had broken out there and much resembled plague, he says, writing under date August 12th, 1897:

The German Imperial officials in Dar-es-Salam received the first information regarding the occurrence of the disease in the German protectorate from Staff Surgeon Zupitza, stationed at Bukoba. He reported that in Kisiba,⁶ a district the eastern boundary of which is the Victoria Nyanza, and which is separated from Uganda on the north merely by the Kagera river, a disease frequently appears which is accompanied by violent fever and swelling of the axillary and inguinal glands, and in most cases is swiftly followed by death. At the time of his report two banana groves were infected, and from five to six of the victims died each day. In the months of August and November last year Dr. Zupitza sent further reports, stating that the disease was spreading, and that two other banana groves had become infected. This news Zupitza had received from missionaries and natives. He himself, unfortunately, owing to his duties at the station, and in consequence of prolonged illness from fever, had been unable to study the disease at the place of its occurrence. Recently, after a two years' sojourn on the Victoria Nyanza, he returned to Dar-es-Salam, and an excellent opportunity was thus offered to me to learn from him all he knew regarding the subject. From this it appears that we are really face to face with a malady which, both as regards symptoms and the number of cases of death, does not differ from bubonic plague.

It is peculiar only that the disease has been introduced into Kisiba long ago and on various occasions, and has remained strictly confined to that territory.

In this, however, it resembles mahamari, the plague-like disease in the remote villages of the Himalayas, mentioned by me in reports of an earlier date. This malady also rages for years, and even for decades, in the mountain villages, until suddenly, favoured by conditions as yet unknown to us, it expands over large territories of Northern India. In the same way bubonic plague can remain for a long time localized in Mesopotamia, until it unexpectedly invades the neighbouring countries. Therefore there may be localized, and may have been existing for a long time, a plague focus also in the interior of Africa, from which in former times, by means of the slave trade, plague was carried into Egypt, and in more recent times into Tripoli, where, as late as 1856 and 1874, plague appeared, though it could be shown to have been imported from Mesopotamia or other plague centre. In this case the plague-like disease in Kisiba might be one of the most southern outposts of this ancient African plague centre. Whether we are dealing with genuine bubonic plague, however, can only be settled by researches made in the districts invaded by the disease, above all in Kisiba.

Dr. Koch then points out that an expedition sent to the latter country, in order to investigate the matter, would require from two and a-half to three months for the journey from the coast to Kisiba, and the same amount of time for the return journey. Adding to this another two months spent in studying the subject, a period of eight months would be required for the enterprise. As it seems to him not desirable to devote so long a space of time to this one object merely, he suggests that Dr. Zupitza, already well acquainted with the subject and trained in his methods of research during the period that he acted as his (Dr. Koch's) assistant in Dar-es-Salam, should be placed in charge of the expedition, accompanied by another medical man as assistant. This arrangement would enable him (Dr. Koch) to devote his researches meanwhile to other matters of importance for the German colony, such as malaria, cattle plague, the discovery of a suitable situation for a sanatorium in a locality free from fever, malaria, etc. To these suggestions the German Government assented. On August 30th Dr. Zupitza left the coast, and arrived in Kilossa on September 12th, M'papa September 17th, Tabora October 9th, whence he proceeded to M'nanza at the southern end of the Victoria Nyanza, and crossing the lake arrived in Bukoba at the western shore on November 3rd.

In his report from Dar-es-Salam dated February 14th, 1898, Dr. Koch writes:

Zupitza at once, after his arrival, entered into communication with Mutatembwa, the Sultan of Kisiba; and, with the latter's consent, he proceeded to the infected territory, which begins a day's march west of Bukoba, representing a narrow strip extending westward. Camp was pitched at Grucati, near the banana groves in which the plague was said to be localized; and excursions were made into neighbouring territory. The disease had recently been increasing again, so that Zupitza had at once occasion to report five cases of the malady called by the natives "ruburunga." They all showed high temperatures and very severe illness. Four of them had bubos in the inguinal region, one of them had a bubonic swelling at the corner of the jaw. Other symptoms were not discoverable. Especially it is to be noted that the functions of digestion, respiration, and circulation were unimpaired. Four of the patients died within a day or two; one only escaped. Zupitza drew blood from all of them by incision at the finger-point, and made microscopical glass-cover preparations. In two cases blood withdrawn by an incision near the glands was used. For the time being, however, only one obduction could be made, though the doctor hoped he would succeed in making other obductions later.

