

ENTOMOLOGICAL RESEARCH IN BRITISH WEST AFRICA.

IV. SIERRA LEONE.

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(With a Map showing the distribution of Glossina and Sleeping Sickness, and 10 photographs by the Author.)

(PLATES XVIII.—XXII.)

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INTRODUCTORY.

The following report is the fourth of a series dealing with the blood-sucking insects which are or may be implicated in the transmission of disease in man and other animals. The previous reports have appeared in different issues of this Bulletin* and should be consulted in conjunction with this, as many aspects of a general character, which are equally applicable to all West African Colonies, have been discussed there and need not therefore be reiterated here.

The aims of the author and the methods adopted by him have also been given in considerable detail in the introductory chapter in the Southern Nigeria report and call for no further comment here, but the following paragraph from that report may serve to give some idea of the nature of what follows.

“The main object of the writer in order to further this investigation . . . was, therefore, to make as extended a tour as possible, visit the various stations,

* I. Gambia, Vol. II., pp. 187–239.

II. Northern Nigeria, Vol. II., pp. 301–356.

III. Southern Nigeria, Vol. III., pp. 137–193.

and so come in contact with those already interested in such work, or, by explaining the aims and methods of the Entomological Research Committee, to secure the co-operation of those who might be persuaded to aid in the scheme. Consequently, it was impossible for the writer to do any actual experimental work or devote any time to the study of life-histories or such-like investigations in any special locality. The report must, therefore, be considered as a general geographical survey, and taken with other notes and papers published . . . forms a résumé of recent work. Further it is hoped that it may serve to show not how much, but how little, is known of this aspect of the subject."

The Colony and Protectorate of Sierra Leone was traversed by the writer from March to November 1912, and the report, therefore, deals mainly with observations made during that time, but incorporated with these are the results obtained by other officers, chiefly medical, stationed in the Colony, to whom the thanks of the Committee are due.

The table of contents shows the general arrangement adopted, but a few words are necessary in explanation of this. I have laid great emphasis in previous reports on the factors which influence the distribution of the various blood-sucking insects, and have shown how geographical situation, various topographical features, climate, rainfall and humidity, the length and duration of the wet and dry seasons, and the various types of vegetation all have a bearing on such distribution. In this report I have also added two short chapters dealing with these aspects in Sierra Leone.

The arrangement of the material in the narrative always presents difficulties. It is obviously out of the question to discuss the various political divisions, as these are purely arbitrary and in no way connected with this subject. In the case of Sierra Leone the various routes adopted were chosen so as to follow as far as possible the different river systems, and consequently the narrative follows more or less closely the order in which the different regions were visited. With the aid of the appended map, any one desirous of doing so may easily collate all the information available for any particular district.

A list of all the blood-sucking insects and other arthropods so far known from Sierra Leone has been drawn up for reference, but it must be noted that several new species await description, and doubtless further research will add more.

A map has been added showing the distribution of the various species of *Glossina*, and the route followed by the author has been indicated so that it will be easy to locate any place mentioned in the text. It might be noted that a large number of villages not shown on the original map (G.S., G.S., no. 2082) have been added in red.

Sufficient has been said to indicate the lines along which this report was possible and on which it has been framed, and it is to be hoped that this résumé of work done may help to stimulate others to an elucidation of the important bearing of insects in relation to disease, to indicate lines along which such work may be most profitably accomplished, and to point out the means by which these pests may be diminished in number, and, if possible, eventually abolished.

I. GEOGRAPHY OF THE COLONY AND PROTECTORATE.

(1.) **Position and Extent.**

The colony and protectorate of Sierra Leone lies at the extreme western end of the Gulf of Guinea and, with the exception of the Gambia, is the most westerly British possession in West Africa. It is very irregular in shape, but roughly hexagonal; its extreme depth north and south is about 210 miles, and the extreme breadth east and west is roughly 180 miles. The coast-line runs irregularly in a north-westerly to south-easterly direction; it is about 210 miles in length, and has its extreme limits on the seventh and ninth parallels north of the equator. The total area is approximately 32,000 square miles.

The population of the colony is estimated at 77,000; that of the protectorate at 1,000,000. The Peninsula of Sierra Leone, on which Freetown stands, together with Sherbro' Island, Turner's Peninsula, and a number of small islands, of which the most important are the Banana Islands near the town of Kent on the Peninsula, the Turtle Islands off Sherbro' Island, and the Plantain Islands near Shenge on the mainland, constitute the Colony proper. The remainder is known as the Protectorate of Sierra Leone.

The Peninsula is about 25 miles in length, and from 10 to 12 miles in breadth at the widest part. It is one of the few points on the West African coast where there is high land near the sea. It is formed by a range of volcanic mountains running parallel to the sea; and there are numerous high peaks, the highest of which, Sugar Loaf Mountain, rises in conical form to a height of about 2,500 feet. The mountains are composed principally of syenite and laterite (a decomposition product), and are thickly wooded. They are intersected by numerous ravines and small valleys, and there are considerable tracks of level ground, especially on the eastern side, where it sinks into the mainland.

Freetown, the capital of Sierra Leone and the seat of Government, is situated about four miles up the Sierra Leone River at the foot of the chain of hills already mentioned. It is a large and important seaport and coaling station, with a magnificent harbour—the best in British West Africa; the population being estimated at 40,000 natives and over 1,000 Europeans.

Freetown holds a unique position amongst the ports of West Africa from the fact that a large number of Imperial Troops are permanently stationed there. These include, in addition to a local native regiment, a West Indian regiment and several hundred European troops. It is thus evident that the European population is augmented much in excess of that of any other town in West Africa.

It has already been noted that Freetown is an important coaling station. Practically every steamer which arrives there, either outward- or homeward-bound, takes on coal and water, and this necessitates a considerable intercourse between the steamer and the shore in the form of coolie labour. Further, it must be pointed out that all outward-bound steamers take on native crews at Freetown to work the cargo at the various ports on the coast and put them ashore again there on the return journey. The question of the intercourse between Freetown and the West Indies has also to be considered, when it is

remembered that troops are frequently transferred backwards and forwards between these two places.

From these facts, it will be evident that, from the point of view of the subject in hand, the sanitary conditions in Freetown merit serious consideration in connection with the possibilities of the spread of insect-borne protozoal diseases.

From Freetown a railway runs nearly due east for a distance of about 230 miles, nearly to the Liberian frontier, while a branch railway extends northwards from Boia Junction, about 65 miles from Freetown, through Ronietta, Roruks and Makump, where it crosses the Rokell River.

The only other port of call for ocean-going steamers in Sierra Leone is Bonthe, on Sherbro' Island; but this is visited only by intermediate and cargo steamers, and its importance entomologically will be discussed at greater length in the general narrative.

The configuration of the Protectorate varies much in the different localities. The parts on the banks of the rivers are, for the most part, low and swampy, while away from the rivers the country consists of low rolling downs, with here and there a range of hills rising to a height of about 3,000 feet. The country is well watered by rivers and streams, and is on the whole fertile.

(2.) Vegetation.

It is almost impossible to describe in any general way the distribution of the various zones of afforestation found in Sierra Leone. I have elsewhere* given in greater detail the nature and composition of the various types of forests, and the following classification must, therefore, be taken in conjunction with what was stated there.

As a general rule, it may be said that the type of forest found in any locality depends greatly on the length and duration of the wet and dry seasons respectively, and on the intensity of the rainfall; but the conditions in Sierra Leone have been seriously altered by extensive felling and cultivation on the part of the native. Consequently, the extent of the primeval forest and of the types of vegetation which follow its destruction depends greatly on the density of the population in the various parts.

The forest growths of Sierra Leone may be divided into:—(a) tropical rain forests, (b) savannah forests, (c) fresh-water swamp forests, (d) fringing forests and (e) mangrove forests.

It will be noted that there are no monsoon forests; this type of vegetation is associated with a fairly porous soil and a distinct differentiation of wet and dry seasons, with the latter more in evidence—a combination of factors not to be found in Sierra Leone.

At one time the whole of Sierra Leone must have been covered by tropical rain forests, but for the reasons given above, this type is now confined to the tops of mountains and a few isolated portions of the Protectorate. In addition

* Bulletin of Entomological Research, Vol. III., p. 143.

to these, one comes across a small patch near every town and village which has been preserved for fetish purposes. These groves are known as the "Bundu" and "Porro" Bush, and their sacred nature prevents their destruction.

As the distribution of the various species of *Glossina* in Sierra Leone depends almost entirely on the distribution of the different zones of afforestation, it might be well to note briefly the regions where each type is at present to be found.

(a) Rain forests. This name is given to a characteristic tropical forest in which the trees reach a height of 100 feet and over, and in which there is little or no liana growth. Nearly one-third of the Peninsula of Sierra Leone is covered with forest of this primeval type, while other mountain forests are found on the Kessewe Hills, south-east of Yonnibanna, and on the Kagnari Hills, 20 miles north of Bo (on the railway). These hills extend in a north-easterly direction for ten miles, from Mongheri to Makump. Rain forest is also found on the Kambui Hills north of Kennema (on the railway); on the Nimmini Mountains around Panguma; on the hills around Bumbonla; on the Loma Mountains (in Koinadugu district); also in the Gola Forest near Daru and Kailahun (Kanre Lahun); and on the right bank of the Mano River near Bandasuma and Mendikama.

