presence of malarial fever. Not only was there a marked degree of anaemia, but the total leucocyte count was below 1,000 per cubic millimetre, and the proportion of white to red corpuscles less than 1 to 3,000, these being figures which we have already seen are very rarely, if ever, met with in typhoid fever, although not very uncommon in malarial fever of long duration. Just, then, in those cases where the increase of the large mononuclears fails, other changes which are of diagnostic value are present, while in the cases which present little anaemia (so that the other blood changes are similar to those which obtain in typhoid) the large mononuclear increase is most marked. The low figure of 8 per cent. at the first count in Case 4 is an exception to this rule. Stephens and Christophers consider that the presence of 15 per cent. or more of large mononuclears is diagnostic of malarial fever, in which opinion I concur, only with the method of counting mentioned above I think the limit might be fixed even lower, such as at about 12 per cent. In the absence of parasites, due generally to previous dosage with quinine, this large mononuclear increase is of the greatest diagnostic value, and can be easily and quickly ascertained from a stained slide.

Presence of Myelocytes.—Another point which has attracted my attention in the present research is the frequency of the occurrence in malarial fevers of very large mononuclear corpuscles with a darkly-stained nucleus and deep blue stained protoplasm with Romanowsky's stain, which appear to be myelocytes. That myelocytes are often present in marked anaemia of malarial origin is mentioned by Cabot, the highest count found by him being 3 per cent. In the tables they are included with the large mononuclear corpuscles, as unfortunately it is only in the most recent cases that they were counted separately, but in the second count in Case No. 6 they formed no less than 5.4 per cent. of the white corpuscles, and in several others from 1 to 3 per cent. of them have been met with. On the other hand, in typhoid an occasional myelocyte has only very rarely been met with in a count of 500 corpuscles. These bodies are so striking that when 2 or 3 per cent. are present they are easily detected on examining a stained slide, and as far as my experience yet goes their presence in these numbers during a continued fever is diagnostic of a malarial remittent, while they may occur in cases with no very marked degree of anaemia. For example, in Case No. 3a with nearly four million red corpuscles, 2.4 per cent. of them were found. If these observations are confirmed by further experience, the presence of myelocytes in any numbers will prove to be of considerable diagnostic value in malarial remittents.

Decrease of Polynuclears and Increase of Lymphocytes.—Lastly, we have to deal with the changes in the proportion of the other leucocytes, namely, the decrease in the polynuclears and a proportionate increase in the lymphocytes. This change is met with in a very variable degree, being most marked as a rule in those cases which present a high degree of anaemia, and least marked or entirely absent in those with little or no anaemia, as illustrated by the first four cases in the table. The increase of the lymphocytes is also most marked in those cases in which the total leucocyte count is lowest, as illustrated by the latter part of the table, but it is just in these that the high degree of anaemia and great proportional decrease in the total number of leucocytes excludes uncomplicated typhoid fever, while the increased percentage of large mononuclears will still be present if malarial fever persists or has only ceased within a few days. On the other hand, I have found a marked increase in the lymphocytes without any excess of large mononuclears in some cases of greatly enlarged spleen, due to malarial cachexia in which no recent fever of a malarious nature has occurred, but these could not possibly be confused with typhoid fever. The extreme decrease of the polynuclears to below 40 per cent. shown in cases, several of the cases in Table II I have only yet met with in chronic malarial fevers.

Leucocytosis.—Although there may be a relative increase in the leucocytes at certain stages of a malarial paroxysm, true leucocytosis very rarely occurs in malaria, not even when it is complicated by broncho-pneumonia, in several cases of which disease I have found a very low leucocyte count in malarial subjects. The presence of marked leucocytosis in cases of intermittent and remittent fevers is, then, of great value in excluding malaria and uncomplicated typhoid fever and

pointing to some form of local inflammation, the most important of which, in my experience in India is liver abscess. On three occasions within the last few months I have found a very high degree of leucocytosis, from 30,000 to 40,000 white corpuscles per cubic millimetre, in cases which were being treated for malaria, and in each case the suspicion of the fever being due to liver abscess thus aroused proved to be correct. Moreover, I have found that the presence of leucocytosis can be detected by a short examination of a stained blood slide, for from twenty to forty white corpuscles may be seen at once in the fields of an ordinary high power all along at the edge of the smear, about 90 per cent. of which will be polynuclears, a condition never met with when the white corpuscles are not increased in numbers, and one which may be taken as evidence of leucocytosis without the necessity of counting the white corpuscles with a haemocytometer.

CONCLUSIONS.