The preparations and parts of the body preserved in alcohol reached me safely after my return from the Usumbara mountains in Dar-es-Salam, and I discovered the following:

In the spleen, liver, and kidneys of the body dissected during the obduction, plague bacteria were found in an extraordinary quantity and in pure culture (*Rein-kultur*). The blood, also, which had been drawn from an incision in the bubo while the man was still alive, contained numerous plague bacteria. In the blood drawn from the finger in the other cases, only in two instances plague bacteria, and in small numbers only, were found.

I have compared the preparations with plague preparations from Bombay, and cannot discover the slightest difference between the plague bacteria from Kisiba and those from Bombay. They resemble each other as regards dimensions, appearance, and behaviour toward colouring matter, etc., so completely that it is not necessary to give a special description of the Kisiba bacteria.

Since the ruburunga plague in Kisiba also fully coincides with bubonic plague as regards clinical features and great mortality, there remains for me no longer any doubt that we are dealing here with genuine bubonic plague; and the opinion to which I heretofore gave expression, namely, that also in the interior of Africa, just as in Asia, a plague focus exists, and has, perhaps, been existing from the remotest times, is thus confirmed.

For this view another circumstance also speaks. During previous inquiries regarding the ruburunga plague I could not find out whether, at the time of a plague outbreak, there appears to be a notable mortality among the rats or not. Even Zupitza had not heard of such during his former residence in Bukoba. At present, however, he reports: "In the plague-stricken district rats are dying in great numbers; the people maintain that it is through these animals that the plague is spread and leave their huts as soon as they notice the dying of the rats." The very same thing was told to me during the plague epidemic in Bombay.

Fortunately, Zupitza succeeded in getting for investigation two rats which had died in different huts of a plague-stricken banana grove. In both specimens I found in all microscopical preparations, but especially in those taken from the spleen, plague bacteria in pure culture (*Rein-kultur*). Zupitza modifies his former statement regarding the ruburunga plague, in so far as, according to more recent and exact statements on the part of the missionaries, plague in this part of the country appeared for the first time seven or eight years ago; while, in the neighbouring district of Uganda it has been existing for forty years.

In a later report, Dr. Koch informs the Government that Dr. Zupitza supplied him with a great number of additional specimens prepared for microscopical research, as well as portions of infected bodies, and that in studying them he finds the fullest confirmation of the fact that the disease is genuine bubonic plague.

There being nothing new in this report, I merely give a translation of an extract referring to the alleged antiquity of the disease in Uganda, in which he says:

According to information received from the missionaries in Budu (the most southern part of Uganda), the plague has existed in Uganda for ages. During M'tesa's reign it ravaged the capital of the country. At present it occurs there sporadically only. In the course of time it has advanced more and more southward, and has been endemic in Budu for 30 to 40 years. Thence it has been repeatedly carried across the Kagera into Kisiba, the first invasion occurring about eight years ago.

REFERENCES.

- ¹ *Two Kings of Uganda*, 1889.
- ² *Mit Emin Pasha ins Herz von Afrika*, 1894.
- ³ *Medical Report on the Health of the Uganda Protectorate*, 1901.
- ⁴ *Uganda Protectorate*, 1902.
- ⁵ *Reise-Berichte über Kinderpest, Bubonenpest in Indien und Ost-Afrika, Tsetse oder Surra-Krankheit, Texasfieber, tropische Malaria, Schwarzwasserfieber* (Berlin, 1898).
- ⁶ In some of the English maps the name is given as *Usiba*.

A NOTE ON THE DIFFERENTIAL LEUCOCYTE COUNT IN WORM INFECTIONS.

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It has been well known for some years that the presence of many varieties of parasitic worms may be accompanied by an increase in the eosinophile leucocytes in the blood.¹ Positive evidence on this point is of proved value in diagnosis, but no inquiry seems to have been made on the frequency with which worms produce an eosinophilia, and hence the value of a normal differential count as excluding parasites is unknown. It seems worth while to put on record these few blood counts, since they are derived from a consecutive series of cases. Stained films have alone been examined, 500 or 1,000 leucocytes being counted in each case. It is therefore only the question of a relative, not an absolute, eosinophilia which is dealt with. The observations have, however, been made with the object of ascertaining how much information can be obtained by this simple method of examination. As far as could be seen none of the cases showed any considerable leucocytosis.

