REPORT ON A SERIES OF EIGHT HUNDRED AND THIRTY-THREE MEDICAL PYREXIAS OCCURRING IN THE SIERRA LEONE GARRISON DURING THE PERIOD OCTOBER 4, 1912, TO OCTOBER 4, 1913, WITH REMARKS ON THE BEARING OF THESE DISEASES ON THE HEALTH OF THE TROOPS.

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MALARIA.

Of a total of 833 medical cases of pyrexia investigated among the garrison of Sierra Leone during the period October 4, 1912, to October 4, 1913, 623, or roughly three-quarters, were proved microscopically to have been malarial in origin. These figures are sufficient to show the overwhelming preponderance of this disease on the West Coast of Africa, and are supported by a collateral investigation carried out among the civil population, where the percentage of sick native children suffering from malaria was higher still—80 per cent—and by a malarial census of apparently healthy native children, carried out by Major A. H. Morris, R.A.M.C., in 1906, which showed about two-thirds of them to harbour malarial parasites in their blood.

The type of parasite found in the 623 cases of malaria was the subtertian in all instances but seven. The absence, practically speaking, of quartan and benign tertian affections in these adult cases is curious, inasmuch as the proportion of these parasites found in the blood of 100 sick native children suffering from malaria amounted to as much as twenty per cent of the total. It is not difficult to understand why the adult African soldier should be free from quartan and benign tertian malarial infection, as it may be assumed that immunity is more readily acquired against these less virulent types of parasites. The similar freedom of the West Indian soldier from such malarial infections may be due to an immunity acquired in Jamaica. I do not see, however, why the European soldier practically never suffers from quartan or benign tertian malaria, for he can have no such immunity, unless, owing to segregation, the source of his malaria is the adult native and

1 Extract from an Annual Report.
It is possible that the subtertian parasite of West Africa is somewhat different from that found in Asia for the following reasons:

(1) The gamete ("crescent") forms are more rarely found than in other countries. Out of 176 cases of malaria one of my predecessors found only six cases in which crescents were present in the blood, although they were specially looked for. In the series of cases under review the proportion is still smaller, but no special search was made for these sexual forms. In the blood of 100 malarial children, crescents were found in five of the cases.

(2) The great difficulty occasionally met with in finding parasites in malarial cases. This difficulty is comprehensible when the immune West African is in question, but in a West Indian or European soldier it is also often encountered, and the parasite is only found after hours or even days of searching, though no quinine may have been taken and periodicity be allowed for. I have had similar difficulty with subtertian malaria in South Africa, but cannot remember such cases in India. This difficulty of demonstrating the parasite may account for some of the cases in the group labelled "probable malaria," though it has to be admitted that in the majority of these cases only one blood examination was carried out. It may also account for some of the cases in the "gastro-intestinal" group, and in the "?" group, where some of the clinical symptoms pointed to malaria, but no parasites could be found.

(3) The third reason for supposing that in West Africa we may be dealing with a different "race" of subtertian parasite is its amenability to quinine. There is a general consensus of opinion, I believe, among medical men on the Coast, that the subtertian type there yields more readily to quinine than the Indian and other subtertian malarias.

It is comparatively easy to distinguish between the temperature charts of (a) the West African soldier, (b) the West Indian soldier, and (c) the European soldier. The febrile curve differs in each of the three cases. In the West African, as a rule, the fever is very short, lasting but one or two days, its briefness being, of course, due to his immunity. The West Indian, on the other hand, reacts to malaria by showing high temperatures, accompanied usually by marked remissions and intermissions. He appears to suffer more severely from malaria than the European

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1 The table to which these remarks refer is not reproduced.
soldier. This is curious, because one would expect a certain degree of immunity in these men, most of whom, having already served a previous term on the coast, must have suffered from malaria. Perhaps ankylostoma infection, which is almost universal among these men, renders them less resistant to malaria. Relapses of malarial fever are frequent among the West Indian soldiers, but unusual in the cases of European troops.

_Bilious Remittent Fever of Malarial Origin._—Jaundice, unless looked for, may easily be missed in West Africans and West Indians, owing to the condition of chronic conjunctivitis and pterygium from which they suffer, but I am inclined to believe that malarial bilious remittent fever is uncommon among the troops. I have personally seen only some half a dozen cases where jaundice (slight in all cases but one) was present. Bilious vomiting is more frequently seen. The one case of malaria with marked jaundice died. In this case, which occurred in an alcoholic, besides a very heavy malarial infection, a large fatty and cirrhosed liver was found. The case was peculiarly instructive, firstly because the clinical features simulated those of yellow fever, and secondly it is probable that the heavy mortality caused by malaria in earlier years at Sierra Leone, when the troops were not as temperate as they are now, was due to similar conditions, i.e., malarial infection occurring in men whose resistance had been greatly lowered by cirrhosis of the liver due to alcohol.

