

A NOTE ON BLACKWATER FEVER IN SIERRA LEONE.¹

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DURING the year 1905, ten cases of blackwater fever occurred amongst the garrison of Sierra Leone. The strength of the troops was as follows: 238 Europeans, 2,048 West Indians and natives of West Africa. All the cases occurred amongst the men of the 2nd West India Regiment, who were in their third year of West African service. They arrived from Jamaica in 1902.

Their previous history showed that all had had attacks of malaria. The medical history sheets of six out of ten showed entries for malarial fever while serving in Jamaica, besides admissions for malaria in Sierra Leone. In eight out of ten, quinine had been administered previous to the onset of blackwater. I do not propose to give a clinical description of these cases, but will say a few words about two of them. The first was that of Private Mathews, which was the most severe case which recovered. His medical history sheet showed eight previous admissions for malarial fever. The onset of the disease was explosive in character. Ten grains of quinine were given in the morning, and hæmoglobinuria came on at 2 p.m. The following day he was restless and was vomiting incessantly. The conjunctivæ were jaundiced. In the evening the jaundice was more marked. He lay with his eyes half closed and was very drowsy. The vomiting still continued and he had had no sleep the previous night. His condition was worse on the third day. On the fourth day he was *in extremis*. The red cell count was 1,470,000 and the hæmoglobin 30 per cent. Twenty-four hours later, the pulse could only be felt every second beat at the wrist, and the vomiting had not ceased. Bile pigment was present in the urine for the first time. On the eighth day the red cells were 1,107,000 per c.mm., the hæmoglobin 25 per cent., and the leucocytes 13,800. The blood was examined daily for thirteen days; no malarial parasites were seen. No examination of the blood had been made previous to the onset of hæmoglobinuria. Convalescence was very prolonged. On the thirty-seventh day the red cells were 3,250,000 and the hæmoglobin 63 per cent. The patient recovered and was discharged to duty after being in hospital

¹ Read before the Pathological Society of London, March 19th, 1907, when blood films showing malarial parasites from some of the cases were shown.

over three months. I will now pass on to a brief description of a case that ended fatally.

Private Willock was admitted to hospital with blackwater fever on September 15th. There was no evidence that he had taken any quinine for ten days previous to the onset of hæmoglobinuria. He had been on furlough in a Creole village near Sierra Leone. He had fever for four days before admission, and he treated himself with what he called "bush tea," which is a native diaphoretic medicine prepared from a local plant. He died from suppression of urine on the eleventh day. The following amount of urine was passed every twenty-four hours. On the first day, 6 ozs.; the second day, *nil*; the third day, *nil*, three drams only were withdrawn by catheter. On the fourth day, 6 ozs., then 3, 3, $2\frac{1}{2}$, $2\frac{1}{2}$, 7 and 10 ozs. respectively every twenty-four hours up to the tenth day. A blood count on the sixth day showed 1,800,000 red cells, 20 per cent. of hæmoglobin and 12,000 leucocytes. The differential count gave 71.5 polynuclears, 24 per cent. lymphocytes, 4.5 large mononuclears and no eosinophiles.

Malarial parasites were present in the peripheral blood of (36 per cent.) four out of eleven cases. Unfortunately no examinations of the blood were made before the onset of blackwater. In one patient the parasite was present on the second and third day, and reappeared on the ninth and tenth days. I also found a malarial parasite in the blood of a European civilian who died from blackwater.

The parasites were usually very few in number and difficult to find. Young forms only were seen, without any pigment. I never found any sexually-mature parasites, and crescents were never seen. Blood taken by spleen and liver puncture during life was negative. I counted the red cells fifteen times and estimated the hæmoglobin with Gowers' apparatus on fourteen occasions. I have shown that the destruction of red cells and loss of hæmoglobin is very marked in a severe case. The blood regeneration takes place fairly rapidly in a comparatively mild case. For example, Private Lovell's blood count on the fifth day gave 3,700,000 reds, with 70 per cent. of hæmoglobin, and on the twenty-third day the reds had risen to 4,990,000, with 96 per cent. of hæmoglobin.

In two fatal cases the hæmoglobin fell to 20 and 28 per cent. respectively. The colour index was usually low, ranging from 0.9 to 0.7. This, however, was not invariable; in one case the index varied from 1 to 1.5. The ratio between the percentage of hæmoglobin and red cells does not necessarily represent the true corpus-

cular richness, as the hæmoglobin which has left the red cell, but is still present in the serum, is taken into account. Normoblasts were present in scanty numbers in two patients. Shadow corpuscles, irregular forms and microcytes are common, while megalocytes were noted during convalescence. An absolute polynuclear leucocytosis occurs with the onset of hæmoglobinuria, and later on if suppression of urine threatens. 13,800 leucocytes per c.mm. was the highest count noted; this with 84 per cent. of polynuclears gives 11,592 polynuclears per cubic millimetre. Eosinophilia was present in some cases, but was explained by the presence of the ova of the *Ankylostomum duodenale* in the stools.

