off, the last joint of the toe being attached by a strip of skin only. I cut through this, and removed the gangrenous part at once, and brought the patient to hospital, where I removed the other phalanx and scraped out the cavity with a sharp spoon. At the time of my second visit I took away all the worms that remained. In all sixty-seven worms were removed from this man's toe. The phalanges of the toe were completely destroyed, the bones being so rotten that they crumbled away when I attempted to seize them with forceps. This man is still under treatment and doing well, but, owing to the septic nature of the case and the great destruction of tissue his progress towards recovery is necessarily slow.

The fly which causes all this mischief is a small species, less than $\frac{1}{2}$ in. in length, although it varies considerably in size. The body is of a bluish-green (see below) colour, with metallic reflections, and covered with stiff black hairs. It is distinguished from other flies which are related to it by the presence of three longitudinal black stripes on the thorax. The head and eyes are of a brick-red or yellowish colour during life, but after death the eyes become darker.

In depositing its eggs it selects some wound or decaying matter, and lays a mass of eggs at once. I find them a great nuisance when I have to make a necropsy in the country, especially if the body is at all offensive, as it frequently is in the tropics. It is said¹ that at least three or four hundred eggs may be deposited by a single female within a very few moments, and that the same fly may oviposit at different times and in different places hundreds or even thousands of eggs. I think this an exaggeration. I have never seen as many as one hundred larvae in any one case.

The eggs are cylindrical like those of other flies, about one millimetre in length, and white. "Under the microscope the eggs show a prominent ridge on one side" (Weed). They hatch within from one to nine hours.

The larvae are whitish, footless, rather slender maggots, and quite active. They are composed of twelve segments, each with a ring of minute spines or bristles, giving the worm the appearance of a screw. They burrow into the tissues of the affected animal, or into the mass of putrid flesh or decaying matter that furnishes them food, devouring everything that comes in the way, even the bones (Case v), and, when they attack the head (nose, ear, or scalp), may penetrate to the cranial cavity and cause death. They grow rapidly, and mature in a week or less. When mature they escape from the wound or decaying mass in which they have developed, and bury themselves in the ground, or hide in crevices, bedding, etc., to transform.

The pupae are brown in colour, cylindrical, and rounded at the ends. The length of time passed in the pupa stage varies from nine to twelve days.

When freshly hatched the flies are brown, but after a very short exposure to the air they become blue or green. (See above.) All of those that I bred from larvae were blue, and all of those that I caught in the open were green. I killed and pinned all my flies without giving them a meal, so it is possible that the blue ones would have changed to green had they been fed.

I venture to suggest that the size of the adult fly depends upon the stage of growth that the larva has reached within the wound or sore before passing to the pupa stage. In Case iv the existence of screw-worms was not suspected until the full-grown larvae began to drop out of the patient's nose and mouth. These were quite large and fat, and the flies which were bred from them were nearly if not quite half an inch long. In Case v, on the contrary, the worms were discovered and removed when only half grown, and the flies bred from them were hardly, if at all, larger than ordinary house flies.

Owing to the immense area of its distribution (about half the New World) and to the nature of its ravages, it would be Utopian to expect that any remedial measures that could be devised would be successful in stamping out this pest; but much could be done to lessen the damage caused by it. Attention should be paid to the destruction of all kinds of filth, carcasses, etc., particularly in the country, and to the prevention of wounds, barbed wire scratches, and especially the punctures of tick, which, according to Weed and Francis, furnish the greatest number of cases in cattle.

The fatal cases in man are due to the deposition of eggs, mainly in the nostrils, sometimes in the mouth, and such deposition is most liable to occur to persons sleeping in the open air or to those suffering from catarrh. The evident precaution is to avoid these sources of danger by the use of mosquito netting or wire gauze for sleeping rooms, and of a protection for the nostrils when exposed in places where the flies are common.²

All wounds, ulcers, etc., should be covered with a suitable dressing, and care should be taken that flies do not have access to the sore while the dressing is being changed.

As a direct application for the sores infested with worms a

wash of carbolic acid³ or creolin is advised. After the worms have been killed and removed the sore may be dressed in whatever manner the medical attendant may think necessary. For cattle a final dressing of pine tar, or in deep sores a packing with oakum and coating with tar is recommended.