(b) Savannah forests. When primeval rain forest is destroyed it is replaced by a drier type, namely savannah forest, and this in turn gives way to pure savannah. Savannah forests are to be found in the north of the Ronietta, Panguma, and Konnoh districts, and also in Karene and Koinadugu districts. There we find open woodlands with trees which rarely exceed 30 feet in height and which stand at some distance from each other—the intervening space being covered with grass and other herbaceous plants.

(c) Fresh-water swamp forests are composed of edaphic forms, and occur in swamps and swampy places. The vegetation is different from that of other forests, and bamboos, wine palms (*Rapha vinifera*) and screw pines (*Pandanus* spp.) are predominant. The ground is covered with shrubs, ferns, and mosses. No general idea of the distribution of these can be given, except that they occur wherever there is low-lying ground and an abundance of telluric moisture.

(d) Fringing forests also contain edaphic forms, but not so predominantly as in the case of swamp forests. They are found along the banks of rivers in the savannah country and owe their existence to the permanent supply of water.

(e) Mangrove forests are limited to the sea coast and are to be found along all the creeks and in all the rivers up to the limit of tidal influence, *e.g.*, from Freetown to Port Lokko, almost to the town of Rokell on the river of that name, to Kambia on the Great Skarsies River, and to Waterloo. Especially are they predominant in the vicinity of Bonthe on Sherbro Island, and in the numerous creeks and rivers which open into this region.

Without entering into any detail for the present, we might point out that *Glossina palpalis* is to be found predominantly in the mangrove forest, fresh-water swamp forest and fringing forest areas; *G. longipalpis* is restricted almost

entirely to the savannah forest ; and *G. fusca* to the tropical rain forest regions. More detailed information of the distribution of these species will, however, be given in the general narrative, but enough has been said to show the bearing of the nature of the vegetation on the subject in hand.

II. CLIMATE AND RAINFALL.

The Colony of Sierra Leone is small and compact, and at no point is it much over 200 miles from the sea. Consequently, one would not expect to find very great differences in the various parts. It must be remembered also that the meteorological data are very scanty and have not been kept in any regular manner over a definite period. After considerable difficulty I have, however, collected such data as are available, and have arranged them in tables so as to bring out the major features. Only for the year 1911 have I been able to get anything like complete information, but as no attempt has been made, prior to this, to tabulate systematically the data available, it is hoped that this grouping may serve as a basis for future work. The writer is fully aware that further information may modify some of the conclusions arrived at, but it is improbable that any radical changes will be necessary.

There are two distinct seasons in Sierra Leone, known respectively as the "wet" and the "dry." The former is generally spoken of as the "rains." It commences in May and lasts until about October, the commencement and close of the rainy season being heralded by tornados—violent thunderstorms accompanied by strong winds. The minimum humidity occurs at the end of March or the beginning of April, when the moisture is absorbed by the dry harmattan which blows intermittently from December to March. The harmattan is a very hot, dry wind which comes from the north-east, carrying with it fine impalpable dust from the Sahara.

The temperature, on the whole, varies little from day to day, the daily range, as well as the average daily temperature, being least in the middle of the rains, the period maximum of humidity.

Before one proceeds to tabulate and analyse the available meteorological data, it might be well to point out the locations of the various places where these were taken.

- (1.) Freetown—the exact locality of this station is described on p. 153.
- (2.) Bonthe is also situated on the coast, on Sherbro Island (*see* p. 180).
- (3.) Bo is a large station on the railway, 136 miles from Freetown, and about 60 miles from the coast (*see* p. 171).
- (4.) Daru is also on the railway, where it crosses the Moa River, 213 miles from Freetown, and less than 100 miles from the coast (*see* p. 172).
- (5.) Batkanu is situated on the Rokell River, about 60 miles from the coast ; it is the headquarters of the Karene District.
- (6.) Kaballa is in the north-east of the Protectorate, and is the most northerly station in Sierra Leone ; it is the headquarters of the Koinadugu District ; the country around is mountainous.

TABLE A.
Monthly Temperatures for 1911.

—	—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Freetown	Max.	91·3	91·7	92·0	91·7	87·8	86·6	84·1	80·2	85·1	85·1	89·3	89·5	87·86
	Min.	73·8	74·2	74·5	75·2	74·5	71·8	71·7	71·0	71·8	70·9	73·0	72·9	72·94
	Mean	82·55	82·95	83·25	83·45	81·15	79·2	77·9	70·6	78·45	77·5	81·15	81·2	80·58
	Range	17·5	17·5	17·5	16·5	13·3	14·8	12·4	19·2	13·3	14·2	16·3	16·6	15·8
Bo	Max.	88·32	94·25	94·3	91·5	88·44	86·3	83·2	81·6	84·8	88·7	87·2	88·4	88·08
	Min.	65·45	68·33	70·2	73·2	71·03	70·2	69·8	69·2	70·3	69·6	69·2	65·7	69·36
	Mean	76·88	81·29	82·2	82·7	79·73	78·2	76·5	75·4	77·5	79·1	78·2	77·05	78·72
Batkanu	Range	23	26	24	18	17	16	14	12	14	19	18	23	18
	Max.	90·9	95·3	96·27	95·4	93·8	90·6	86·8	84·67	87·12	90·04	89·3	89·09	90·77
	Min.	67·6	69·4	71·87	74	74	72·5	72·35	71·93	72·88	72·5	72·85	69·46	73·4
	Mean	79·2	82·3	84·07	84·7	83·9	81·5	79·57	78·3	80	81·27	81·67	79·27	81·26
Daru	Range	23	25	24	21	19	18	14	13	15	18	17	20	19
	Max.	86·86	97·17	94·14	89·7	89·6	86·9	83·3	86·7	87	89·6	93	87·4	89·28
	Min.	58·86	69·5	69·09	70·14	71·4	71·3	70·3	69·5	70·7	69·9	69·5	66·5	68·89
	Mean	71·86	83·3	81·6	79·9	80·5	79·1	76·8	78·1	78·8	79·7	81·2	76·9	79·73
Kaballa	Range	28	28	25	19	18	15	13	17	17	20	24	21	20
	Max.	92	94	96·9	95	92	87	83	82	84	86	87	89	88·99
	Min.	60·3	65	47·8	49	49	47	69	66	67	61	50	58	57·42
	Mean	76·14	79·5	72·35	72	70·5	67	76	74	75·5	73·5	68·5	73·5	73·2
Kaballa	Range	31	29	49	46	43	40	14	16	17	25	37	41	32

The foregoing table gives the maximum and minimum temperatures for each month in 1911, taken at five stations. A cursory glance is sufficient to show that, with the exception of Kaballa, there is very little variation at any of the meteorological stations, either as regards the monthly distribution of the maximum or minimum temperatures or the annual mean. The monthly range of temperature is also similar at all four stations. Kaballa, however, is furthest from the coast, being situated on a high range of hills, and consequently, although the maximum there is nearly the same as at the other stations, the minimum is considerably less, and the range is increased correspondingly. To this fact we shall return later when discussing this station.

TABLE B.
Monthly Record of Rainfall in inches in 1911.

—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Bonthe	1·00	0·43	0·40	2·95	11·82	23·19	24·54	33·53	25·66	17·33	8·17	0·71	149·63
Freetown	0·01	0·07	0·02	0·66	4·00	15·52	26·05	36·08	33·04	14·23	6·00	0·91	136·59
Bo	0·35	0·25	4·51	2·50	7·14	18·29	13·21	26·41	25·93	11·00	9·22	0·35	119·16
Batkanu	—	—	0·87	2·71	8·24	13·66	18·03	17·15	18·95	19·99	7·61	0·62	107·73
Daru	—	3·38	4·42	10·45	15·65	7·63	7·93	7·16	14·02	8·44	8·12	—	87·20
Kaballa	—	—	0·10	3·76	6·68	10·31	11·07	14·52	18·86	14·59	0·24	—	80·13

This table gives the monthly record of rainfall in inches for six stations in 1911. It serves to show graphically the duration of the wet and dry seasons

and the intensity of the rainfall in each month. The first obvious deduction to be made from it is the enormous rainfall in the coast towns, *i.e.*, 149·63 inches at Bonthe and 136·59 inches at Freetown, with a progressive diminution in the places more remote from the coast; *e.g.*, Bo and Batkanu (60 miles), 119·16 and 107·73 respectively; Daru (100 miles), 87·20 inches, and Kaballa (about 150 miles), 80·13 inches.

On one year's data it is hardly permissible to compare the monthly distribution of the rainfall, but the contrast between Bonthe and Kaballa can hardly be overlooked.

TABLE C.

Number of days on which Rain fell in 1911.