1. The percentage of the different forms of leucocytes counted in a stained blood film is of great diagnostic value in differentiating typhoid and malarial remittent fevers, and is easily ascertained.
2. An increase of the lymphocytes to 40 per cent. or over, without any increase in the large mononuclears, points to typhoid as against malarial fever.
3. An increase in the large mononuclears to about 12 per cent. and upwards, especially during the remissions of the temperature, strongly indicates malaria as against typhoid fever. This change is of great value when parasites are absent from the blood.
4. The presence of myelocytes in any number such as from 1 to 5 per cent. points to malaria as against typhoid fever.
5. A high degree of anaemia, such as a reduction of the red corpuscles to below 3,000,000 per c.mm., is much more frequently met with in malarial than in typhoid fever.
6. A very great reduction in the total leucocyte count, such as to below 2,000 per c.mm., is much more frequently met with in malarial than in typhoid fever, while the proportion of white to red corpuscles in malaria is not infrequently less than 1 to 2,000, which is rare in typhoid fever.
7. Leucocytosis can be detected by the presence of a great excess of white corpuscles, upwards of 80 per cent. of which are polynuclears, in a stained blood film, and is often of service in excluding malaria in intermittent fever due to liver abscess or other local inflammation.

REFERENCES.

- ¹ Indian Medical Gazette, 1893, p. 176. ² Ibid., 1902. ³ Royal Society's Malaria Committee Reports, Fifth Series, 1901. ⁴ Jour. of Path. and Bact., 1898. ⁵ Klinische Untersuchungen ueber das Verhalten des Blutes bei acuten Infektionskrankheiten.

THE CONDITION OF THE BLOOD IN FILARIASIS.

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ABOUT two years ago Mr. D., a Eurasian student, consulted Dr. Charles Kennedy of this city with regard to a swelling of the left inguinal glands, which was giving him a good deal of pain and discomfort. All the ordinary causes of bubo could with certainty be excluded, and, as the swelling was increasing in size, the patient consented to have the glands excised by Mr. H. J. Stiles. While the operation was being performed a quantity of chylous fluid escaped, and this at once determined the true nature of the case. Some of the fluid was collected and sent to me for examination. I could find no filariae, but it was obvious that the fluid was chyle, and it was resolved to examine the blood in the evening. This was done, and numerous filariae were found. I may remark here that the wound healed by first intention without any further escape of chyle.

In examining stained films of the blood I was struck by the large number of leucocytes in the films, and especially by the high percentage of eosinophiles present. This led me to make a differential count of the leucocytes (films taken on November 28th, 9.20 P.M.), when I found the percentages in 500 cells to be as follows:

Polymorphonuclears ...	...	...	...	63.5
Lymphocytes ...	...	...	...	28.5
Eosinophiles ...	...	...	...	8.0

100.0

As the normal percentage of eosinophiles in the blood is 1-4, this constituted a distinct eosinophilia, and I determined to examine the blood more thoroughly and at different hours of the day, in order to see whether there was any relationship between the eosinophilia and the presence of the embryos in the blood, and whether there was or was not a leucocytosis in addition. On December 1st, at 4 p.m., when there were very few embryos in the blood, the leucocytes were 6,800; at 11 p.m., when they were numerous, the leucocytes were 12,500. The percentage of eosinophiles rose from 7 at 4 p.m. to 12 at 11 p.m. On December 12th at 10.15 a.m., when no filariae could be found, the leucocytes numbered 4,600, with 6 per cent. of eosinophiles; at 11.30 p.m. with many filariae, the leucocytes were 13,100, the eosinophiles 9.5 per cent. On January 31st, at 10 a.m. (no filariae), the leucocytes were 5,000, the eosinophiles 3 per cent.; at 3 p.m. (no filariae), leucocytes 6,300, eosinophiles 4.5 per cent.; at 10.20 p.m. (numerous filariae), leucocytes 10,100, eosinophiles 8 per cent. On February 8th, at 10.10 p.m. (many filariae), the leucocytes were 10,600, eosinophiles 7 per cent.

During this time Mr. D. was in perfect health; indeed, more observations would have been made, had it not been that he was attending classes at the University, and as he lived at the other side of the town, and I was very busy at the time, it was very difficult to make arrangements for meeting. The evening leucocytosis could not have been due to digestion, for he took his principal meal at 1 p.m., and the evening meal was a light one.

Table of Percentages of different Varieties of Leucocytes in Blood in Filariasis.

