blocked that the embryos are unable to find their way to the blood stream. Thus Strube in the *Deutsche medicinische Wochenschrift*⁹ describes five such cases, from Natal and the Transvaal, where filarial embryos were found in the urine but none were present in the blood, which was carefully examined during the day and night. Lothrop and Pratt¹⁰ (p. 284) cite this paper in support of the statement that embryo filariae had been found in the blood of the negroes of the Transvaal. As a fact, however, the blood was free from embryos in Strube's cases.

Manson¹ asserts his belief that before embryos can be found in the blood by ordinary microscopic examination large numbers of parent worms must be present in the lymphatics. Annett, Dutton, and Elliott² (p. 67) were led to believe from their investigations that Manson's conclusions were not justifiable. The case which I now place on record would seem to have a direct bearing on the question, and would go to show that very few parent worms may be responsible for a large number of embryos in the peripheral circulation. Lothrop and Pratt,¹⁰ of Boston, report two cases of filariasis observed in that city, in one of which operation was performed for lymphatic varices and chylous hydrocele, with the removal of adult worms. In all nine worms were removed, of which two were males. There was, however, in their case no subsequent disappearance of the embryos from the blood; they were found present six months after operation. In their paper, which was published in 1900, they had collected 11 cases from the literature in which adult filaria bancrofti have been found, and, as far as they were able to ascertain, the adult worms had never before been found in the United States. I can find no case on record of a cure being effected by removal of the adult worms such as I now report. Manson³ (p. 505) states that the disappearance of filarial embryos from the blood which sometimes occurs in cases of lymphatic varix of long standing is doubtless due to the death of the parent parasites, but there is no suggestion that such a result may be brought about by operation.

The interference with the lymph circulation is often very great in these cases, and those who have had much experience in operating state that there is danger in attempting to excise affected tissues, lest in so doing the anastomotic circulation of the lymph may be interfered with to such an extent that matters may be made worse rather than better. Godlee¹¹ has quite recently, on the suggestion of Manson, operated with the view of producing an anastomosis between one of the dilated lymphatic vessels and a tributary of the internal saphenous vein. Subsequently another lymphatic had been introduced into the spermatic vein. The result had been extremely successful.

Apart from the presence of embryos the blood has exhibited other peculiarities in infected individuals. Gulland¹² has shown that there is a distinct eosinophilia observable when the embryos are present in the peripheral circulation. This, Gulland observes, brings filariasis into line with other parasitic infections—for example, ascariis, oxyuris, ankyllostoma, taenia, and trichina, in all of which eosinophilia exists. This, it is asserted, goes to show that the eosinophiles are concerned in protecting the body from the toxins of the parasites. Coles¹³ has confirmed Gulland's observations and has found eosinophilia in bilharzia disease also. Calvert¹⁴ made somewhat similar observations among Filipino prisoners at Manila, but he was of opinion that the eosinophilia was only characteristic of the early stages of filariasis, and that as the disease progressed the leucocytosis and increase in eosinophiles gradually decreased.

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BUBONIC PLAGUE ("KAUMPULI") IN CENTRAL EAST AFRICA.

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In the writings of several of the earlier explorers and missionaries in Uganda and in that part of German East Africa to the west of the Victoria Nyanza, frequent references are made to the occurrence of local outbreaks of a rapidly-fatal disease known in Uganda as "kaumpuli," and in German East Africa as "tubunga."

Their accounts of the disease are vague, but all seem to agree as to its being a bubonic affection, attended with a very heavy mortality. Some state definitely that it is plague. Thus Ashe, a missionary who saw much of the Baganda during the reign of M'tesa and M'wanga, says:¹

This frightful malady [small-pox] and the plague, a kind of black death, called kaumpuli, from time to time decimated the population of Buganda. The kaumpuli is recognized by the swellings in the armpits and in the groin, and by a terrible rise in the temperature of the patient. The fever runs its course in about twenty-four hours, and usually proves fatal. Small-pox perhaps kills more people, yet it is not so much feared by the natives as kaumpuli, of which they have the greatest terror, as it is supposed to be frightfully infectious.

Stuhlmann, referring to diseases prevalent amongst the Baganda, remarks² that the most feared is the so-called kaumpuli, which is in the highest degree contagious and deadly, and often wipes out whole villages. Where it appears the lymphatic glands begin to swell and suppurate, accompanied by symptoms of severe fever. Probably, he says, it is a kind of bubonic plague. The French missionaries use as a remedy plasters made by themselves, which they place upon the chest and back of the patient; but whether with good results or not he does not state.

Dr. Milne, acting Principal Medical Officer for Uganda, reports³ that a chief near Kampala informed him that "in Lugard's time it [kaumpuli] carried off very many people; in fact, it was worse than war." He also states that the Collector of the Budu district, Mr. Prendergast, had in 1900 under his own observation at Masaka seventeen men of the country police force who died in forty-eight hours with all the manifestations of a bubonic disease, and that many more cases were reported to him. The result of Sir Harry Johnston's inquiries⁴ was that

from accounts of English and French missionaries and the German authorities to the south of the Uganda border there is little doubt that in Budu, and perhaps also in Busoga, the bubonic plague, or some disease related to that malady, exists in an endemic or chronic form.