—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Freetown ...	2	1	1	6	18	29	30	30	26	27	11	3	184
Bonthe ...	1	1	2	9	19	23	29	30	26	24	15	2	181
Bo ...	2	1	7	11	19	25	30	28	29	25	15	1	193
Batkanu ...	—	—	2	6	9	26	31	31	27	30	14	1	177
Daru ...	—	5	10	12	18	21	21	19	22	20	15	—	163
Kaballa ...	—	—	1	8	13	22	25	23	23	26	5	—	146

Table C shows the number of days on which rain fell in each month in 1911 at the same six stations. In each case Bo is rather anomalous, but no deduction is advisable from only one year's records. On the other hand, this table bears out the last in such a way as to show that not only does the rainfall diminish in amount from the coast northwards, but the number of wet days also diminishes in a like manner; in other words, the total amount of rainfall is not due to greater concentration on a few days but is spread more uniformly over the rainy period.

TABLE D.

Percentage Humidity in 1911.

—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Bonthe ...	83	84	75	84	84	84	84	88	74	89	82	89	83
Freetown ...	79	76	76	75	82	84	88	90	87	82	80	79	82
Daru ...	78	62	70	74	90	85	88	88	90	87	79	83	80
Bo ...	63	64	92	71	80	84	84	83	83	79	83	75	78
Batkanu ...	66	60	75	67	80	80	83	89	79	83	84	83	77
Kaballa ...	48	58	56	66	78	78	88	88	83	82	83	54	71

In the above table is given the percentage humidity for each month in 1911 at the same six stations, and here again we find that the mean annual humidity is much less in the hinterland than on the coast. But it must be noted that the annual mean is not proportionately decreased by every monthly mean. During the rainy season—July, August, September, October and November—the humidity of Kaballa varies but little from that at Freetown (in one month,

November, it was actually higher). In other words, the humidity on the coast is more evenly distributed throughout the year, and a diminution in the rainfall in that region does not involve a corresponding diminution in humidity.

TABLE E.

Number of days on which Rain fell in Freetown in 1911.

—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1905 ...	2	—	—	3	12	27	25	27	23	21	12	3	155
1906 ...	—	3	2	6	22	24	26	23	21	19	6	10	152
1907 ...	—	—	—	—	—	—	—	—	—	—	—	—	160
1908 ...	—	—	2	3	17	22	20	24	29	23	11	—	151
1909 ...	2	2	8	6	21	23	29	29	26	23	16	4	189
1910 ...	—	—	3	4	15	24	31	30	24	23	11	5	170
1911 ...	2	1	1	6	18	29	30	30	26	27	11	3	184
1912 ...	—	2	—	2	11	26	30	24	21	18	8	3	145

Table E gives the number of days on which rain fell in Freetown from 1905 to 1912, with the exception of 1907, and shows that with few exceptions the number of rainy days is fairly constant. It will also be seen from this table that the months of June, July and August may be regarded as the period of heaviest rainfall.

The following table for 1911 will serve to emphasise in a graphic manner some of the deductions from the foregoing tables.

TABLE F.

—	Freetown.	Bo.	Batkanu.	Daru.	Kaballa.
Greatest amount of rain on one day	7·47"	7·08"	4·58"	2·45"	2·25"
Highest Temperature recorded ...	96·4°	99°	92·8°	97·8°	100°
Lowest Temperature recorded ...	65·8°	52·8°	60°	55°	41°
Greatest diurnal variation... ..	—	34·8°	26·6°	33·4°	57°

III. NARRATIVE.

(1.) Freetown to Port Lokko, Kaballa and back to Port Lokko.

This journey was accomplished between 19th March and 30th April 1912, *i.e.*, towards the end of the dry season when insect life is at its minimum. Consequently, it must be remembered that the number of species or even the number of specimens of any one species cannot be taken absolutely as a criterion of prevalence. A glance at the map will show that the records for *Glossina* on this trip are much fewer than on any succeeding journey, but at the same time there is little doubt that many more of the different species would have been found a month or two later.

The journey from Freetown to Port Lokko is made by steam-launch up what is known as the Sierra Leone River. In the early part, this waterway is very

wide, and consequently the launch never approaches the bank within the limit of flight of blood-sucking insects. After passing Tumbo Island which lies at the mouth of the Rokell River, the steamer enters the Port Lokko Creek, and this gradually narrows towards Port Lokko. Its banks are covered with mangrove swamp, and the number and variety of blood-sucking insects which inhabit its shores may be gauged from the fact that twenty-seven specimens belonging to seven different species were caught (very many more were seen) in about an hour in the launch, which was going at a speed of over 8 miles an hour. The following are the species referred to:—*Glossina palpalis*; *Tabanus fuscatus*, *T. laverani*, *T. socialis*, *T. kingsleyi*, *T. besti* var. *arbucklei*, and another species of *Tabanus* closely allied to *T. kingsleyi* but probably new.

Port Lokko is an important town situated at the head of this creek. It is the headquarters of a sub-district of Karene, and a District Commissioner is stationed there. Two companies of the West African regiment are also permanently quartered there. A launch runs weekly from Freetown to Port Lokko, but in addition to this there is a considerable number of large canoes continually carrying produce between these two places. Port Lokko is the terminus of one of the longest trade routes in the Protectorate, namely the Falaba-Port Lokko Road. Immense quantities of produce continually pass backwards and forwards along this road on the way to and from Freetown. There is one European and many Syrian stores; the permanent population is large, and the floating population sometimes exceeds a hundred daily.

The only blood-sucking flies caught in Port Lokko itself were *Glossina palpalis* and *Tabanus laverani*, and both these species were obtained in the rest-house. Two species of ticks were found, namely, *Haemaphysalis lewli* from a dog, and *Haemaphysalis parmata* from a harnessed antelope (*Tragelaphus scriptus*). Mallophaga were also found on a bush rat and a harnessed antelope, but these have not yet been identified.

The route from Port Lokko to Kambia and back to Port Lokko now to be described, is not one of the main roads in the Protectorate, but was selected as a means of examining the basins of the Great and Little Skarsies Rivers. The road from Port Lokko to Kambia crosses the Little Skarsies at Mange; from Kambia to Yana it follows the Great Skarsies; from Yana to Kamagbonse it again crosses the basin of the Little Skarsies; from Kamagbonse to Kamakoni it passes along the Mango River, which is a tributary of the Little Skarsies; while the remainder of the journey follows the Little Skarsies itself. The complete circular tour, therefore, gives a fairly comprehensive survey of these two river-systems.

The country from Port Lokko to Kambia is undulating, but less so after passing Mange on the Little Skarsies River. The general type of vegetation might be described as orchard-like, thin bush or low scrub, but wherever there are water-courses one finds heavy bush with large trees and interweaving lianes, giving dense shade. The varying nature of the vegetation in the open country away from the rivers is due to the mode of cultivation adopted by the natives. A strip of bush is cut down, burnt, and cleared for a rice farm. After the crop has been taken off, the ground is allowed to remain fallow for five years or more. Consequently the bush grows again, and the height and density of the vegetation

varies according to the number of years which have elapsed after the original clearing. The trees never attain any great height, but the undergrowth becomes denser and denser. The country is very populous, so that very little virgin forest now remains, in fact in this region it is almost entirely restricted to the fringing forests along the banks of the water-courses.

No blood-sucking insects were seen on this three days' journey, but it is more than probable that many exist at the various streams in the rainy season.

Kambia is a large and important town standing on the Great Skarsies River. Large sea-going canoes can ascend to this point at high tide even in the dry season, and this to a great extent determines its position. It is situated at the limit of tidal influence, and although the river bed consists of a mud flat when the tide is out in the dry season, it is several feet deep and about 200 yards wide at high water. A rocky outcrop which crosses the river acts as a dam, beyond which it is dangerous for large canoes to ascend. The banks are covered with heavy dense vegetation, and *Glossina palpalis* is to be found here all the year round.

Between Kambia and Yana the road is never far distant from the river and passes through several large towns, the most important of which are Bassia, Kukuna and Konta. The country is undulating and gradually becomes more hilly towards the north. The nature of the vegetation varies in the different places according to the density of the population and the amount of annual cultivation. On the whole it may be described as open bush country, but everywhere along the banks of the rivers and streams there is the usual heavy densely-shaded bush with high overhanging trees. The only blood-sucking insects seen during this trek were *Glossina palpalis* and *Tabanus laverani*. The former was found at Konta and Yana, the latter at Ganya. Ticks, however, were not uncommon; *Haemaphysalis leachi* was obtained from a dog, and *Amblyomma variegatum* and *Boophilus australis* were found in a cattle compound at Konta.

Konta is an important town situated on the left bank of the Great Skarsies. A custom's clerk is stationed here, as it is on one of the main trade routes between French Guinea and Sierra Leone, the river at this part forming the boundary between these two countries. According to this clerk, who was stationed there during my visit, tsetse are extremely troublesome in Konta during the rains, but diminish in number in the dry season, although they never entirely disappear.