REFERENCES.

¹ Bulletin. No. 5, New Series, U.S. Department of Agriculture, Division of Entomology, p. 131. ² Loc. cit., p. 132. ³ Loc. cit., p. 133.

THE DIAGNOSTIC VALUE OF BLOOD COUNTS IN MALARIAL AND OTHER FEVERS.

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In the following notes I desire to publish the results of blood examinations I have made in the Medical College and Eden Hospitals, Calcutta, during the last nine months, with special reference to the diagnosis of malaria.

Technique Adopted.

I employ the usual method with the Thoma-Zeiss haemocytometer for enumerating the red blood corpuscles. In counting the white cells, however, I use the same pipette (namely, a 1 in 100 dilution) as for the red corpuscles, but I count whole "fields" of the microscope ($\frac{1}{2}$ lens), having previously ascertained the area of the field, and from this and the known depth of the space between the cover-glass and slide, ascertained the cubic contents of the space beneath the "field."

I usually count 100 squares on the marked slide supplied with the haemocytometer for the red corpuscles, and 100 "fields" for the white corpuscles. For the differential count of the white corpuscles I stain a large film on a slide with Ehrlich's haematoxylin solution and eosin, and count 500 in all. I place them under the headings polynuclears, lymphocytes, large mononuclears, eosinophiles, and myelocytes. I always place "transitional" forms under the heading "polynuclears."

The differentiation of lymphocytes from large mononuclears is the most difficult part of the work, and for this I adopt the standard adopted by Captain Leonard Rogers, I.M.S.—namely, to place every single unlobed nucleated corpuscle which is as large or larger than a polynuclear under the heading "large mononuclears."

This portion of the blood diagnosis requires an amount of skill which will only be attained by a beginner when he has examined many normal bloods. Another difficulty to contend with is, that in severe malaria cachexia cases a number of nucleated red blood corpuscles are to be found in the blood. These will, if not recognized, cause one to give a too high total white blood corpuscle count, and a too high percentage count of lymphocytes in the differential count.

Again, in cachexia cases it may be quite impossible to find 500 white corpuscles on a slide, as they are sometimes very much diminished in number; but the fact that this difficulty occurs in any given case stamps it at once as a malaria cachexia case.

The method I refer to above for counting the white cells considerably shortens the time spent over each blood examination. Ehrlich's haematoxylin is a rapid stain for the nuclei of white cells, and the film can readily be stained while the white and red cells are being enumerated by the haemocytometer. The more the process of blood examination is shortened and facilitated the more likely it is to be universally adopted; but such as it is at present it is very tiring work, and three bloods at a sitting of three to four hours is the most any one can hope to do.

Skill acquired by frequent examinations alone will enable one to overcome the difficulties of blood examination. I find I have examined 197 bloods in nine months since I came to Calcutta.

Tabulation of Cases.

For the purposes of this paper I divide the 66 cases I am now publishing into three heads under Tables I, II, and III.

Table I shows cases recognized as malaria from the beginning and subsequently proved to be such by the clinical, quinine, and examination for parasites test. This table then is a sort of control and as such enhances, I consider, the diagnostic values of the blood counts exemplified in Tables II and III.

Table II includes cases not appearing at first by clinical methods to be malaria cases, in which the blood examination