The duration of hæmoglobinuria varied from thirteen to ninety-six hours, the average being about thirty hours.

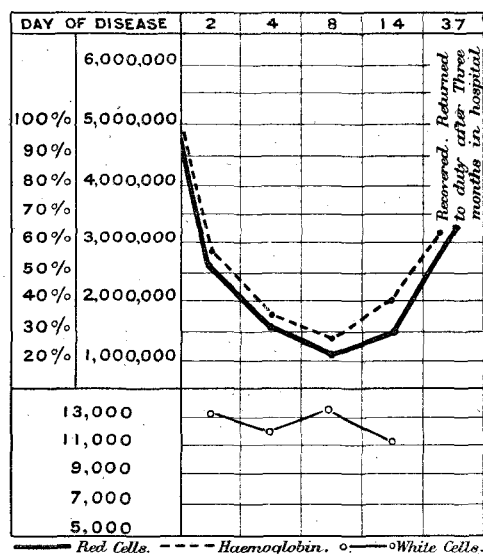
Albuminuria usually persists for some days after the hæmoglobinuria has ceased. In some cases the albuminuria ceases very abruptly; for example: $\frac{1}{4}$ albumen on the second day, a trace on the third, with *nil* on the fourth and subsequent days. In another instance, $\frac{1}{6}$ on the second day, $\frac{1}{20}$ the third day, with none on the fourth and following days.

Ova of the *Ankylostomum duodenale* were present in the stools of 50 per cent. of the cases. I at first thought that there was some connection between the presence of the ankylostomum and the occurrence of blackwater. The geographical distribution of malignant malaria and ankylostomiasis on the one hand, corresponds closely with the distribution of blackwater fever. I found that about 25 per cent. of the non-commissioned officers and men of the West India Regiment harboured ankylostomes.

I will now pass on to the *post-mortem* appearances of the case of Private Willock. The examination was commenced two hours after death. Body well nourished. *Rigor mortis* marked. *Liver*.—Weight 51 ozs., engorged with blood, substance firm. *Gall bladder* distended with bile. *Spleen*.—Weight $7\frac{1}{2}$ ozs., substance of a peculiar mauve colour. *Mesenteric glands*.—Very numerous and enlarged. The largest glands were in the vicinity of the upper part of the jejunum. *Stomach* contained 4 ozs. of bile-stained fluid, walls coated with mucus. Mucous membrane congested, several punctiform hæmorrhages noticed. Small intestine contained no fæcal matter. The walls were covered with thick tenacious mucus. The mucous membrane of the duodenum was congested, and the congestion was more marked in the upper portion of the jejunum. The external surface of the intestine was normal. The cæcum was congested, but the rest of the large intestine was

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normal. No entozoa found. *Kidneys* weighed $11\frac{1}{2}$ and $11\frac{1}{4}$ ozs. respectively. Capsule stripped easily; surface covered with punctiform hæmorrhages; pyramids acutely congested; the organ was full of blood. *Bladder* contained 3 ozs. of clear urine. *Lungs* collapsed, weighed $8\frac{1}{2}$ and $7\frac{1}{2}$ ozs. Right lung adherent to diaphragm, left lung adherent to chest wall. *Heart* weighed $11\frac{1}{2}$ ozs., substance firm; left ventricle contained three clots which showed signs of commencing organisation. The other cavities contained clots. All the valves were normal. Slight roughening of the aorta $\frac{1}{2}$ an inch above the valves. *Brain and membranes*



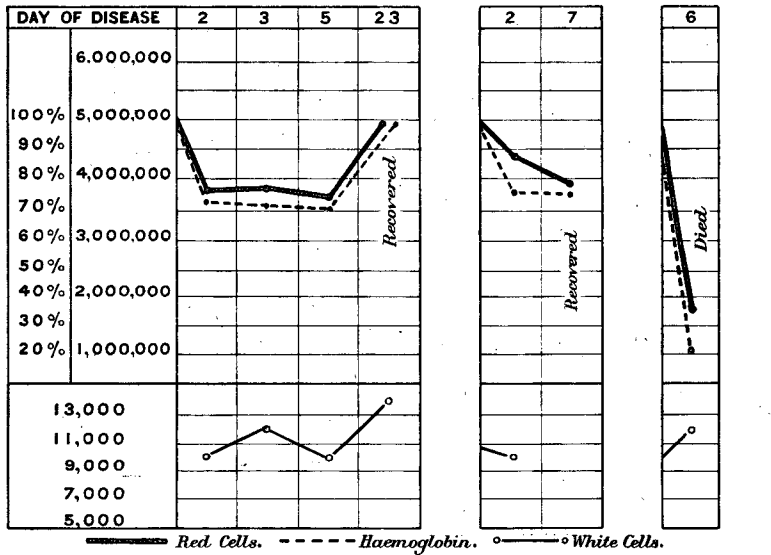
Pte. Mathews.