A few cattle are to be seen at nearly every town on this road. They are not very large, are chiefly of a dun colour, have long horns, and no hump (Plate XVIII, fig. 1). The majority of them were in excellent condition and they seem to thrive well. Horses too are not uncommon—a remarkable occurrence for Sierra Leone, in most parts of which horses are practically unknown. Their presence here is due to the proximity of this part to French Guinea, and all have been brought at one time or another from that country.

The question of animal transport in Sierra Leone has occupied the attention of the Government for some time, and a number of donkeys were taken from the Gambia to Sierra Leone and sent to Port Lokko—perhaps the most unfortunate

situation which could have been selected. I shall return to this question later, but in the meantime, I should like to recapitulate what information I could gather from the owners of the various horses seen.

At the town of Pettifu there were two horses, one mare and one stallion, which had been brought from French Guinea about four months before. They both showed typical signs of trypanosomiasis, *e.g.*, considerable oedema of stomach, legs and scrotum; but I was unable to discover whether these symptoms had developed prior or subsequent to their importation into Sierra Leone. A mare at Laminaiia also showed signs of trypanosomiasis, and trypanosomes were found in its blood. On the other hand, one horse which had been in Bassia for over four years looked perfectly normal and healthy, and no history of swelling or sickness could be elicited from the owner, who rode it frequently. At Kukuna there were two horses; one had been there for about a year and seemed quite sound, the other presented very marked symptoms of trypanosomiasis, but the owner assured me that it had been six years in Kukuna and had never been what he called "sick," although it had always shown the same amount of oedema.

The subject is therefore well worth further investigation. Game is abundant in this region, and an examination of the blood of the various types, together with a systematic study of the different blood-sucking insects which are to be found there, might lead to very definite results. It is more than probable that the only species of tsetse in this district are *Glossina palpalis* and *G. longipalpis*.

Soon after leaving Yana, one enters the valley of the Little Skarsies, or the Kabba, the name by which it is known in this region. The country is very mountainous, and as the majority of the towns are situated either on the side or the top of lofty hills, trekking is very arduous—up one side of a hill some 900 feet and down the other. The sides of the hills and valleys are densely clad with heavy forest, but in most cases the tops of the hills are covered with grass and thin scrub. The sides of the hills are intersected by deep ravines which carry torrential streams in the wet season.

While the writer was crossing the River Lolo, a tributary of the Kabba, which in the dry season is merely a trickling stream with numerous small pools, *Stegomyia fasciata* was caught, along with *Tabanus kingsleyi*, while nearer Kondita the same species of *Tabanus* and also *Tabanus besti* were found. At the town of Kondita itself, at least one other species of *Tabanus*, not yet identified, was troublesome, and it is interesting to note that males of this species were obtained—a very rare occurrence. On the banks of the River Kabba, between Kondita and Kamagbonse, *Glossina palpalis* occurs. At Kamagbonse cattle, sheep and goats seem to thrive well.

The road from Kamagbonse to Kamba climbs steeply through thick bush and cane brakes to a height of 1,150 feet, when the country opens out into thin bush and scrub. About 2 miles from Kamagbonse *Glossina longipalpis* was captured. Kamba is the principal town of the western kingdom of the Yallunkas; it is well situated in an open clearing on the top of a large circular hill, and is extremely clean. The water supply is at the foot of the hill, and in the valley in which the stream runs the following blood-sucking insects were found:—*Glossina longipalpis*, *Tabanus* sp., *T. kingsleyi*, *T. quadrisignatus*, and one species of *Hæmatopota* near *cordigera*.

Between Kamba and Mussaia the country is broken, several hills of 500-600 feet rising up from the general level of the plateau. The vegetation consists of open bush, a certain amount of grass land (savannah-like), and frequent bamboo clumps—typical country for *Glossina longipalpis*. The town of Mussaia is situated about a mile from the Mango River. It is a very old town, the capital of the Yallunka kingdom, and is surrounded by an enormous stockade of large cotton trees. In the town itself mosquitos were very troublesome and a large number of both *Anopheles funestus* and *A. costalis* were caught. *Glossina palpalis* was found at the watering place on the Mango River and also in the town, along with *Tabanus pertinens* and *Tabanus* sp., the former of which was very abundant. A large number of ticks, *Haemaphysalis leachi*, were taken off the dogs and cattle.

The country between Mussaia and Kaballa consists of an open plateau covered with grass and a certain amount of thin bush merging in several places into open orchard-like patches.

The town of Kaballa is the headquarters of the Koinadugu District, and is excellently situated in a very mountainous region at an altitude of between 1,600 and 1,700 feet. Formerly it was one of the posts of the West African Frontier Force, but the troops have now been removed to Daru. Two European officials are, however, still stationed there, namely, a District Commissioner and a Medical Officer. The general plan of the station is as follows:—Several small hills, separated by shallow valleys, form a crescent, which encloses an extensive level plain, and opposite these are two other hills with valleys on each side which descend to the same level as the plain. On the highest of the first-mentioned hills stands the Commissioner's bungalow, with a commanding view of the station below and a large portion of the surrounding country. On another of these hills, but much lower down, is the Medical Officer's house, while still lower down—on the road to the plain—is the European rest-house. On the plain below (Plate XVIII, fig. 2) are situated the District Office, Post Office, Hospital, Jail, court messengers' barracks and clerks' houses. At one side of the valley there is a small stream which in the rainy season forms an extensive swamp, and it is noteworthy that the prevailing wind blows across this swamp towards the European quarters.

The slopes of the hill between the native lines and the European quarters are covered with low scrub and grass, and tall elephant grass actually extends to within a few yards of the Medical Officer's house. Cassava is extensively grown around the court messengers' lines, the clerks' quarters, the jail and the hospital. There can be no doubt that this state of affairs accounts to a great extent for the prevalence of mosquitos, sandflies, and other biting insects in Kaballa, and until the whole of this area is cleared, no hope for a diminution of these pests can be expected. Malaria is said to be extremely common in Kaballa, and one case of sleeping sickness was diagnosed there.

At the time of my visit, mosquitos were very troublesome, far in excess of what should be expected at that season of the year. The chief species found were *Anopheles funestus*, *A. costalis* and *Stegomyia suguens*. A small sandfly, *Ceratopogon* sp., constituted one of the chief pests. Other blood-sucking insects caught in Kaballa include *Tabanus kingsleyi*, *Tabanus luerani* and *T. besti* var. *arbucklei*. *Ctenocephalus felis* is not uncommon, while *Rhipicephalus sanguineus* and *Haemaphysalis leachi* were obtained from dogs

One cannot emphasise too strongly the necessity for extensive and continued clearing in Kaballa station.

From Kaballa the country is very hilly to Katanta, and the road, though following the valleys in places, nevertheless crosses over some moderately high hills. These hills are much more rocky than in the north, and the vegetation is scantier, but the valleys are thickly wooded, and oil palms occur in great numbers. Some of the towns are situated on the tops of these rocky hills, and are very inaccessible. Simimaia, the first of these at which a halt was made, is a densely populated Warra-Warra Limba town, built on a granite shelf on the south-east side of a ridge at a height of 2,300 feet. *Haemaphysalis leachi* was found on the cattle in this town.

Between Simimaia and Bafodea, *Glossina palpalis* was caught in numbers on the banks of the Mantia Stream, while *Tabanus kingsleyi* occurs in the town of Bafodea itself. The same species of tick as that found at Simimaia was obtained from the cattle here. Between Bafodea and Kamakumba the country is open, and the hills are very rounded, boss-like, and covered with grass, a few trees and some low scrub. The town of Kamakumba is situated in a kurimi, and *Glossina palpalis* was very abundant. Not far from Kamakumba *G. palpalis* was again found in a kurimi, and at the next halting place, Kamatoto, the same species of tsetse was taken, along with *Tabanus kingsleyi* and *T. argenteus*.

Kamatoto is a new town under a Limba Chief, but the great majority of the inhabitants are Foulahs and Mandingos who migrated from the town of Karima (see p. 167) owing to the population of the latter place becoming too large for the food supply, and the lack of grazing for their cattle. The migration commenced in April 1911, and over 200 head of cattle were transferred. In October of the same year the cattle began to die off, and before the following March 189 in all had died. The owners informed me that, prior to death, the cattle became emaciated, and in some cases the heart was considerably swollen. The general symptoms and course of the disease as described by the natives led one to suspect trypanosomiasis. The natives attributed the deaths to two causes: (1) they say that if cattle eat grass which has been previously cropped by bush-cow, the former inevitably die; (2) they attributed some of the deaths to a fly which they call Sisafi, and which they describe as slightly larger and darker than a tsetse. They had never caught one of these flies, but gave this opinion from the recollection of those which they had seen on the cattle and which were compared with some specimens of *Glossina palpalis* which I showed them. Their idea, however, was that these flies sucked all the blood, and the cattle died of anaemia. The connection between the deaths of the cattle on one hand and bush-cow and a blood-sucking insect on the other, in the mind of the native, is, to me, suggestive, when it is remembered that this information was given quite voluntarily and not after a number of leading questions.