TABLE I.—*Malaria Remittents recognized as such from the Beginning.*

Number of the Case in my Notebook.	Race or Religion and Sex.	Age.	Red Blood Corpuscles per Cubic Millimetre.	White Corpuscles per Cubic Millimetre.	Ratio of White to Red Corpuscles.	Percentage of Haemoglobin.	Colour Index.	Percentage of Polynuclear White Cells.	Percentage of Lymphocytes.	Percentage of Large Mononuclears.	Percentage of Eosinophiles.	Percentage of Myelocytes.	The Nature of the Case proved by the—
11	Mo., M.	32	2,360,000	4,032	1.5850	—	—	27.0	54.0	19.0	0.0	0.0	Clinical and quinine tests.
12	H., M.	24	1,248,000	8,364	1.1490	—	—	31.0	56.0	13.0	0.0	0.0	Ditto.
13	H., M.	25	4,016,000	3,808	1.1577	—	—	48.0	32.0	18.0	0.0	0.0	Ditto.
15	H., M.	40	2,306,000	1,836	1.1256	—	—	38.0	48.0	14.0	0.0	0.0	Ditto.
17	H., M.	20	3,280,000	4,590	1.7140	—	—	24.0	60.0	16.0	0.0	0.0	Ditto.
21	E., M.	22	2,624,000	5,814	1.4510	—	—	24.8	28.4	45.5	1.3	0.0	Ditto.
27	Mo., M.	21	3,880,000	1,190	1.3260	—	—	31.8	37.8	30.1	0.0	0.3	Ditto.
33	N. Ch., F.	33	2,000,000	6,824	1.2930	—	—	64.2	21.8	12.7	1.3	0.0	Tertian parasites in the blood.
38	H., F.	29	2,210,000	7,140	1.3160	—	—	60.1	24.7	12.4	2.8	0.0	Clinical and quinine tests.
39	H., M.	40	2,832,000	14,790	1.1910	—	—	30.0	37.5	32.5	0.0	0.0	Ditto.
41	H., F.	30	3,952,000	5,820	1.5790	—	—	27.2	60.8	12.0	0.0	0.0	Ditto.
52	E., M.	26	3,240,000	4,600	1.7040	—	—	65.5	26.5	5.5	2.5	0.0	Clinical and quinine tests; attack short, only 6 days; never previous attack.
53	E., M.	26	2,925,000	2,652	1.1404	—	—	53.0	28.0	17.0	2.0	0.0	Crescents in blood.
63	E., M.	28	3,333,000	700	1.4761	—	—	25.0	55.0	20.0	0.0	0.0	Tertian parasites in the blood.
72	H., F.	36	2,502,000	1,500	1.7077	—	—	10.2	56.2	27.6	0.0	0.0	Clinical course and quinine test; death.
79	H., F.	29	1,928,000	30,600	1.0400	55	1.4	22.2	60.6	17.2	0.0	0.0	Clinical course and necropsy.
112	E., F.	15	1,624,000	1,100	1.1407	48	1.4	52.9	20.0	17.8	9.3	0.0	Clinical; cause of leucocytosis unknown, possibly pelvic.
115	N. Ch., M.	10	3,712,000	2,700	1.3744	—	—	47.3	22.9	0.0	0.0	0.0	Clinical; death two months later with large liver and spleen.
149	E., F.	32	2,752,000	1,316	1.2098	—	—	45.2	35.2	19.0	0.0	0.0	Tertian parasites in blood.
153	E., M.	20	2,000,000	1,500	1.3333	60	1.5	49.0	33.0	14.0	0.0	0.0	Clinical; death seven weeks later.
164	H., M.	40	3,600,000	5,100	1.7050	—	—	64.1	74.2	15.0	0.0	0.0	Clinical and quinine.
173	E., F.	28	3,656,000	2,300	1.5866	—	—	55.8	37.8	0.64	0.0	0.0	Tertian parasites found; 6 days fever only; no fever before.
181	E., F.	28	2,730,000	6,500	1.4200	58	1.06	55.8	37.8	0.64	0.0	0.0	Clinical and quinine tests; 8 days fever only.
								41.0	53.1	9.8	0.0	0.0	History; clinical and quinine tests.

Mo., Mohammedan.

E., European.

H., Hindu.