Table I. (p. 1268) contains the details of the counts of 18 children and 1 young adult who were infected with oxyuris. The eosinophiles vary from 0.4 to 13.7 per cent., the average being 5.8 per cent.; 42 per cent. of the cases show a percentage of

TABLE I.—*Oxyuris*.

	Age.	Sex.	Lympho- cytes.	Inter- mediate.	Large Hyaline.	Neutro- phils.	Eosino- phils.	Mast Cells.
J. E.	8	M.	12.9	3.8	3.8	64.8	13.7	1.0
C. E.	6	M.	19.6	16.8	1.6	48.6	12.8	0.6
A. S.	7	M.	33.6	9.6	4.4	42.6	9.6	0.2
R. U.	3½	M.	20.2	9.8	4.8	54.8	9.2	1.2
M.	3	F.	23.4	7.6	3.2	57.0	8.6	0.2
V. H.	2½	F.	38.2	12.2	5.8	35.8	7.4	0.6
J. H.	10	M.	43.0	6.6	4.8	39.4	6.2	0.0
M.	2	M.	17.4	7.0	4.4	43.8	6.2	1.2
M.	4	M.	35.8	10.3	3.6	42.9	4.8	0.6
J.	4	F.	39.6	9.0	3.6	43.0	4.6	0.2
P.	12	F.	51.4	7.6	4.4	34.4	4.2	0.6
W.	3½	F.	33.2	8.2	4.4	50.2	3.8	0.2
M.	1½	F.	31.2	8.2	6.2	50.6	3.6	0.2
B.	6	F.	33.2	13.2	6.2	43.6	3.6	0.0
S.	6	F.	44.8	6.9	4.3	40.4	3.6	0.4
V.	2	F.	41.8	4.2	6.2	44.4	3.6	0.0
R.	2	F.	34.6	10.8	3.2	48.8	3.6	0.0
			46.2	7.8	6.2	38.2	1.4	0.2
A. P.	18	M.	23.8		2.1	73.0	1.1	0.0
A. P.*	—	—	23.0		4.2	71.8	0.4	0.6

* Second examination.

more than 6—that is, a distinct increase—while 36 per cent. are less than 4 per cent. In less than half the cases, therefore, is any indication of diagnostic importance found in the blood examination. Indeed, it may be that the number of positive results should be considered to be lower even than this, since an eosinophilia may occur in children without any apparent cause. Zappert² was the first to call attention to this point, and for normal children gives 46 blood counts where the numbers of eosinophiles as a whole far exceed those recorded here, reaching in one instance the remarkable figure of 19 per cent. Zappert does not, however, exclude or take into consideration the question of worms, and it is at least not improbable that some, at any rate, of his children were infected with parasites. The experience of other observers has not confirmed the very high figures given by Zappert, though the fact that sporadic eosinophilias do occur in children has been confirmed. Table II. gives the percentage of eosinophiles in 10 consecutive cases of normal and (as far as could be ascertained) wormless children:

TABLE II.

Age.	Sex.	Eosinophiles.	Age.	Sex.	Eosinophiles.
		%			%
4	M.	0.0	3½	F.	3.0
5	M.	0.6	5½	F.	3.2
3	F.	1.6	2½	M.	4.8
4	M.	2.8	5	F.	5.2
5	M.	3.0	3	F.	5.4

Average=3.0 per cent.

It seems, then, to be clear that in the present series children who harbour oxyuris have definite increase of eosinophiles in about two-fifths of the cases.

Table III gives a few results of the blood counts for other varieties of worms:

TABLE III.

	Age.	Sex.	Infection.	Lymphocytes.	Intermediate.	Large Hyalines.	Neutrophils.	Eosinophiles.	Mast Cells.
E. P.	9	M.	T. saginata	14.4	15.8	9.4	47.0	13.0	0.4
E. H.	25	F.	Taenia	32.6	5.6	2.2	58.0	0.8	0.8
L.	10	M.	"		42.0		52.0	6.0	0.0
M. B.	13	F.	"	18.2	6.8	4.4	63.4	7.2	0.0
M. A.	27	F.	T. solium, 3 yrs. history, July 19	41.6	9.4	3.2	42.0	3.0	0.8
			July 21	38.8	14.0	1.8	42.2	2.6	0.6
A. B.	47	M.	" 4 yrs. history, July 19	25.4	12.2	8.8	55.2	2.6	1.0
			July 22	15.8	20.4	8.8	49.2	5.0	0.8
F. M.	2	F.	Ascaris	49.4	13.6	3.8	31.4	1.8	0.0
H. J. H.	5½	M.	"	19.2	8.0	3.8	66.0	2.8	0.2
R. J.	30	M.	Bilharzia, S. Africa, March 7	23.2	15.0	5.4	42.8	12.2	1.4
			March 30	19.8	9.6	5.2	51.8	13.2	0.4
			April 20	10.0	6.4	3.0	32.0	47.6	1.0
			July 23	19.6	6.8	2.6	64.0	5.2	1.8