A similar state of affairs to that described above came to my notice at a place called Yiraia Sokurella, also in Koinadugu District. A number of cattle, which were quite healthy when quartered in the town with its surrounding clearing for farms, were transferred to a new cattle compound about a mile from the town. This compound was made in an absolutely new clearing in the bush. In a short time, sickness broke out and soon all had died, while those left in the town were perfectly healthy.

In both these places, bush-cow and other forms of game are abundant, and in both places tsetse occur. Can it possibly be that, in making a new clearing in an area which has been overrun with game, a race of tsetse infected with a virulent strain of trypanosomes may be encountered, and that after extensive clearing has been accomplished and the game has been driven back, the infected insects die off, and the percentage of infected tsetse in succeeding generations becomes gradually less owing to the source of infection (on the assumption that this is the game) being reduced in numbers or removed altogether?

Whether this be the case or not cannot be determined off-hand, but it opens up a fruitful line of enquiry, and one which is of great importance to the Colony, inasmuch as it affects the native and European food supply, one of the chief industries of the natives, and a source of revenue to the Colony.

These two cases furnish an object lesson to the administration with regard to the removal of cattle from towns. There can be no doubt that there are too many cattle kept within the precincts of towns in Sierra Leone, but in view of these facts it would be highly injudicious to order the immediate transference of such cattle to camps some distance away. It might be well to see that the area selected for such camps was thoroughly cleared at least one year in advance of the removal of the cattle.

From Kamatoto to Karassa the country is open; bush-cow and elephant are not uncommon. *Glossina longipalpis* occurs in the bush, and *G. palpalis* was found on the banks of the Mango River. Near Katanta, on the same route, is a small stream which flows into the Mango River. *G. palpalis* was abundant there, and *Tabanus laverani* was found in the town itself. Two species of ticks, namely, *Amblyomma tholloni* and *Dermacentor circumguttatus*, were obtained from an elephant. This is the southern end of the hilly region. After Katanta the country slopes more gradually to the coast.

Between Katanta and Kamakwie, the only blood-sucking insect seen was *Tabanus kingsleyi*, but at Kamakwie, ticks (*Rhipicephalus sanguineus*) were found on dogs. Between Kamakwie and Kamakoni, the country is open and there is a large number of small villages. The following species were caught on this journey:—*Tabanus laverani*, *T. kingsleyi*, *T. quadrisignatus* and *Glossina palpalis*, while *Haemaphysalis leachi* were found on dogs. It is worthy of note that no fewer than eight male Tabanids were obtained between Katanta and Kamakoni on 21st and 22nd April—an exceptionally large number out of a total of thirteen.

Towards Laminaia, there are numerous extensive swamps, some with very tall, and some with short grass; there are also large rice farms—a type of country which reminds one of parts of the Gambia. Game is plentiful here including bush-cow, water-buck, cob, harnessed antelope, and duiker. The town of Laminaia is very dilapidated and filthy. A large herd of cattle is kept, and as these are all quartered within the town, houseflies constitute a regular pest.

G. palpalis was found near the river, and *G. longipalpis* in the more open parts; *Tabanus pertinens* was caught in the town itself, while the dogs and cattle simply swarmed with *Haemaphysalis leachi*, *Boophilus australis* and *Rhipicephalus sanguineus*. A number of immature nymphs of a species of *Amblyomma* were found on a water-buck.

The next two towns at which a halt was made, namely, Resorse and Rowerre, are what are known as "true cattle towns." Resorse is a large town of over 200 compounds, and Rowerre, is only slightly smaller. Each compound consists of one or more houses situated within a large strongly fenced cattle corral. The cattle are driven out to pasture during the day, and return at night to the corrals. Sometimes between one and two thousand cattle may thus be quartered in the town. These compounds are not over-clean, and the plague of flies may be better imagined than described. The following blood-sucking flies were caught at Rowerre:—*Glossina palpalis*, *Tabanus laverani*, and *T. kingsleyi*; while the cattle and the compounds swarm with ticks, chiefly *Amblyomma variegatum* and *Boophilus australis*. Rowerre may be regarded as the southern limit of the cattle country of the Timanis. The country south of this is practically all grass land with forests of African oak. It is very sparsely inhabited and there is little cultivation.

The only blood-sucking insect seen between Rowerre and Port Lokko was *G. palpalis*, while we were crossing the Mabole River at Mabanta. The latter is one of the outpost stations of the West African Regiment.

(2). **Port Lokko to Kaballa, via Batkanu** (main route).

The road from Port Lokko to Kaballa, *via* Batkanu, is at present the main north route for all officials to and from Kaballa. As soon as the northern extension of the railway crosses the Rokell River at Makump, a closer connection will be established with Freetown, and it is probable that this route will be more extensively used.

The Batkanu road runs in the valley of the Mabole almost the whole way to Kaballa, but the latter part lies in the basin of the Mawolo River. From Port Lokko to Batkanu the chief towns passed are Konta and Roballandugu. The whole of this country is practically level and the vegetation is park-like, with patches of low bush and grass land, and abundant oil palms. No blood-sucking flies were seen on this march.

Batkanu is a small town of about 25 huts on the Mabole River. Its importance, however, lies in the fact that it is the headquarters of the Karene district. Here are stationed a District Commissioner, an Assistant Commissioner, and a Medical Officer. The European station is situated some distance away from the native town and is a model of what can be done in the way of laying out and maintaining a station. Col. Warren, the District Commissioner, is fully alive to the necessity of extensive clearing, and not only is this being carried out around the station, but he has prohibited the growing of any crops within the station which might tend to shelter or serve as breeding places for noxious insects.

It might be noted, however, that the thick low bush which extends between the river and the Medical Officer's bungalow might with advantage be cleared in the vicinity of the bungalow, or, better still, when the time comes for the erection of a new bungalow, a new site might be chosen further away from the river.

The country around is park-like, with extensive stretches of grass. These latter are inundated with water during the rains. The banks of the river are very high and steep and are covered with dense bush and overhanging trees.

The advantage of clearing an area on either side of the watering places and main crossings might be considered. Game is plentiful within a very short distance of the station.

The following blood-sucking insects have been found at Batkanu :—*Glossina palpalis*, *Tabanus kingsleyi*, *T. taeniola*, *T. par*, *Culicomyia nebulosa*, *Anopheles costalis*, *Stegomyia fasciata* and *S. sugens*. The commonest tick is *Haemaphysalis leachi*.

Between Batkanu and Karima, the boundary between the Karene and Koinadugu districts, the road crosses the River Mabole twice. The country is practically level, and the general type of vegetation is similar to that south of Batkanu. One species of *Haematopota* was seen, but not captured, on this road.

Karima is a large cattle town of about 150 huts situated on the right bank of the Mabole River. Formerly it was much larger, but owing to its increasing size and the paucity of farming land and pasture, several small towns have separated off. One of these is Kamatoto, to which reference was made on page 164. The town of Karima is laid out in practically the same manner as Rowerre (see page 166). *Glossina palpalis* was the only blood-sucking fly seen there.

North of Karima, the hilly country is again entered and this extends the whole way to Kaballa. The road lies in the valleys of a long mountain range, so that with the exception of a few places travelling is not arduous.

Near Kaniki, the hillsides and valleys are covered with thin bush, and the country is extensively farmed. At this town *G. palpalis* and a species of *Ceratopogon* were abundant. Between Kaniki and Kafogo, *G. palpalis* was found at most of the streams, and *Tabanus kingsleyi* was seen at several places. At Kafogo the following were caught :—*G. palpalis*, *T. kingsleyi*, *T. besti*, *Simulium damnosum*, and *Ceratopogon* sp. From Kafogo to Kaballa, the road passes through Igaia. The country is mountainous as before and the vegetation is very similar to that described, but if anything, slightly higher and denser. At Igaia, *Glossina palpalis*, *Tabanus besti* var. *arbucklei*, and *Hippocentrum trimaculatum* were found. It is worthy of note here that between Igaia and Karassa (see map) *Glossina longipalpis* and *G. fusca* were captured by Dr. J. Y. Wood—the former at two places, the latter once.

(3.) Kaballa to Hangha.

The route now to be described is a very tortuous one (see map), and is divided between three distinct river systems :—the Rokell, the Bum or Sewa, and the Moa. The journey was accomplished between 30th May and 3rd July, a season when travelling was arduous and not without its discomforts, owing to the rains having set in, but at the same time a season when insects are much more numerous than in the preceding months.

The road from Kaballa to Yiraia Sokurella, via Falaba and Kombile, encircles the head-waters of the Rokell River (known as the Seli in this region), and crosses, not only the Rokell itself near its entry into Sierra Leone, but also a large number of its tributaries. From Kaballa the road to Falaba passes through Benikoro and Sonkonja, and this is part of the main Falaba-Port Lokko Road. The country is hilly, but the road for the most part follows the valleys.

The vegetation becomes more and more scanty towards the north, and the dense bush which clothed the hillsides and valleys south of Kaballa is gradually replaced by grass.