	Nov. 28th, 9.20 p.m.	Dec. 1st, 4 p.m.	Dec. 1st, 11.10 p.m.	Dec. 12th, 10.15 a.m.	Dec. 12th, 11.30 p.m.	Jan. 31st, 10 a.m.	Jan. 31st, 3 p.m.	Jan. 31st, 10.20 p.m.	Feb. 8th, 10.10 p.m.
Polymorpho- nuclears...	63.5	68.5	55.5	57.5	59.0	65.0	66.0	61.0	67.0
Lymphocytes ...	28.5	24.5	32.5	36.5	31.5	32.0	29.5	31.0	26.0
Eosinophiles ...	8.0	7.0	12.0	6.0	9.5	3.0	4.5	8.0	7.0

I have tabulated the whole of the differential counts, which were of 500 cells in each case, for it is to be noted that in addition to the evening eosinophilia, there was a constant high proportion of lymphocytes, which did not show much variation throughout. This may have been an individual peculiarity, but there are many conditions in which eosinophilia and lymphocytosis are associated. In contrast to this is the low proportion of the polymorphonuclears, which never reached the normal minimum percentage of 70. The relation between lymphocytes and polymorphonuclears remained fairly constant, and of course both varieties must have been increased absolutely in order to produce the high evening counts of leucocytes. The increase of eosinophiles is brought out better if, instead of taking the percentages, the total number present in the cubic millimetre is calculated. We then find—

Between 10 and 11 a.m.	276 and 150
at 3 p.m.	283
" 4 "	476
" 10.10 "	742
" 10.20 "	808
" 11.10 "	1,500
" 11.20 "	1,244

The red corpuscles showed no abnormality in number or otherwise during the observations. These were brought to a close by the patient's return to India soon after the last date.

I was unwilling to publish an isolated observation, and have been in hopes of being able to examine other cases in the same way, but have had no opportunity of doing so. I therefore read a note of the case at the November meeting of the Edinburgh Pathological Club last year. The attention of workers in countries where filariae are found seems to have been directed entirely to the embryos, and no observa-

tions similar to the above have been published until January of this year, when, in the *Johns Hopkins Hospital Bulletin*, Dr. Calvert gives a preliminary note on two cases of filariasis in Filipino prisoners. In both of these he found leucocytosis and eosinophilia, and in both, also, the lymphocyte percentage was fairly high in the two differential counts which he gives, though not so high as in my case. He seems, however, to have made no attempt to ascertain whether there was any association between the time of day when the blood was examined, or in other words, the number of filariae present in the blood and the amount of leucocytosis and eosinophilia. It seems to me that that is the most interesting point in my case, that the percentage of eosinophiles rose steadily from a normal figure in the early morning, when no filariae could be found (though, of course, a few may have been present) to high figures just before midnight, when the number of embryos in the blood was at its highest point.

These observations, incomplete as they necessarily have been, bring filariasis into line with several other parasitic infections. It has long been known that several intestinal parasites—ascaris, oxyuris, ankylostoma, and taenia—produce eosinophilia, though not in every case, while Cabot and Brown have recently shown that very extreme eosinophilia may be produced in trichiniasis, though here again different cases differ in the amount of reaction produced. I may note also that in some observations I made some time ago on the intestines of salmon and trout, I found that where intestinal parasites were present, and they were rarely absent, the walls of the intestine were packed with eosinophile leucocytes.

All these facts go to prove that the eosinophiles are concerned in protecting the body from the toxins of parasites, whether these are absorbed from the intestine or are actually elaborated in the blood. That the other varieties of leucocytes have also to do with this would seem to be indicated by the general leucocytosis which I have described as concurrent with the increase of filariae, but observations are wanting as to whether other parasites produce a leucocytosis of this kind.

NOTE.—Since the above lines were sent to the Editor I have seen another case, with Mr. J. M. Cotterill, of varicose inguinal glands from filariasis. The condition was of four years' standing. As yet I have only made one examination of the blood, at 9.30 p.m. Very few filariae were present; the leucocytes were not increased in absolute number, but there was distinct eosinophilia and also a high lymphocyte percentage—polymorphonuclears 52.5, lymphocytes 40.5, eosinophiles 7. I am glad to have had this confirmatory observation, and hope to publish full details of the case later.

OBSERVATIONS ON THE STATE OF THE VASCULAR SYSTEM AFTER DEATH BY ASPHYXIA AND BY CARDIAC FAILURE.*

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ASPHYXIA.

THE characteristic distribution of the blood in the heart and great vessels after death by asphyxia has been ascribed to various causes, and a glance at the textbooks now in use will show that different opinions are still held as to why, on examination of the body some hours after death, the right side of the heart and the great veins opening into it are usually found to be largely distended with blood, while the left heart is empty or contains little blood.

Among various causes that have been assigned there may be mentioned as the chief ones: (1) The greater distensibility of the right heart; (2) the influence of violent respiratory movements and muscular spasms in drawing and driving blood into the great veins and right heart; (3) an alleged strong contraction of the pulmonary arterioles opposing the discharge of blood from the right ventricle, and so leading to an accumulation of blood in the right heart and great veins and a state of comparative emptiness on the left side; (4) the influence of rigor mortis coming on in the left ventricle after death.

Before entering on a brief consideration of these causes, it is important to determine the actual condition of the heart at

*Read in the Section of Anatomy and Physiology at the Annual Meeting of the British Medical Association at Cheltenham.