N. Ch., Native Christian.

TABLE II.—*Malaria Remittents the Nature of which was not at First Apparent.*

Number of the Case in my Notebook.	Race or Religion and Sex.	Age.	Red Blood Corpuscles per Cubic Millimetre.	White Corpuscles per Cubic Millimetre.	Ratio of White to Red Corpuscles.	Percentage of Haemoglobin.	Colour Index.	Percentage of Polynuclear White Cells.	Percentage of Lymphocytes.	Percentage of Large Mononuclears.	Percentage of Eosinophiles.	Percentage of Myelocytes.	Parasites Found.	Appeared at First to be—
22	H., M.	32	3,560,000	3,060	1.1163	—	—	31.6	61.4	5.3	1.6	0.0	Nil	Hepatic liver abscess.
28	H., M.	31	2,688,000	4,284	1.6290	—	—	56.7	28.6	14.7	0.0	0.0	"	Liver abscess. Liver explored with negative results.
40	H., M.	38	4,640,000	7,548	1.6140	—	—	34.0	54.3	11.7	0.0	0.0	"	Typhoid fever.
44	Mo., M.	24	2,180,000	10,000	1.2180	—	—	44.4	26.4	29.0	0.2	0.0	"	Typhoid fever.
45	H., M.	30	2,480,000	8,432	1.2940	—	—	72.2	12.5	15.0	0.3	0.0	"	Liver abscess.
48	H., M.	26	3,760,000	1,748	1.2151	—	—	27.8	36.1	36.1	0.0	0.0	"	Typhoid fever.
58	H., M.	21	1,676,000	3,060	1.5580	—	—	28.8	51.2	20.0	0.0	0.0	"	Typhoid fever.
60	H., M.	13	1,714,000	1,326	1.1292	—	—	16.9	67.2	15.0	0.9	0.0	"	General tuberculosis; post mortem proved to be malaria.
73	H., M.	13	4,616,000	6,800	1.6790	—	—	50.5	31.2	17.9	0.1	0.3	"	Enteric and pneumonia.
74	H., M.	21	4,000,000	6,800	1.5890	—	—	40.0	46.0	14.0	0.0	0.0	"	Typhoid.
80	E., M.	30	4,528,000	4,400	1.1132	—	—	40.0	23.8	30.2	2.7	3.3	"	Pleurisy.
83	E., F.	24	5,048,000	6,038	1.9410	—	—	63.0	24.6	11.7	0.4	0.3	"	Sepsis following miscarriage.
85	H., M.	27	1,696,000	1,800	1.9420	32	1.06	48.4	35.9	15.6	0.0	0.0	"	Ankylostoma, anaemia, death.
90	H., M.	23	2,400,000	3,500	1.6850	—	—	40.4	18.8	40.5	0.0	0.3	Crescents numerous	Plague.
94	H., M.	27	2,640,000	3,200	1.8250	—	—	19.5	47.0	31.5	0.0	0.2	Quartan	Plague.
104	E., M.	25	4,600,000	5,400	1.8520	—	—	46.0	42.2	11.6	0.0	0.0	Nil	Enteric.
111	E., M.	18	5,064,000	3,000	1.1188	—	—	5.0	72.6	21.4	0.0	0.0	"	Enteric.
112	E., F.	15	1,624,000	1,100	1.1467	48	1.4	29.8	47.3	22.0	0.0	0.0	"	(?) Anaemia; death six weeks later.
120	H., M.	25	3,936,000	2,600	1.5113	—	—	42.0	43.0	17.0	0.0	0.0	"	Enteric.
121	H., M.	28	2,012,000	3,700	1.5430	42	1.05	54.3	34.0	10.5	1.2	0.0	"	Ankylostoma, anaemia.
125	H., F.	26	3,664,000	11,400	1.3210	—	—	57.3	23.2	18.5	0.5	0.0	"	Sepsis after ovariectomy.
132	E., M.	43	3,208,000	2,000	1.1604	—	—	62.1	26.2	11.7	0.0	0.0	"	Liver abscess; liver explored; negative results.
133	E., F.	15	2,464,000	2,400	1.1026	—	—	20.2	63.6	16.2	0.0	0.0	[Crescents	Insanity.
134	E., M.	33	5,040,000	7,000	1.7200	—	—	74.3	15.0	10.7	0.0	0.0	Nil	Alcoholic coma.
137	H., M.	30	1,872,000	2,900	1.6450	—	—	16.5	66.0	17.2	0.3	0.0	Crescents	Cerebro-spinal fever or plague coma.
143	E., M.	26	5,136,000	3,000	1.1712	—	—	58.6	22.1	19.3	0.0	0.0	Nil	Plague (bubo present).
144	J., T.	16	4,032,000	1,900	1.2122	—	—	44.0	40.0	15.0	0.1	0.0	"	Enteric.
146	E., F.	31	3,440,000	12,600	1.2730	—	—	66.8	14.8	18.4	0.0	0.0	"	Puerperal fever.
150	N. Ch., F.	42	384,000	3,600	1.1060	15	1.9	57.8	23.4	17.6	1.2	0.0	"	Ankylostoma, anaemia.
160	H., M.	30	1,144,000	38,000	1.3000	—	—	80.6	11.4	8.0	0.0	0.0	Crescents teeming	? Coma.
161	H., M.	14	4,400,000	10,000	1.4400	—	—	46.4	33.2	20.4	0.0	0.0	Tertian plentiful	Plague, delirious.
165	H., M.	29	3,656,000	14,300	1.2550	—	—	81.6	10.4	8.0	0.0	0.0	Crescents plentiful	Plague, delirious.
166	H., M.	45	3,600,000	8,100	1.4440	—	—	84.1	10.6	5.2	0.0	0.1	Tertian teeming	Plague, comatose.