At the town of Benikoro, the following blood-sucking insects were captured — *Glossina palpalis*, *Tabanus kingsleyi*, *T. biguttatus*, *Hippocentrum trimaculatum*, *Stegomyia fasciata*, *S. sugens*, and *Ceratopogon* sp. *Stegomyia fasciata* was also caught at the riverside some distance from the town. Within the town itself I came across a “dug-out” log containing water used for tanning, and this vessel simply swarmed with *Stegomyia* larvae.

At Sonkonja, *G. palpalis*, *Hippocentrum trimaculatum*, *Anopheles funestus*, and *Stegomyia sugens* were the only blood-sucking insects obtained.

Falaba, a large town of over 200 houses, is an important trading base. *Tabanus kingsleyi* was troublesome on the road, while at Falaba itself the following were caught :—*G. palpalis*, *Tabanus* sp. n., *T. kingsleyi*, *T. taeniola*, *T. laverani*, and *T. subangustus*.

Between Falaba and Kombile, the country consists of low rounded hills almost entirely covered with grass. The whole area is burnt during the dry season, and this, to a great extent, accounts for the small number and the unhealthy appearance of the trees which remain, and the preponderance of grass. The only town of any size on this route is Gberea, but there are many fakais—the local name for small temporary farms or grazing grounds. Many cattle are kept in this region, and they are, on the whole, healthy-looking. One horse was seen at Kombile with all the outward signs of trypanosomiasis.

At Gberea, the following blood-sucking flies were obtained :—*Glossina palpalis*, *Tabanus* sp. n., *T. kingsleyi*, *T. ruficrus*, *T. subangustus*, *T. congolensis*, and *Stegomyia fasciata*; while at Kombile only *G. palpalis* (at the River Seli) and *T. kingsleyi* were captured.

Between Kombile and Serakolia, the country is an extensive undulating plateau intersected by small steep ravines. These ravines are covered with dense vegetation and abundant undergrowth. In most of these, *G. palpalis* was found. The plateau consists of open orchard-land, is park-like in character, or what is often described as open, African Oak forest. *Glossina longipalpis* was caught on the plateau. In addition to these two species, *Tabanus* sp. n., *T. kingsleyi*, *T. subangustus*, and *Hippocentrum trimaculatum* exist.

From Serakolia to Yiraia Sokurella is a long and arduous journey over very hilly country with abundant low bush; there are numerous small streams and swamps, and the road would hardly be passable towards the end of the rains. A very interesting feature of this journey was the finding of mosquito larvae in the “bush.” At a small river called the Waliki, while searching for pupae of *Glossina*, I came across several isolated pools in rocks, containing mosquito larvae. On breeding these out I found them to be *Stegomyia sugens*. A little further on, while crossing a large expanse of exposed rock at least 40 yards from any shade, I came across another pool of water, less than one inch in depth, also containing larvae. I had no thermometer to take the temperature of the water, but it was distinctly “warm” being exposed to the full force of the mid-day sun. These also turned out to be *S. sugens*. It may be noted that both these places were at least five miles from any human habitation and on a route that is not very frequented.

At Yiraira the following blood-sucking insects were taken :—*Glossina palpalis*, *G. longipalpis*, *Tabanus kingsleyi*, *T. pluto*, *Simulium damnosum*, and *Culicomyia nebulosa*. The last-named species was bred from larvae found in a pit containing a filthy liquid mass used in tanning. One tick, *Amblyomma splendidum*, was found on grass, and another species, *Rhipicephalus sanguineus*, was taken along with *Ctenocephalus felis* from dogs.

The first stage from Yiraira Sokurella is to Banda Karafa, with a halt at Firiwa. The country is hilly, and there are numerous kurimis. In several of these kurimis, *Glossina palpalis* was caught, while in the more open country *G. longipalpis* exists. At the town of Firiwa itself, in addition to the former species, *Tabanus kingsleyi* and *T. pluto* were taken. From a borrow-pit near the rest-house, swarming with mosquito larvae a number were taken. These, on being bred out, proved to be *Stegomyia sugens*, while from a tan-pit in the town, and from a hole in a decayed tree near the rest-house, several *Stegomyia fasciata* were bred out. One species of tick, *Haemaphysalis leachi*, was found on grass. At the crossing of the Bagwe (or Bagbe) River, as the Bum River is called in its higher reaches, and also at a tributary, *G. palpalis* was found on the road to Banda Karafa, while near this town the same species of *Glossina*, along with *G. longipalpis*, *Tabanus besti* and *T. kingsleyi*, were captured.

From Banda Karafa to Tirikoro the road passes round the base of the Loma Mountains and another smaller chain of hills which forms an eastern continuation. All the towns are situated high up on the rocky hillsides, and the vegetation is very dense. Numerous small streams and swamps had to be crossed, and travelling in this region is extremely arduous. The first town of any size on this journey is Kimadugu, where *Glossina palpalis* and *Tabanus argenteus* were found. A number of *Culicomyia nebulosa* were bred from larvae obtained from a "medicine" or "ju-ju" pot. Between this town and Kurubum, several *Hippocentrum trimaculatum* were caught, chiefly in the vicinity of the swamps mentioned. *G. palpalis* and *T. kingsleyi* were found near Kurubum. At Sandea, a small filthy town on the hillside, *G. palpalis* and *Stegomyia fasciata* were abundant; while at Tirikoro only *Tabanus besti* var. *arbucklei* and *T. pluto* were seen. The country around Tirikoro, an unimportant dirty village, is extremely interesting geographically, as it contains the sources of four large rivers. Its chief importance lies in the fact that here the Niger takes its origin, and flows almost due north; north-west round the Loma Mountains runs the Bagwe or Sewa or Bum; south-west flows the Bafi, a tributary of the Bagwe; and south-east runs the Mum, a tributary of the Meli.

Near the source of the Niger, in an exposed rock pool, similar to that described on page 168, several mosquito larvae were obtained and bred out. These proved to be *Stegomyia sugens*.

From Tirikoro to Kondundu the road traverses the region watered by the River Mum, a tributary of the Meli. The only blood-sucking flies obtained on this stage were *G. palpalis*, *Haematopota grahami*, and *Stegomyia fasciata*. The last-named were bred from larvae found in a hollow of a decayed tree near the River Mum. The country from Kondundu to Jahama lies in the basin of the River Bafi, a large and important tributary of the Bagwe. Owing to the different types of country and vegetation which occur in this region, it might be

well to take this part by stages. From Kondundu to Kokaro the country consists of a large plateau, from which huge granitic bosses arise on all sides. The vegetation is scanty, and tall grass predominates. The following are the records for *G. palpalis* on this route :—(1) At Telebo on the River Buo, (2) at Kenewa on the River Mansai, (3) very abundant at the River Bafi, (4) at a stream near Beraia, (5) at the River Sangha near Kokaro. On the road from Kokaro to Ka Yima, the same species was obtained at :—(1) a small river near Bumbanya, (2) the River Sumunyi, and (3) Ka Yima. *Tabanus besti* var. *arbucklei* was also found at Bumbanya, and *Hippocentrum murphyi* at Ka Yima.

Between Ka Yima and Iamadu, the country is undulating, and this may be regarded as the southern end of the Loma Mountain region. The vegetation is scanty and grass predominates, except on the banks of rivers and streams, where there is heavy bush and high shady trees. Iamadu stands on the bank of the River Bafi. *Hippocentrum murphyi*, *Glossina palpalis*, and *Simulium damnosum* were found here. Never have I seen the last-named species in such enormous numbers ; they rose in black clouds from a small stream which runs into the River Bafi.

Between Iamadu and Jahama *Glossina fusca* was found in thick bush on a ridge which forms the watershed between the Rivers Bafi and Moa. *G. palpalis* was obtained shortly after the crossing of this ridge at the base of the Nimmini Mountains. The trek from Jahama to Panguma parallel with the Nimmini Mountains was very uninteresting. Only one blood-sucking insect was seen, namely, *G. palpalis* at the River Woa (a tributary of the Moa), north of Panguma. At Panguma itself, *Haemaphysalis leachi*, *Rhipicephalus sanguineus*, and *Ctenocephalus felis* were obtained from dogs.

At Hangha *G. palpalis* was found near the railway line, and on dogs, *H. leachi* and *Rhipicephalus simus* were abundant.

(4.) The Sierra Leone Government Railway.

This railway runs from Freetown to Pendembu, a distance of about 230 miles, in an almost easterly direction ; a branch line extends north-east from Boia Junction, 65 miles from Freetown, to Makump, where it crosses the Rokell River. The country through which the main line passes rises gradually from Freetown to the terminus ; there are extensive clearings on both sides of the line and numerous swamps are crossed ; in places oil palms are cultivated, but rice is the staple crop in the vicinity of the railway.

As has been shown elsewhere, the rivers of the Protectorate flow from north-east to south-west, and consequently the railway crosses them all, with the exception of the Great and the Little Skarsies and the Rokell. The Rivers Jong and the Bum or Sewa are navigable for large canoes at the height of the rains from the sea to the railway.