_Incidence of Malaria._—Taking one year with another, the percentage of malarial attacks is at least five times as great amongst the European troops living on the Signal Hill, Murray Town Battery, as amongst those at Tower Hill.

In the year 1913 the figures were approximately:

<table>
<thead>
<tr>
<th>Station</th>
<th>Period</th>
<th>Average strength</th>
<th>Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tower Hill</td>
<td>January to September, 1913</td>
<td>158</td>
<td>43</td>
</tr>
<tr>
<td>Signal Hill,</td>
<td></td>
<td>23</td>
<td>46</td>
</tr>
<tr>
<td>Murray Town</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

This probably much understates the true proportion in favour of Signal Hill, Murray Town Battery.

**Blackwater Fever.**

This term probably covers a group of pathological conditions which might with advantage be differentiated, and the term “blackwater fever” limited to the cases which are not obviously haemoglobinuria due to drugs such as quinine, or to the severe blood
destruction in intense malarial infections. Among the seven cases of hæmoglobinuria I came across during the last twelve months, one was a native child, probably a case of malarial hæmoglobinuria. The malarial infection in this case was intense, the blood destruction very great, and the hæmoglobinuria transitory. Of the cases, four in number, among the troops, one might also, I think, be considered malarial hæmoglobinuria, for here, too, the infection was a heavy one and the hæmoglobinuria transient. In two others the hæmoglobinuria was due to drugs. In the first case, that of a West Indian serjeant’s son suffering from malaria, it followed soon after the administration of a strong dose of camphor and gin. The hæmoglobinuria was very transitory, and the urine strongly aromatic in odour. In the second case, the blackwater condition was closely associated with the taking of quinine, appearing soon after its exhibition on two separate occasions. When quinine had been taken, and the hæmoglobinuria had developed, no malaria parasites were found in this man’s blood, but the patient had suffered from a very severe subtertian infection only a month before. In the fourth case there was a very slight transient hæmoglobinuria in a patient who had suffered frequently from malaria, and in whose blood subtertian parasites had been found only two days before. A fifth case of hæmoglobinuria amongst the troops occurred in a time-expired man who, in Sierra Leone three months before, had suffered from only one attack of fever, which was diagnosed pyrexia of uncertain origin as no malaria parasites could be detected. Before embarkation this man was detained a day in hospital with fever, but there is no record of a blood examination having been made, and he was in hospital on board ship from embarkation onwards.

I found what I considered to be “cell inclusions” in one of the series of the seven blackwater cases.

Trypanosomiasis.

Two cases of this disease have been found among the troops, both occurring in soldiers of the West African Regiment. One case was detected in December, 1912, and the second in June, 1913. After the discovery of the first case some 300 or more blood smears and eleven gland punctures from West African soldiers were examined, with only one positive result, that of the case found in June, 1913. In a search conducted in Freetown and the Protectorate by Major H. W. Grattan, R.A.M.C., when specialist sanitary
officer in 1905, eighteen cases altogether were found; two of these were amongst the troops. Several of the cases were followed up in subsequent years, and some developed "sleeping sickness" and died.