Also that

the bubonic plague, which is always simmering in these countries near the Victoria Nyanza, has visited Unyoro repeatedly, having largely brought about the depopulation of the Bwenli subdivision.

During 1900 and 1901 several letters were received by the administration authorities at Entebbe from the White Fathers of Bikira, a large missionary station in Budu, two marches south of Masaka, relating the occurrence of severe outbreaks of kaumpuli at their station and in its neighbourhood. One letter told of the death of one of the Fathers after only four days' illness; another stated that many rats had died in the huts of the natives and in the mission buildings. A medical officer was sent to them, but at the time of his visit there was no outbreak, nor did he discover any dead rats. I believe he came to the conclusion that the disease, whatever it was, was not plague. Shortly afterwards, early in 1902, the mission station at Bikira was closed by an order of the Bishop, and the Fathers were dispersed to other districts.

At the time of my recent visit to Uganda (November, 1902), a good deal of speculation as to the nature of kaumpuli was indulged in; but no medical officer of the Protectorate had succeeded in observing an authentic case of the disease. The Baganda are apt to apply their word for "plague" to any disease which carries people off suddenly; and, to add to the confusion, sleeping sickness was frequently called "kaumpuli" in the Sese Islands. It was certain, however, that sudden localized epidemics of some very fatal disease of a bubonic character, and of which the natives stood in great dread, did occur from time to time in the province of Budu, and had occurred in the past on a large scale in other parts of Uganda.

Having served for three years under the Indian Government as Special Medical Officer for Plague in the Bombay Presidency, I had been able to study the disease in the dark, ill-ventilated, low, mud houses, and filthy overcrowded

chawls of Bombay; and it appeared to me at first sight extremely unlikely that bubonic plague should be found in its most virulent form in the heart of Africa, where the natives live in grass huts, and where mud houses and overcrowding, from an Indian point of view, are almost unknown.

I left Entebbe on October 15th, 1902, with the object of journeying through Budu to make inquiries into sleeping sickness; but, after crossing the Katonga River into Budu, I found that sleeping sickness was practically unknown there. On the other hand, kaumpuli was talked of incessantly. From Masaka I paid a visit to the Sese Islands, where I learnt from Father Ramond, who spoke very good Kiswahili, that in kaumpuli swellings appeared in the neck and groin; while frequently there was great pain in the throat and chest, and sometimes dysentery. From Sese I returned to Masaka, and continued my march southward.

At Kiabogo I met with Father Essier, who had lived for some years at the ill-fated mission station of Bikira. He told me that in kaumpuli there was high fever and pain in the chest; the bubos, particularly those in the neck, were extremely painful, hard, and never had pus; they were treated with marking-nut or a cantharides blister. The odour from the patients was always very bad. Infection was conveyed, he thought, by clothing. In some cases there was dysentery. The average duration of the disease was three days. In the stage of collapse brandy or whisky was of great service. Most cases died suddenly. He informed me that hundreds of rats had died in the houses of the natives, but whether before the epidemics or after he could not say definitely.

From Father Gorgu, whom I afterwards met at M'barara, I learnt that, of the many cases of kaumpuli that he had seen, all had bubos—most commonly in the groin, but some in the axilla, a few beneath the jaw. They seldom suppurated, and were usually treated by the application of marking-nut, hot irons, or cantharides. He noticed no ulcerations, but dysentery and pneumonia were frequent; the latter cases were always fatal. Some cases died in six hours, but the majority lasted two or three days; all ages were affected; this year most of the cases were women. During the worst epidemics at Bikira deaths occurred at the rate of seven per week; and, where two or three occurred in one house and the rest ran away, they usually developed the disease later and died of it. Seven out of the eighteen cases in the mission hospital died in one week. Father Gorgu informed me also that kaumpuli was well known to the natives and dreaded by them long before the missionaries came to Bikira, eight years previously. For the first two years it broke out almost every month; but, since then, the disease had been most prevalent in March, April and May. Cases always occurred as soon as the rains began in March. He attributed outbreaks of both kaumpuli and kawali (small-pox) to the fêtes which were held annually in February. Fêtes were also held in December, and after them cases of both were sure to occur. Two or three dead rats were always to be found in the huts in which persons were suffering from kaumpuli, and once or twice they had been found in the mission itself. Father Gorgu told me further that he had heard from Monseigneur Tivenhac, the first Roman Catholic Bishop of Uganda, and now in Algiers, that about 25 years ago kaumpuli frequently killed very many people at Rabaga, the headquarters of their mission at Kampala.