J., Jew.

Mo., Mohammedan.

E., European.

H., Hindu.

N. Ch., Native Christian.

proved the malarial nature of the cases before the clinical quinine or parasite tests, and which were subsequently undoubtedly proved to be malarial by the latter tests.

Table III shows cases the nature of which at first was not evident, which were suspected to be possible malaria cases, but which the blood examinations proved to be non-malarial.

TABLE III.—Cases Clinically like Malaria at first; subsequently proved to be Non-malarial.

Number in my Notebook.	Race and Sex.	Age.	Red Blood Corpuscles per Cubic Millimetre.	White Corpuscles per Cubic Millimetre.	Ratio of White to Red Corpuscles.	Percentage of Haemoglobin.	Colour Index.	Percentage of Polynuclear White Cells.	Percentage of Lymphocytes.	Percentage of Large Mononuclears.	Percentage of Eosinophytes.	Percentage of Myelocytes.	Cases were proved to be Non-malarial by Blood Count as well as by.
26	H., M.	32	3,640,000	15,484	1.235	—	—	86.1	12.5	1.4	0.0	0.0	Operation. Liver abscess.
32	H., M.	32	3,662,000	15,788	1.189	—	—	77.0	16.7	5.0	1.3	0.0	Ditto.
34	H., M.	21	4,200,000	12,546	1.350	—	—	75.0	15.0	6.4	3.6	0.0	Ditto.
70	E., M.	54	3,500,000	13,400	1.269	—	—	87.7	8.5	3.6	0.2	0.0	Patient left hospital with a suspected liver abscess.
128	E., F.	32	4,568,000	14,900	1.306	—	—	80.0	14.5	5.5	0.0	0.0	Subsequent course, namely, sepsis following confinement.
148	H., F.	29	3,872,000	15,000	1.251	—	—	82.0	12.4	5.2	0.4	0.0	A case of fever after Caesarean section. On discovery of a stitch abscess temperature fell to normal.
162	E., M.	28	4,800,000	11,200	1.428	—	—	80.0	15.6	4.4	0.0	0.0	Clinical course and failure of quinine. Patient left hospital refusing operation for a liver abscess.
177	E., F.	32	3,904,000	9,800	1.398	—	—	75.9	17.4	5.1	1.6	0.0	Failure of quinine and subsequent course, namely, pelvic abscess.
185	H., F.	25	4,696,000	60,000	1.70	—	—	89.4	8.6	2.0	0.0	0.0	Failure of quinine. Successfully treated by antistreptococcus serum.

H., Hindu. E., European.

and in many the blood examination gave the first hint as to the nature of the case.

Analysis of Results in Tables I and II.

As first indicated by Drs. Christophers and Stephens¹ and subsequently fully confirmed by Captain Leonard Rogers, I.M.S., it will be seen that the cases in Tables I and II show an excessive percentage of large mononuclears. My experience leads me to follow Captain Rogers in fixing 12 as the limit, a large mononuclear percentage above which is diagnostic of malaria.

From the 57 cases in Tables I and II a percentage of cases giving the 12 per cent. large mononuclear count can be estimated.

