated at short intervals. It occurred to him that this is what the malaria parasite accomplishes in its victims, and that it might be used as a curative agent. Although patients were treated on these lines so early as 1917, nothing was published on the subject until 1920; but the remarkable results obtained in certain instances, and the fact that, in most cases, distinct benefit resulted, led to extensive trials of the new treatment on the Continent, and later to its employment in Great Britain.

Ere now one malady has been used to combat another, but never before has a serious disease been utilised in therapeutics which, once its good work is accomplished, can be effectively and speedily controlled. This is possible in the case of malaria, thanks to quinine, which, so far as its introduction into Europe is concerned, we owe to a woman, the Countess of Chinchon. We are able also to select one of the three forms of malaria which is the least dangerous, but naturally care must be taken that this use of the malaria parasite as a drug does not result in its dissemination by mosquitoes from those treated by it. In Great Britain there is little danger of such an accident, but in Germany serious attention has been directed to it.

The method, promising though it be, is still in its infancy. It is possible that it may be applicable to other diseases of the central nervous system, at least those due like G.P.I. to a specific spirochæte; but great care must be exercised, and this new therapy should be in the hands of experts familiar with the malarial plasmodium, and able also to gauge its effects. Those effects, it may be said, are not exercised on the other parasite, the spirochæte, nor does the high temperature affect this invader. The action appears to be on the damaged tissues of the brain itself; but the precise mechanism is still obscure. If, however, malaria proves itself able to cope with locomotor ataxia, with disseminated sclerosis, and with paralysis agitans, then indeed it will be hailed as a benefactor, and be considered as having in some small degree made amends for its past atrocities.

Indirectly malaria has undoubtedly aided the human race. Mr. Jones ingeniously argues that it was responsible for the increased respect shown for women in the later days of ancient Greece, and cites the New Comedy (320–250 B.C.) as proof thereof. He considers that the value of women as nurses was made apparent by it, and that, as the wife was usually the nurse, endemic malaria vastly increased her duties and importance.

The chief indirect beneficial action of malaria is to be found, however, in the way it has stimulated men to thought and action. From the earliest days mankind was forced to exercise ingenuity in protecting themselves from fever. Egyptian and Cretan fishermen slept under fishing-nets folded again and again until their meshes were small. They believed they were

excluding miasmata, but they were really keeping mosquitoes at bay. Yet so little is history regarded, perhaps because Herodotus wrote of this habit of Egyptian fishermen as a mere curiosity, that we find Prof. Traill in 1837 stating that the proposal to defend the body against marsh miasma by the interposition of gauze nets was first made by Rigaud de l'Isle in 1817, and recording that Brocchi had taken up the same idea, and averred that he had successfully employed it against malaria.

Malaria inclined men from very early days to attribute the infection of fevers to mosquitoes or other biting insects. Susruta, an Indian physician who probably flourished in the fifth century B.C., taught this truth, and there is a picture of him expounding it to an Eastern potentate.

Varro and Columella at the time of the Christian era associated mosquitoes with insects bred in marshes; but perhaps the most remarkable announcement was that of Lancisi, who, in 1717, stated that marshes were the cause of the fever owing to the transformation of minute worms into "stridulous culices," and that the poisoned animals kill, not by the wounds which they inflict, but by infusing a poisoned liquid through the wounds. The Abbé de Fortis, writing of his "Voyage in Dalmatia" in 1774, refers to his meeting with an ecclesiastic who suspected that fevers were due to insects, the infection being derived from corpses or poisonous plants, and who thought that miasmas might be conveyed in this manner. The conjecture, says the Abbé, is at least ingenious.

So it went on with such protagonists as Nott the American, Beauperthuy the famous French Creole, Finlay of Havana, and King, the soundest of them all, reasoning and arguing in favour of the hypothesis and none paying much attention to them. Yet malaria had taught benighted barbarians the lesson and they had accepted it. Richard Burton in his "First Footsteps in East Africa," published in 1856, states that the people of Zayla in Somaliland believed that mosquito bites occasion deadly fevers, and says that the superstition (save the mark!) probably arose from the fact that mosquitoes and fevers became formidable about the same time.

But malaria led also to closer and more scientific reasoning. The ancestors of the malaria parasite were probably coccidia, tiny protozoa inhabiting the cells lining the wall of the intestine. Some of these, naturally enough perhaps, got a little discontented with their surroundings, changed their habit of life, and eventually found a more congenial habitat in the red blood corpuscles. Now Richard Pfeiffer, a trained observer, had been studying the coccidia of rabbits in 1889-90. He noticed that these parasites not only multiplied within their host, the rabbit, but, in a special resistant form, provided for their transference to another rabbit once they had got outside the body of their original host. He recognised that the multiplication of the coccidia in the epithelial cells of rabbits and that of the malaria parasite in the red blood cells of man was a very similar destructive process, and thought that possibly the malaria parasite, like the coccidium, might have two cycles of development. If so it would have to get outside man's body. Provided it did not produce any resistant form to enable it to withstand

the dangers it would encounter in the wide, wide world, say in soil or water (and such a form was unknown), he considered that it might make use of some insect in which, sheltered and comfortable, it could undergo the second, or as it is called exogenous, cycle of its development. It could then, as Koch had suggested to him, get back to man through the bite of some blood-sucking insect.

This, as events have shown, was a prophetic utterance, but it was linked up with the earlier work of the great Sir Patrick Manson, who, long before, working in Amoy, far from books and skilled help, had proved that a mosquito served as the intermediate host of a human blood parasite, that tiny filarial worm, to the presence of which in the human body the disease elephantiasis is attributable. He showed that the mosquito was a necessary link for the fulfilment of the life-cycle of the bloodworm. This was a new conception in pathology of which both Koch and Pfeiffer were aware. Still this does not detract from the merit of Pfeiffer's carefully reasoned hypothesis. Neither he nor Koch, however, followed up the matter. The solution of the problem was left to Ross, who, at Manson's instigation, took up the work in India, and after manifold trials and tribulations emerged victorious. Certain Italian observers also contributed notably to our knowledge, and Ross himself, not content with mere scientific work, at once turned it to practical account.

Malaria, then, benefited man by stimulating him to undertake work for its own destruction, surely rather an altruistic action, and not unlike that of the medical profession itself. This stimulation has had other and far-reaching results, for, more or less as a direct outcome of the discoveries regarding malaria transmission and prevention, attention was directed to all kinds of protozoal and allied diseases. The American work on yellow fever was, in fact, the sequel to the researches of Ross, and an immense stimulus was given to the scientific study of tropical medicine and hygiene. One of the latest developments has been the application of electricity for the purpose of destroying mosquito larvæ and pupæ. Montellano, of Argentina, introduced the method of electrocution which is now being given an extensive trial.

Not only did malaria excite inquiry and interest, but education of the public was also found needful, and propaganda were launched broadcast. Man's ingenuity was stimulated afresh, for it was by no means easy to explain to lay audiences the intricate life-history of the malaria parasite; and further, his enthusiasm was aroused in an endeavour to present the problems of preventive work in an attractive and effective manner. Here it is that the Americans have forged ahead. Malaria is a very serious problem throughout the Southern United States, and indeed has been the reason why some of them have, until lately, been backward and depressed. The Americans are a practical people, and moreover are easily fired by that idealism which, if well regulated, so often spells success. Hence they have spared neither time nor money in combating malaria and bringing before the public by cinematographic films and other educational means the mysteries of the life-cycle of one of man's greatest foes, the measures taken to defeat it, and the results of a campaign well and truly waged.