The case of bilharzia (haematuria only present) had much improved, and only occasional ova could be found when the percentage of eosinophiles rose to 47.6; later on, when the count had fallen nearly to normal, eggs were still present in the urine, though there had been no blood for some time. In neither of the cases of ascariis was any eosinophilia present.³ Three of the six cases of tapeworms show some increase (6 to 13 per cent.), but the three cases in adults show normal counts.

An explanation of the irregular occurrence of an eosinophilia in these worm infections may possibly be found in the length of time for which the worm has been present. I have shown for ankylostoma⁴ that the greatest leucocytic reaction occurs soon after infection, and after a time wears off without the worm leaving the intestine. The same may well be true for oxyuris and taenia, though here it is impossible to ascertain the date of infection, even approximately. Two of the present cases of taenia infection had long histories. On the other hand, the variation may be due to individual predisposition, and may possibly be connected directly with age, as some of these results suggest.

There is nothing further remarkable in any of the counts except that in some cases the mast cells reach a rather high figure. In the oxyuris cases there are three counts of 1 per cent. or more. The cases with an eosinophilia of more than 6 per cent. have an average for mast cells of 0.62 per cent., while those with less than 4 per cent. eosinophiles only reach 0.26 per cent. mast cells. The association is also seen in the case of bilharzia (eosinophiles 19.5 per cent., mast cells, 1.15 per cent.), and in the two cases of T. solium, though there is no eosinophilia, the counts of mast cells are rather high.

For two of the cases here recorded I am indebted to Dr. H. S. D. Browne and Dr. C. G. Seligman.

NOTES AND REFERENCES.

¹ The figures of Bucklers (*Munch. med. Woch.*, xli, 1894, p. 22) are classical, but refer largely to mixed infections. ² *Zeit. f. klin. Med.*, xxiii, p. 244, 1893. ³ Has a case of pure trichocephalus infection with an eosinophilia been recorded? ⁴ *Journal of Hygiene*, vol. iii, 1903, p. 121.

THE ETIOLOGY OF BERI-BERI.

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In this asylum beri-beri has been endemic since shortly after its opening in 1887, the deaths from the disease averaging 45 per annum and the number of cases treated about 150 per annum for the five years ending 1900 out of an average daily number of 207. Since that date the disease had been nearly stamped out. Our numbers having considerably fallen it has been possible to move the patients at every few days' interval from one part of the asylum to another, thoroughly cleaning and disinfecting up behind as we move; more attention has been paid to the disinfection of clothes, bedding, furniture, single rooms, etc., and the ventilation and drainage have been recently improved. Above all, three years ago, two small wards were constructed on the sea beach four miles from town, and here all cases have been sent upon showing the slightest symptoms of beri-beri. These wards are washed out, walls included, in sea water, and then in a solution of mercury perchloride weekly. All woodwork is frequently whitewashed or tarred. The bed boards are soaked in sea water and dried in the sun twice a week. All clothing, bedding included, is changed and disinfected twice a week. The whole compound, consisting of sand, is raked over weekly, and thus thoroughly exposed to the rays of the sun, and from time to time the surface sand is collected and put on the beach below high water mark for a tide and then returned. All patients are bathed for at least half an hour daily, and are kept in the open during the whole day. Massage is used in all cases. The administration of strychnine, digitalis, iron, and very free purgation is the common medical treatment. To these precautions our present immunity from the disease—12 cases to date for the year and but 5 deaths in the last two years—is, in my opinion, due. One of these 5 deaths occurred in the seaside hospital, the other 4 patients were too maniacal to be sent there for treatment. Our patients, I may add, are all fed on Siamese rice.

Thirteen years ago I separated twenty healthy native patients on admission in two cottage blocks, giving them European food and no rice whatever. At that time beri-beri was very prevalent among the natives—we have never had any cases in Europeans or Eurasians—and I wondered