Before doing so, however, I will exclude four cases—namely, numbers 160, 161, 165, and 166, Table II, as they are examples of a curious condition in malaria—namely, leucocytosis, which I will discuss later. Excluding these four cases, there are 53 cases of malaria remittents, 44 of which give the 12 per cent. large mononuclear count, and 9 fail to give it. This works out at 83 per cent. giving the count, and 17 per cent. failing to do so.

But I consider Cases 40, 83, 104, and 132, Table II, giving percentages of 11.7, 11.6, 11.6, and 11.7 respectively may fairly be considered to give the 12 per cent., as they are so near that figure, especially as they conform to some other characteristics of malarial blood, as will be shown afterwards. If these cases be included we get 48 cases giving the mononuclear count out of 53 cases, or over 90 per cent.

Now, if this result be compared with the diagnosis that was possible of the same number of cases by finding malarial parasites; out of the 53 cases parasites were found in 9 cases, that is about 17 per cent. I think I shall be supported by most observers in India that this about represents the percentage of success in finding malarial parasites in the malarial fevers of India at a single examination, and on this point both textbooks and writers on the subject are, I consider, very misleading. If, then, the diagnosis of malaria can be made in over 90 per cent. of cases by the blood count against 17 per cent. by the parasitic test, there can be no question as to which is the superior method.

I should perhaps have mentioned that in all the cases in the three tables I carefully searched in fresh specimens for malarial parasites: and that the house-physicians of the Medical College Hospital invariably did so too, and noted the results on the clinical notes of the cases. These notes I have always perused with the object of ascertaining if the house-physicians found parasites.

Other Features of the Blood Count in Malaria.

Besides (a) the increase of large mononuclears in malaria, the cases in Tables I and II illustrate other features of the blood count in malaria.

(b) The lymphocytes are usually largely increased (Cabot). Taking the normal percentage of lymphocytes at between 20 per cent. and 30 per cent., or say 25 per cent., they often run up to 60 per cent., or even over this in malaria.

(c) The total white blood corpuscle count is diminished (Cabot and Rogers, and others). Taking the normal as 7,500 white cells per c.c.m., it will be seen that the majority of the cases in Tables I and II give a lower count than normal. They are so much diminished that the relation of white to red cells frequently rises to 1 in 1,000 or more, instead of the

normal of about 1 in 600. Indeed the more severe the case the more marked those figures become.

(d) Myelocytes are frequently present to an appreciable extent. Myelocytes are, no doubt, "occasional visitors of the blood" from the bone marrow as Cabot writes, but they seem to be frequent enough visitors in malaria (Rogers).

(e) The red blood corpuscles are diminished, but the loss of white cells seems to be much greater than that of the red cells as a rule, as many of the cases in the tables illustrate.

(f) The haemoglobin is so much less diminished than the red cells in anaemic cases that the colour index is usually above 1.

Prognostic Value of the Blood Count in Malaria.

A reduction of the white blood corpuscles to 1,500 or less is of grave prognostic value. In such cases it is the experience in the Medical College Hospital that large doses of quinine hypodermically will alone save the patients, and frequently enough this will fail to avert a fatal issue. Thus in Cases 149, Table I, and 60, 85, and 112 Table II, death resulted in spite of large doses of quinine hypodermically and by the mouth. From this it will be seen that the blood count has a distinct prognostic value, a point which will probably be more fully worked out later.

Captain Rogers, I.M.S., has frequently pointed out to me in the post-mortem room and pathological laboratory the association of marked atrophy of the mucous membrane of the small intestine with the failure of immense doses of quinine by the mouth, and will, I hope, publish the results of his investigations in this direction at an early date.

Exceptions to the Malarial Blood Count.

In certain cases the 12 per cent. large mononuclear count and the other characteristics of the blood in malaria may not be present.