Father Achte, whom I met subsequently at Fort Portal, kindly supplied the following facts with regard to Bikira:

He said that April, 1895, was the most severe outbreak—seven or eight people dying in a day. The wife of a small chief near Bikira died of it. Then the chief caught it and was taken to the mission, attended by all his household. He died on the road, and within a few days 11 of his people, including sons, relations, and attendants, all died of kaumpuli—in fact, I believe (said he) all the people who came with him, except one, died. Some persons who went to live in the house these people had occupied at Bikira became infected and died in four or five days. During the week after the chief left many other people died in his village; then the outbreak ceased. Some were sick only six hours and died while talking rationally. Father Achte himself saw many dead rats in infected houses and even in the house he himself lived in.

On nearing Bikira, I instituted a careful search for cases of kaumpuli. I divided my police escort into three parties—one to look after the camp, one to visit all the plantations and villages on one side of the road, while I took the opposite side with the third party and visited practically every habitation for miles round, returning to camp to examine cases of illness brought in by the second party or going with them to visit

persons who could not be moved. In this way I treated some 80 sick persons, but did not see a single case of kaumpuli, the majority of them suffering from ulcers, fever, or other simple disease. Throughout the chiefs asserted that there were no sick persons in their district. I found the mission station not altogether abandoned but in charge of a native priest. Although I spent a whole day in company with this man, three of my own people, one askari (policeman) and a native chief, examining every hut within a radius of a mile from the church and mission buildings, I found no kaumpuli—only a few cases of malaria, and one of venereal bubos. Out of 130 houses, only some 15 or 20 were inhabited, having been evacuated when the Fathers left the station six months before. Many of them contained beds, bedding, and cooking utensils, just as they had been left. There was no doubt that some serious outbreak had occurred, but it was equally clear that I had not been fortunate enough to arrive at a time when an epidemic of kaumpuli or any other disease was in progress.

After leaving Bikira I marched southwards to the Kagera river, on the south bank of which, at Kifumbo, in German East Africa, I had the pleasure of meeting Dr. Feldmann, the medical officer in charge of Fort Bukoba, who had very kindly arranged to meet me at that place. He at once declared kaumpuli to be genuine bubonic plague, and said that the disease was very well known at his station on the shores of the Victoria Nyanza and in the surrounding districts. At Fort Bukoba, in June, 1902, 15 cases of bubonic plague had occurred (he said), and 5 others were seen outside, resulting in the evacuation of the post for a fortnight, after which no more cases occurred. He had frequently found the bacillus pestis in the blood of the cases, both before and after death. Rats had died in numbers during the epidemic, and whilst it was threatening. Natives frequently brought them to the hospital, and he seldom failed, upon microscopic investigation, to find the bacillus in the glands, but he had then no media or apparatus for making cultures. He had had several cases of pneumonic plague, all of which proved fatal, but he had seen no plague carbuncles. The natives adopted no treatment for the disease, but as soon as a case occurred it was generally isolated in a hut specially built some distance from the village. If several cases occurred, the village was evacuated and a fresh one built some distance off. Dr. Feldmann said, too, that it was generally believed at Fort Bukoba that the plague was introduced each year into German East Africa from Budu because of its always occurring in the former place about June, when the rains had ceased, and when the natives were able to cross the Kagera River and journey southwards. This would appear to be supported by Father Gorgu's assertion that most of the cases at Bikira, in Budu, occurred during the rains in March, April, and May.

Dr. Feldmann's description of the various symptoms of the disease occurring at Fort Bukoba coincided accurately with those of bubonic plague in Bombay, as did all the accounts I was able to obtain from the missionaries, with the exception of the occurrence of bubos in the region of the neck. And there can be no doubt, however extraordinary it may seem to those who have studied the disease in India and elsewhere, that there exists at Bikira, in Budu, a province of the Uganda Protectorate, to the west of the Victoria Nyanza, a focus of bubonic plague, which annually gives rise to small but very virulent epidemics, and that from this focus the disease is carried at certain times of the year into German East Africa. It is also probable that the Egyptian epidemics have had their origin in this endemic centre in Uganda. The small epidemic of plague which occurred early in 1902 at Nairobi, in British East Africa, where some 40 cases, with 17 deaths, were reported, had its origin, in all probability, in India, for there is constant connexion between Bombay and the port of Mombasa, which is connected with Nairobi by means of the railway.

Kaumpuli seems, then, to have been known to the natives of Uganda for ages, but for the first account of the disease we are indebted to Koch, who, with Zupitza, a German colonial surgeon, proved that the disease was genuine bubonic plague.

Koch, in his report to the German Government,⁵ gives an interesting account of his and Zupitza's work in German East Africa, and as this plague centre in Equatorial Africa is, I believe, quite unrecognized by British authors, I attach here a translation of those parts of Koch's report dealing with the subject. After stating that he was requested by the German Government, in a message dated June 30th, 1897, to proceed to German East Africa in order to investigate a disease that

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.

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- 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