Though "sleeping sickness" was known in Sierra Leone as long ago as 1803, and on the Guinea Coast in 1721, yet it never appears to have been of a severely epidemic character on the West Coast of Africa. The disease, however, when carried by Stanley's Congolese soldiers to Central and East Africa, appears to have set up the severe and fatal form of sleeping sickness now devastating Uganda and some portions of East Africa. There is no reason to suppose that the *T. gambiense* (the type found in Sierra Leone) is not a virulent type of the trypanosome family, as people attacked by it appear finally to succumb, and its pathogenicity to animals is fairly high. There is apparently no reason why the disease should not spread, as *Glossina palpalis*, the selected transmitter of the disease, is present in many parts of the colony, and even close to Freetown. The fact that the disease does not spread may be due to: (1) The immunity of the local population, who have had the disease among them for centuries; (2) the possibility that, after all, the trypanosomiasis found to be present at Sierra Leone is not entirely due to *T. gambiense*; (3) the fact that game, the natural reservoir of trypanosomes, is comparatively scarce in that colony. With regard to the first point, we know that where a disease is endemic it remains so as long as fresh and non-immune human material does not invade its area; but both West Indians and Europeans must frequently have been bitten by *G. palpalis* on Wilberforce Ridge and Aberdeen, yet not one case of trypanosomiasis of local origin is known to have occurred amongst them. With regard to point (2), the discovery in 1910 of a new strain of trypanosome, *T. rhodesiense*, more virulent than *T. gambiense*, and more recently of *T. nigeriense* (?) in 1913, a trypanosome described as morphologically distinct, of low virulence both to men and animals, and causing a mild form of trypanosomiasis in Southern Nigeria, suggests the possibility of the local trypanosome being of yet a different strain. With regard to point (3), it must be remembered, however, that recent research has established *T. gambiense* to be a human, rather than an animal, trypanosome. If then, the trypanosomiasis occurring in Sierra Leone is entirely due to *T. gambiense* the absence of game would have no material bearing on the question of the absence of epidemic sleeping sickness in the Colony.
Leishmaniases.

No cases of infection by Leishmania have been found amongst the troops. In two native civilian cases I have found what may have been Leishman-Donovan bodies in large mononuclear blood cells; but as only one body was found in each case nothing further can be said about them, except that in both these patients, the spleens were greatly enlarged and leucopenia was present.

A number of dogs were examined for the presence of Leishmania infantum, but with negative results. Large spleens are not infrequent in native children, as might be expected in a malarious country. Enlarged livers are less frequently found.

In one case of Dr. Butler’s, a child with pyrexia and enlarged liver and spleen, we discovered in the liver juice curious bodies superficially resembling Koch’s granules of East Coast fever. In a second case, similar to this clinically, I found one or two similar bodies in two slides of liver juice examined. The nature of these bodies, which were submitted to Sir W. Leishman, is undetermined.

Pappataci Fever, Dengue, Three-Day Fever, and Seven-Day Fever.

There have been some seventy cases of undiagnosed fever, in which no malaria parasites have been found in the blood. Some of these cases have been so incompletely investigated, from a clinical and bacteriological standpoint, that they cannot be satisfactorily discussed. The majority of the remaining cases were, I think, on clinical and bacteriological grounds, cases of malaria in which the parasites had been missed, either owing to a single blood examination only having been made, or to the great scarcity of parasites, a condition which one often notices in subtertian malarial infection on the West Coast. There remain other cases in which the most complete search on successive days failed to reveal malaria parasites, and some of these cases may have belonged to the group of diseases mentioned above.

The sporadic rather than epidemic nature of these cases, and the absence of rashes, conjunctival injection, and joint affections, appear to negative pappataci fever or dengue in epidemic form; but some of the cases may have been of the nature of sporadic dengue, or seven-day fever, if these are clinical entities. Amongst the group of undiagnosed cases have been several with definite gastro-intestinal symptoms. I would prefer to defer any opinion on this group of cases until I have had more time to study them.

Though simulids and cheironomids abound in Sierra Leone, I have never met with or heard of the Phlebotomus papatassii.
Report on a Series of Medical Pyrexias

YELLOW FEVER.

This disease appears in such protean forms in mild cases that it seems impossible to say that it has not been met with and remained unrecognized. The only case with clinical features at all resembling yellow fever was the one already mentioned in whose blood and organs large numbers of subtertian parasites were found. This was considered to be a case of bilious remittent malaria, with cerebral symptoms and complicated with cirrhosis of the liver.

TYPHOID AND PARATYPOID FEVERS.

There has been one case of typhoid fever in which the typhoid bacillus was isolated from the urine, and marked agglutination reactions against Bacillus typhosus were obtained. As the patient was a sailor on a German cruiser, it is not certain that the case was contracted on the Coast. There have been two cases among West African soldiers with typhoid symptoms. Blood cultures were made in both cases, but as the culture flasks had to be carried along a rough road for a long distance and were much shaken up, pure cultures were not obtained in either case. From both cases Gram-negative, motile organisms, giving rise to the production of acid in lactose, and acid and gas in glucose, maltose, and sucrose, were obtained. The micro-organism isolated from the first case did not agglutinate with the patient's serum, and the one from the second case only to the extent of a one-twentieth dilution in one hour. I am convinced, notwithstanding these results, that typhoid fever will be proved to exist amongst the West African natives, though probably to a less extent than found amongst the natives in India.