1. If the fever is very recent in one otherwise previously healthy, the blood changes may not have time to take place, and the first examination of the blood may give a count from which nothing can be inferred. This occurred in Cases 41, 164, and 173 (Table I) in which the fever had been present, only 6.6 and 8 days respectively, and the patients either stated that they had never previously had fever or had not had fever for some years. Case 41 represents about the normal blood count for a native woman. Case 164 shows a slight (probably beginning) blood change in the diminution of red cells, slight rise of lymphocyte percentage, and slight rise of large mononuclears. It will be seen that a few tertian parasites were found, and from this one can infer that the patient had not recently taken quinine; and from this again that he had not recently suffered from fever. Case 173 shows a still more advanced malarial blood change, for remembering that the patient was a European female, the diminution of red and white cells and high ratio of white to red cells, along with diminution of polynuclears and slight increase of lymphocytes, gives a blood picture of probably the early stages of malaria. The temperature rapidly fell to normal under quinine treatment. In cases such as these, should the fever continue the 12 per cent. large mononuclear count is likely to be obtained some days later, and should always be sought for. These three cases will, in part at least, account for some of the 10 per cent. failures to find the large mononuclear count in my cases.

2. If leucocytosis is present from any cause the characters

of the blood may not appear to be those of malaria. In this case the 12 per cent. mononuclear count may be apparently absent, though not really so. Thus a total white blood corpuscle count of 12,000 may give but 8 per cent. of large mononuclears. Still, this would represent a very high percentage for 12,000 white cells, and probably equals about 16 per cent. large mononuclears for a white corpuscle count of 6,000 per c.mm. A number of my cases gave the mononuclear count in spite of leucocytosis, such as Nos. 39 and 79, Table I; and 44, 125, 146, and 161, Table II. On the other hand, considering the high total white corpuscle count in Nos. 160 and 165, the 8 per cent. large mononuclear counts given in these cases is more than sufficient to justify one in calling the cases malarial.

3. If the temperature is up to 103° or more at the time the blood is taken the malaria count may be absent. As it is not always possible to be present at the period of remission in the fever, and should the temperature be above 103° , it is advisable not to take the blood until remission occurs.

Is a Leucocytosis ever found in Uncomplicated Malaria?

Cases 160, 161, 165, and 166, Table II, were examples of very severe malaria with leucocytosis. In all of them parasites were very numerous in the peripheral blood. In the diagnosis of liver abscess from malaria by the blood count, leucocytosis in the former is so constant as to be almost diagnostic. To this I would add that these four cases furnish the exception "that proves the rule." These cases would seem to indicate, however, that when this exceptional leucocytosis does occur parasites are so numerous in the blood that diagnosis from a fresh specimen is an easy process.

Leucocytosis in malaria seems to be comparatively rare, as it has not been much noted before. Dr. Manson, in his book on *Tropical Diseases*, pp. 98 and 99, edition 1900, mentions that an increase to as high as 30,000 may occur in the white cells in certain pernicious malarials, and Captain Rogers³ mentions the possibility of it at certain stages of the malaria paroxysm.

These were all severe cerebral cases, and were either very delirious or comatose. They were admitted into the contagious ward at first as suspected cases of plague, and clinically there was nothing to distinguish them from septicaemic plague. They occurred during the month of September, when our most severe pernicious malarials occur in India. Immediately on admission I examined the bloods, and, finding parasites in the fresh specimens, at once transferred them to the general ward.

If I might be permitted to theorize on the point, I would say that leucocytosis in those severe malarials indicates a reaction of the blood to the intense poisoning, and that in these same severe cases the leucocytosis varies directly with the intensity of the poison. The converse to this latter rule no doubt holds good—namely, that the more chronic the malaria the more marked the leucopenia, as in Case 63, Table I, and Cases 85 and 112, Table II, which were markedly cachectic from malaria, and all died.

Case 143, Table II, deserves special mention, as it very well exemplifies the diagnosis from blood count alone of malaria. The patient, a European policeman of good physique, was admitted to the plague ward as a suspected case of mild plague. He had a well-marked right femoral bubo, temperature 105° , with severe constitutional symptoms, though not delirious. There was no wound on the leg or foot and no sign or history of venereal disease. Fresh specimens carefully examined showed no malaria parasites, but the blood count was so typical that I transformed him to the general ward. His temperature fell in two days under quinine, with occasional intermissions every third day afterwards. The bubo disappeared.

Value of Blood Counts in the Diagnosis of Post-operative and Post-puerperal Fevers in the Tropics.