From Freetown, the line passes along the north-eastern side of the Peninsula at the foot of the Sierra Leone Mountains to Waterloo. Several ravines are crossed and the sides of the mountains are densely wooded ; here and there steep waterfalls occur in the ravines, and the general effect of picturesqueness and grandeur is characteristic of this part of the line.

Waterloo, the headquarters of the District Commissioner for the Colony, 20 miles from Freetown, is situated at the northern end of the isthmus which separates the Peninsula from the Protectorate. It stands at the head of a large creek which is navigable at high water from Freetown. The vegetation in and around the town is very dense, and mangroves predominate at the head of the creek, which is tidal to this point. The out-going tide leaves an extensive mud flat, and this combination is extremely favourable for the occurrence of *Glossina palpalis*. In addition to this species the only other blood-sucking fly caught there was *Tabanus fasciatus*.

At Newton, 25 miles from Freetown, no blood-sucking flies were seen, but one tick, *Haemaphysalis leachi* was found on a bush-shrike (*Dryoscopus turetii*) shot there. At Songo Town, on the river of that name, *Tabanus besti* and *T. fasciatus* were caught, while on the dogs *Rhipicephalus sanguineus* were abundant. Rotifunk stands on the River Bumpe, which is tidal to this point; there *G. palpalis*, *T. besti* var. *arbucklei* and one male specimen of the rare blood-sucking fly, *Thaumastocera akwa*, were obtained.

Moyamba, 76 miles from Freetown, is the headquarters of the District Commissioner and Medical Officer of the Ronietta District; it stands on the banks of the Yambuta River. *Glossina palpalis* is abundant near the river, and *G. fusca* in the more densely wooded part around. *Tabanus fasciatus* and *T. besti* var. *arbucklei* are also very prevalent, while the following mosquitos are common:—*Stegomyia fasciata*, *Culex decens*, *Eretmopodites chrysoaster*, and *Toxorhynchites brevipalpis*.

The town of Bo is probably the largest native town on the railway, but its chief importance lies in the fact that it is also a large railway centre, since all passenger trains upwards and downwards remain there overnight. It is the headquarters of the Puisne Judge of the Protectorate, the Medical Officer of the Railway District, and numerous railway officials. The undenominational school for the sons of chiefs is also situated here, and teachers belonging to this institution along with the representatives of the trading firms augment the European population. In addition to these Europeans permanently stationed there, one must not overlook the fact that there is a considerable floating population, for example, the engine-drivers, who, in the case of up-trains, remain one night at Pendembu and the next at Bo; and in the case of down-trains one night at Freetown, and the next at Bo, and so on. Further, there are the passengers both up and down, who are compelled to leave the train for the night and occupy quarters in the Government rest-house. Bo has, therefore, probably the largest and most constantly floating population in the Protectorate.

Much has already been done to ameliorate the conditions of life at Bo, but considerably more will have to be accomplished in the way of clearing and general upkeep, especially in the railway reserve, before the blood-sucking insect fauna can be reduced to such an extent as might be expected in so important a station. Mosquitos are troublesome in the quarters of the permanent officials, but a perfect pest in the Government rest-house.

This rest-house stands in the railway grounds. The clearing of the surrounding bush is far from adequate (Plate XIX, fig. 1), and the supervision necessary when one remembers that the occupants are for the most part

quartered there only from 6 p.m. to 6 a.m. on the following day is almost totally neglected. Consequently one finds all sorts of rubbish and water-holding receptacles, *e.g.*, empty tins, hidden in the grass around. To these and many similar water-collecting utensils seen in a scrap-iron heap attached to the railway workshops may be attributed the large number of mosquitos which invade the rest-house.

According to the Medical Officer in charge of Bo during my visit, the supervision of this area does not come under his jurisdiction, and certainly no one else takes any interest in the matter—a truly lamentable state of affairs which ought to be altered in justice to the health of the visitor who pays nightly for his quarters.

The predominant mosquito is *Anopheles costalis*, but *Toxorhynchites brevipalpis* is also common. *Glossina palpalis* is frequently seen here, but not in any great numbers, while numerous *Tabanus brumpti* have been caught in the bungalows around the light in the evenings. It is rather characteristic of this species, as well as of *T. subangustus*, that it is nocturnal in its habits and is attracted by light. *Stomoxys nigra* was found in the train at Blama, but whether it actually breeds there or was conveyed some distance by the train is not certain. *Tabanus kingsleyi* occurs at Kennema and *G. palpalis* on the south side of the railway from the station. At Hangha *G. palpalis* is common, and the dogs there were infested by *Haemaphysalis leachi* and *Rhipicephalus simus*, while at Segbwima, about 20 miles further on, *Tabanus pluto* was captured. At Baiima *G. palpalis*, *G. fusca*, and *T. besti* var. *arbucklei* were seen in numbers.

Daru, the headquarters of the Sierra Leone Battalion of the West African Frontier Force, is situated on the Moa River about 213 miles from Freetown. The cantonments lie in the angle formed by the railway and the river, but the native town is on the opposite side of the river about a mile further on. Some of the Officers' quarters are placed along the top of a bank overlooking the railway, but the others are situated on high ground along the river bank. The native lines are laid out in such a manner as to extend inward from the river bank some distance higher up than the European reserve.

Owing to the untiring efforts of Drs. Murphy and Powell the blood-sucking insect fauna of Daru is now very well known. Thanks, however, to the energy of these two Officers and Col. Newstead, the Officer Commanding the Battalion, the number of insects now seen is not commensurate with what might be expected from an examination of the list of species.

The following have been recorded from the immediate vicinity of the cantonments:—*Glossina palpalis*, *Stomoxys calcitrans*, *Tabanus pluto*, *T. ruficrus*, *T. fasciatus*, *T. besti*, *T. besti* var. *arbucklei*, *T. secedens*, *T. thoracinus*, *T. marmorosus*, *T. postacutus*, Aust., i.l.,* *Stegomyia fasciata*, *S. apicoargentea*, *Culex invidiosus*, *Eretmopodites chrysogaster*, *Ochlerotatus cumminsi*, and *Toxorhynchites brevipalpis*.

As may be surmised, *G. palpalis* and the various species of *Tabanus* are confined chiefly to the bank of the river, but, especially in the wet season, one

* [A description and figure of this new species will be published by Mr. Austen in the next part of this Bulletin.—Ed.]

and all of these invade the various officers' quarters and the mess. Mosquitos were very troublesome during my visit, and along with Dr. Powell I made a survey of the various parts where larvae might be expected. In the house kindly put at my disposal by the Officer Commanding during my stay in Daru, nearly all the species of mosquitos mentioned above were obtained, and this may be taken as typical of all the European quarters.

Larvae were found in various water-filled depressions in the soil, in hollows in trees, in the receptacle formed by the bases of the leaves of pineapples, in canoes at the river-side, in pools in the concrete floor of the verandahs of unoccupied houses, and in the bamboo fencing around the gardens kept by the native soldiers. The last-named of these was the most important. Bamboos were used for fencing purposes and no attention was paid to where these were cut; so that in nearly every pole several inches of the terminal internode formed a receptacle for water. In every one of these examined, larvae were found, and in almost every case *S. fasciata* and *S. apicoargentea* were bred out. Three remedies for this unfortunate and dangerous state of affairs suggest themselves:—(1) to discontinue the use of bamboo for fencing purposes; (2) if bamboo must be used, to see that all the tops are carefully trimmed off immediately above the node; or, (3) to split the bamboo for some distance from the top.

The third of these is not very satisfactory, but it was the method adopted with the existing fences at Daru owing to its being impossible to uproot all the fencing at that time. It can be looked upon, however, as only a temporary measure, but Col. Newstead, when this state of affairs was pointed out to him, very willingly agreed to discontinue the use of bamboos for fencing at the earliest opportunity.

Of equally great importance and of a more permanent character is the question of extensive clearing around the cantonments. Dense bush extends from the railway line to the fencing around the various officers' compounds on the one side, and from the river bank to the compounds on the other. There can be no question that this whole area should be absolutely denuded of all vegetation, as the ground, being very uneven, contains many water pools in the wet season, and is a favourite dumping ground for all sorts of tins and rubbish by careless servants.

As pointed out to me both by the Medical Officer and the Officer Commanding the Battalion, the sanitary gang, as at present constituted, is totally inadequate for undertaking new work such as this; in fact, it has more than enough to do to keep the station as it exists at present in anything like a sanitary condition. Certainly some special effort should be made on the part of the sanitary authorities to establish and maintain in the first instance such a clearing as that mentioned, in order to abolish, so far as possible, the scourge of mosquitos and other blood-sucking insects from a station where so many white officials are constantly resident and in close contact with native troops.

At Baiima, a few miles further up the railway, *Glossina palpalis*, *G. fusca* and *Tabanus besti* var. *arbucklei* were found, while at Pendembu *G. palpalis* and a new species of *Tabanus* were the only blood-sucking insects seen.