AGCHYLOSTOMIASIS.

The ova of these worms have been found in twenty-eight cases of pyrexia during the year, and in nearly all (twenty-one) of these cases agchylostomiasis was the only discoverable cause of the pyrexia. In others the fever was partly accounted for by malaria. Twenty-one of the cases were among the West Indian troops and seven among the West Africans. One of my predecessors found that 56 per cent of the men of the West India Regiment admitted to hospital were harbouring agchylostomes. No cases of agchylostoma infection have been found among European troops.
It is now generally considered that much of the agchylostoma fever is due to a secondary infection by intestinal bacteria acting on an intestine injured by these hook-worms. This does not, however, alter the serious nature of the original infection. The type of fever met with in the West Indian is usually the prolonged intermittent. Thymol treatment has not been successful.

**The Bearing of these Notes on the Health of the Troops, with some Sanitary Recommendations.**

*Mount Aureol and the Health of the West Indian Troops.*—Nine out of ten cases of medical pyrexia at Mount Aureol are due to malaria, the attacks are typical clinically, and in practically every case the parasites are demonstrable: the tenth case will, as a rule, be one of agchylostoma fever.

The agchylostoma question may be briefly dismissed. The West Indian soldier brings the disease with him from Jamaica. Half of the regiment is probably affected. Most of the cases are slight and do not interfere seriously with the men's work—in peace. Treatment seems almost hopeless, and the severe cases are better invalided out of the service.

Malarial fever is the only fever of moment to Mount Aureol and the West Indian soldier. Situated as the barracks are on a steep wind-swept spur, and a half to one mile from the nearest native huts, Mount Aureol should show the lowest sick-rate from this disease amongst the garrison. As a fact, however, the West Indian soldier suffers from malaria more than even the European. The reasons for this are, I think, as follows:—

1. The anopheles mosquito, *Myzomyia funesta*, is present in the neighbouring Kortright water catchment area.
2. The West Indian soldier seems to spend a great many of his evenings and nights in Freetown.
3. The windy and colder climate of Mount Aureol seems to set up chills in these men who are unsuited to it. The arrival at dawn on the hill after a sweaty march up the steep rise from the town is very likely to cause such a chill and a malarial relapse.
4. The reinfections and relapses maintain the human reservoir and enable the anopheles continually to disseminate the infection.

*What are the Remedies?*—It would be extremely difficult, if not impossible, to deal with the first condition. There are a few *Myzomyia funesta* breeding in the brook, but more frequently in inaccessible tree and rock holes in the dense bush forest that
protects the Kortright water catchment area and the water supply of Tower Hill. These conditions cannot be materially altered without great expense, and without endangering the pure water supply of the European soldiers. We are thus left to deal with the second, the human factor, in the spread of malaria at Mount Aureol.

I believe that a great diminution in the disease in the West Indian soldier could be brought about by dealing with the human factor. The question of allowing the men into Freetown at night, with the danger of infection while there and relapse due to chill while returning, and the question of the more careful use of mosquito nets, rests with the regimental authorities. The prevention of malaria carriers and a more prolonged treatment with quinine concern the medical officers on the hill.

_Tower Hill and the European Troops._—Tower Hill remains now as ever anopheles-free and the healthiest of the three cantonments; moreover, what chance there might be of infection from the mosquitoes in the town round the base of the hill is steadily diminishing yearly owing to more energetic sanitary methods. The high percentage of malarial fevers amongst white troops is largely due to infections contracted on the Wilberforce Ridge (Signal Hill, Murray Town Battery, and Murray Town Point). The dangers to health of garrisoning this mosquito and tsetse-fly infected ridge is so great that I believe the European malaria rate would be nearly halved if these outposts were garrisoned by West African soldiers during the unhealthy months of the year. The system of admitting all European soldiers suffering from malaria to hospital, and keeping them there for long periods, first as in-patients, and later as out-patients, under quinine, is responsible, I think, for the fact that relapses amongst them are comparatively rare.

_Wilberforce Cantonments and the West African Regiment._—Wherever he might be the West African soldier would not suffer much from malaria, and the malarial admissions from these troops are low, as might be expected. European officers and non-commissioned officers are protected from the native lines by a wide clearing. This is, of course, a necessity, knowing as we do that probably two-thirds of the children there are reservoirs of infection and that anophelines are more readily found in Wilberforce than in any of the other cantonments.

The wind-swept ridge on which the officers’ lines are built appears to protect them fairly well from malaria.