appeared normal. The *bone marrow* in the shaft of the humerus was of a lemon-yellow colour. Smears from the brain, liver and spleen showed no malarial parasites or pigment; a diminution in the number of nucleated red cells was noted in smears from the bone marrow. Sections of the kidney showed an intertubular round cell infiltration, with cloudy swelling of the cells lining the tubules. Many of the tubules were blocked with broken-down granular material. No malarial pigment was seen.

Unfortunately, the bottles containing the tissues got broken when going through the customs at Plymouth, so I was unable to make any further examination.

Blood taken during life was injected into the peritoneum of guinea-pigs with a negative result. *Post-mortem* material, such as emulsions of spleen, liver and mesenteric glands, were injected into the peritoneum of monkeys and guinea-pigs, without throwing any further light on the nature of the disease.

A small Gram-negative bacillus was isolated from the urine in one case. After twenty-four hours on agar at 37° C. no growth could be seen; after forty-eight hours a delicate growth was visible which resembled that of a *Streptococcus*. A monkey received a large intraperitoneal dose with apparently little discomfort.



Pte. Lovell.

Pte. Cleghorne. Pte. Willock.

No bacteriological examinations of the blood were made.

As regards the theory that the disease is due to quinine intoxication: blackwater fever is rare in the Army in India in comparison with Tropical Africa, yet quinine is a drug that is in daily use in both countries. During six years in India and Burma I never saw a case of blackwater fever or suppression of urine. It is conceivable that hæmoglobinuria might be overlooked, but suppression of urine could hardly occur unnoticed.

In conclusion, the evidence points to the disease being of malarial origin, the reasons being a previous history of malaria

TABLE.

Case No. ..	1 Beck- ford	2 Howell			3 Lovell				4 Mather				5 Cleghorne			6 Willock	7 Liley (Civilian)
Date, 1905 ..	May 11	May 19	May 20	June 6	June 13	June 14	June 16	July 9	June 24	June 26	June 30	July 6	July 29	July 26	July 30	Sept. 20	..
Day of disease ..	5	2	3	20	2	3	5	23	2	4	8	14	37	2	7	6	..
Polynuclears ..	43·5	..	61	..	75	66	53	..	..	84	..	5	..	53	..	71·5	..
Lymphocytes ..	43	..	25	..	20·5	30	44	..	..	12·5	..	3	..	29	..	24	..
Large mononuclears	6	..	5	..	3·5	3	1	..	..	3	..	2	..	13	..	4·5	..
Eosinophiles ..	7·5	..	9	..	1	1	2	..	..	·5	..	0	..	5	..	0	..
Hæmoglobin %	..	..	..	72	75	70	70	96	55	30	25	30	63	73	73	20	28
Colour index ..	..	..	..	·9	·9	·9	1	·9	1·1	1	1·1	1·5	·9	·8	·9	·7	..
Red blood corpuscles	4,260,000	4,900,000	..	3,828,000	3,800,000	3,500,000	3,700,000	4,998,000	2,500,000	1,470,000	1,107,000	1,330,000	3,250,000	4,265,000	3,900,000	1,800,000	..
White blood corpuscles	..	10,000	..	4,400	10,000	12,000	9,549	14,900	13,000	12,000	13,800	13,000	..	9,560	..	12,000	..
Duration of hæmoglobinuria, hours	13*	30*			36				96				32*			Un- certain; present 1st and 3rd days	(?) No examina- tion of stool

* Ova of the *Ankylostomum duodenale* present in stool.

in every case, and the presence of a parasite in the blood of a considerable number of cases. Secondly, the disease is probably due to a special form of malarial parasite, allied to, but distinct from, the parasite of malignant tertian. No pigment was ever found in any of the parasites in the peripheral blood or organs. Instead of forming pigment it may form some other toxic substance, which may be the exciting cause of the hæmolytic. Thirdly, the disease does not affect new comers. No cases occurred in the European battery up to ten months after their arrival in Sierra Leone, while cases were not uncommon amongst the negroes of the West Indian Regiment who were quartered in the same barracks and had been from two to three years in Sierra Leone. Fourthly, anti-malarial measures, such as the proper use of mosquito nets and the systematic treatment of cases with quinine, &c., will reduce the number of cases of blackwater fever in proportion as they reduce the number of cases of malaria.