Cases Nos. 83 and 146, Table II, were examples of what a blood count can effect in the diagnosis of post-puerperal fevers. The nature of those cases was in doubt, and with this of course the proper line of treatment uncertain, up to the time the blood counts were done. On subsequently giving quinine the temperatures came down almost at once. No. 83 had had fever for four days, and 146 for five days after miscarriage and confinement respectively.

Cases 128 and 185, Table III, were markedly in contrast with the foregoing. Case 128 was thought to be possibly malarial and quinine given, but she died of puerperal fever. Here, again, the blood count foretold the condition at an early date.

The patient, Case 185, Table III, was delivered ten days before the blood examinations, and had had fever since her confinement. She looked very ill, and might have been clinically either a severe malaria, typhoid, or puerperal case. It will be seen that the leucocytosis is exceeding high (the highest, in fact, of any of my blood counts). I gave the opinion from the blood count that she was suffering from septicaemia (there were no local signs whatever), and I recommended antistreptococcus serum. In two days after the injections of five phials of the serum the temperature fell to normal, and remained so for seven days more. On the next day (eighteenth day since confinement) the temperature ran up again to 103° , with rigor; and on examining the blood I got the following results: Red cells, 2,528,000; white, 18,000; ratio, 1—140. Polynuclears, 70 per cent.; lymphocytes, 19.3 per cent.; mononuclears, 10.7 per cent. In spite of some leucocytosis still present it will be seen that the large mononuclears are very high. Fresh specimens showed no parasites. I gave it as my opinion that the patient was now suffering from malaria. She got no quinine, but her temperature fell to normal. Two days later the fever was repeated, with rigor, hot stage, and sweating. Quinine was now given, and the patient got well. In my opinion this patient's life was probably saved by the blood count.

Case 148, Table III, also deserves mention. She was operated on by Caesarean section seven days before the blood examination, and had had fever for four days. I concluded that the blood condition was indicative of some local inflammatory process, and suggested "stitch abscess." This was carefully sought for and found, and on removing the offending stitch the temperature fell, and the patient completely recovered.

Diagnosis of Liver Abscess from Malaria.

It is no unusual occurrence in India to get cases of fever, with pain, tenderness, and enlargement of the liver, in which large doses of quinine is the proper line of treatment, though exploration of the liver seems clinically to be indicated. Cases 22, 28, 45, and 132, Table II, are examples. The livers were carefully explored without success in Nos. 28 and 132. No. 28 recovered under quinine. No. 132 was taken out of hospital four weeks later than the blood count, in a dying condition. Nos. 22 and 45 recovered under quinine. Contrast the blood counts of those cases with Nos. 26, 32, and 34, Table III, which were clinically not unlike malaria remittents, without local signs, at the time of the blood counts. All were subsequently successfully operated on for liver abscess.

I cannot conclude this paper without owning my great indebtedness to Captain Leonard Rogers, I.M.S. Without the help he gave on all occasions when I sought it, I should probably never have had the patience to persevere until I possessed the skill necessary to examine the blood properly and interpret the results.

Finally, I would repeat, for the benefit of those who wish to test the value of blood counts, especially in malaria, that the skill to examine the blood and to interpret the results will only be obtained by repeated examinations of normal bloods, and that the greatest difficulty to surmount is in differentiating large mononuclears.

REFERENCES.

- ¹ Royal Society's Malaria Committee Report. Fifth Series. 1901. ² BRITISH MEDICAL JOURNAL, April 5th, 1902. ³ Loc. cit.

BERI-BERI AMONG LASCAR CREWS ON BOARD SHIP.

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BERI-BERI among Lascar crews is a common occurrence, and it may therefore be interesting, in view of the controversy as to its etiology, to look at what is likely to be the cause of the disease on board ship.

Passing over the predisposing causes, such as occupation, age, sex, climate, and overcrowding—and the latter does not occur on board ship (P. and O.), as the Lascars have the same superficial and cubic space as is allowed to European seamen—we come to the specific causes.

The anaemic theory is exploded, the cockroach theory has also little ground, as although they are numerous, yet they have practically no chance of getting infected from faeces, as the latrines are too well looked after. This also may be said of the metallic theory, since the only way of infection would be through cooking utensils. One is therefore drawn by a