As has been said, a branch line runs in a north-easterly direction from Boia Junction, 64 miles from Freetown, to Makump on the Rokell River. It passes

through Ronietta, Roruks, Yonnibanna, and Makump, thence across the Rokell River, and thus taps the oil palm country in the north of the Ronietta district, the Karene and Kaballa districts. At Makump is situated the large experimental factory established by Lever Brothers for the extraction of oil from the fruit. Consequently, this railway is destined to be one of the most important trade routes of the Protectorate, and as such should be duly regarded as a means for the spread of blood-sucking insects and of the dissemination of the diseases transmitted by them.

The following notes will serve to show what insects have so far been found and the localities at which they were taken.

At Ronietta, only *Glossina palpalis* was found, but between that station and Yonnibanna this species was obtained at several places, in addition to *G. fusca*, while the same is true of the road between Yonnibanna, Kumrabai and Mayosso (see map). At Mayosso, *G. palpalis* was abundant on the Pampana or Taia River and also in the houses in the town. *Tabanus secedens* was also obtained there. At Makump, on the River Rokell, *G. palpalis* was a perfect scourge, and in the thicker bush around *G. fusca* was common. In addition to these, *Haematopota* sp. n. and *Stegomyia fasciata* both occur in the native town, the latter in considerable numbers.

It must be pointed out that in this brief survey of the railway only a few of the most important stations were examined, and consequently the enumeration of the species given may by no means exhaust the various types which may occur at other places. Further, it cannot be said that the list given for the places examined are complete, as at other times of the year different species may occur. The systematic examination of the blood-sucking insect fauna of the various places on a railway ought not to be confined to the enumeration of the species which occur at the various stations and the elimination of these from such stations, but should be of a more searching character.

The rôle played by trains in transferring insects from one locality to another cannot be overlooked, so that the regions between stations are equally important in this respect, and too much attention cannot be paid to the nature of the clearings on the banks of streams and such-like, and to the drainage of borrow-pits, for these last, unless properly looked after, are invariably foci for the dissemination of mosquitos. It is well known that tsetse, TABANIDAE, and mosquitos are often carried long distances in trains and motor waggons, and may thereby be introduced with disastrous results into areas where they were previously unknown. Only one example of this need be cited, namely, in Accra, which was free from tsetse up to the time of the construction of the railway through a fly-belt. Now these insects are by no means uncommon, and it only remains to be seen whether they will permanently establish themselves there. Whether they do so or not, their presence is even now a serious menace to the existence of horses in that town.

(5.) Daru Sub-District.

This sub-district was traversed between 1st and 17th August with a view to an enquiry into the conditions which obtained in the out-stations of the West African Frontier Force with regard to blood-sucking insects. Two of these

stations, namely Kailahun and Dodo, which until last year formed part of Liberia, were visited, but the inspection of another, namely Tisani, which is further north, did not justify the time involved, as the Medical Officer in charge there had already made a small collection of such insects. These include the following:—*Glossina palpalis*, *Hippocentrum trimaculatum*, *Tabanus ruficrus*, *T. besti* var. *arbucklei*, *T. postacutus*, Aust. i. l., and two new species of *Haematopota*.

From Pendembu, the railway terminus, a wide, well-made road has been constructed to Kailahun (Kanre Lahun); no blood-sucking insects were seen along this road nor were any found at the station. One company of the West African Frontier Force is quartered there; the country is open and the lines well laid out on high-lying ground.

The next station visited was Dodo, and halts were made at Sandyallu and Kengama. The road to Sandyallu is very hilly and is surrounded by dense bush; the valleys for the most part contain extensive swamps, where *Hippocentrum trimaculatum* was abundant; in fact, this is the predominant species in such places in West Africa. In Sandyallu itself, the following species were caught:—*Tabanus besti* and var. *arbucklei*, *Haematopota* sp. n., *Ceratopogon* sp. and *Simulium damnosum*; the last-named species was very troublesome at the river-side, and *Ceratopogon* was abundant in the native houses. *Auchmeromyia luteola* was also seen in numbers in the native town.

The country between Sandyallu and Kengama consists of large rounded granitic hills, bare or covered with grass; the valleys are clothed either with grass or dense bush. The only blood-sucking fly seen during this trek was *Chrysops longicornis*. The eyes of this species are remarkable in their colouring. The ground colour is metallic emerald green, but along the upper margin there is a stripe of metallic coppery brown, while in the centre of the eye there is also an irregular but definite area of the latter colour.

Dodo is also an out-station of the West African Frontier Force; it stands on the River Keya, a tributary of the Mauwa, which eventually joins the Moa north of Daru. *Glossina palpalis* is by no means uncommon along this stream, and *Stomoxys calcitrans* frequents the town. It may be noted that cattle are kept there. *Auchmeromyia luteola* was also caught at Dodo, but the natives did not know of the floor maggot.

From Dodo to Giema the country is moderately open; at Giema *G. palpalis*, *Stomoxys calcitrans*, *Tabanus besti*, and var. *arbucklei* were obtained. Onwards from Giema to Gondema the country was more hilly and very heavily wooded. *Glossina fusca* was caught at several places between these two towns and also at the latter. Between Gondema and Bomaru the River Mauwa had to be crossed, and there *G. palpalis* was found. At Bomaru the only blood-sucking fly seen was *Tabanus besti* var. *arbucklei*. From Bomaru to Baiima, on the railway, the country is densely wooded and there are numerous small rivers and swamps. *G. palpalis* was very abundant at a moderately large river near Baiima, and *G. fusca* was obtained in the more heavily wooded parts on the road. At Baiima itself *G. fusca* and *T. besti* var. *arbucklei* were caught.

The country now to be described lies to the west of the Moa River, and a start was again made from Pendembu. Between this town and Manawa the

River Moa had to be crossed by canoe. At this part the river is wide and swiftly flowing, and there is a large island in the centre. While my loads were being carried across this island, *G. palpalis* constantly attacked the carriers, and the same species was troublesome at Manawa. From Manawa to Komatendu the road is hilly and runs parallel to the River Moa; at one place it passes close to the junction of this river with the Meli. The country is densely wooded, and *Glossina fusca* is by no means uncommon. At Komatendu a new species of *Tabanus* was caught, along with *T. besti* var. *arbucklei*. *Auchmeromyia luteola* was also obtained in the native town.

On a mongoose (*Mongos paludinosus*) several ticks were found; these according to Professor Nuttall are "apparently *Haemaphysalis leachi*, but not typical, being much shortened." A new species of *Ixodes* was also taken from the same host, while the lungs contained several specimens of *Porocephalus* sp.

Between Komatendu and Bendu the country is extremely hilly, and part of the watershed between the Rivers Moa and Male has to be crossed. The hills are heavily clothed with small trees and thick undergrowth, and *Glossina fusca* may be caught at almost any part of this region. The same species occurs at Bendu. From Bendu to Bunbumbo the road runs nearly parallel to the River Male, the country being fairly level. Several *G. palpalis* were caught at the River Loya, a tributary of the Male, near Bunbumbo. *Stomoxys calcitrans* was also common at Bunbumbo. A well-made wide road runs from there to Segbwima, on the railway; no blood-sucking insects were seen during this stage, but *Tabanus pluto* was caught at the town of Segbwima.

(6.) Daru to Bo, via Bandasuma.

The region now to be described lies south of the railway, and the route traversed crosses three distinct river systems. From Daru to Bandasuma the basin of the River Moa is followed, roughly parallel to the river. At Bandasuma the River Moa is crossed, and the road then passes over the low watershed which separates the Moa from the Kittam River; this last-named takes its origin south of the railway and flows almost due south into Lake Kassa, part of the lagoon which separates Turner's Peninsula from the mainland. At Largo this river is crossed, and near Tikouko the Bum or Sewa is again encountered; the river basin of the latter is followed until Bo is reached.

The country between Daru and Jowati is mostly level in the parts traversed by the road, but hilly to the east and north-east. These hills form the watershed between the Rivers Moa and Morro; they are forest-clad, but the level country is covered with short bush and is much under rice cultivation.

The first town at which a halt was made was Jowati, which stands at the confluence of two small streams which run into the River Moa. There *Glossina palpalis* and *T. besti* var. *arbucklei* were both found in numbers, and from larvae obtained in a "ju-ju" basin on a grave *Stegomyia fasciata* was bred out. It is worthy of note that from one of the *Glossina* caught here a semi-deposited pupa of a pale golden yellow colour protruded; the date was 19th August.

No blood-sucking flies were seen between Jowati and Mendikama, but at the latter town both *G. palpalis* and *T. besti* var. *arbucklei* were caught. Between

Mendikama and Juru the country is more hilly and covered with thick forest growth. *Glossina fusca* was common, and near swampy places and streams on the road *G. palpalis* occurred; *Stomoxys calcitrans* and a new species of *Tabanus* were caught in the town. From Juru to Bandasuma the road passes through thickly forested country, and the predominant species obtained was *Glossina fusca*. Reference to the map will show where these were obtained, so that it is unnecessary to detail each locality here. *G. palpalis* and *Tabanus thoracinus* were also caught near Giggema.

Bandasuma is a very large town, well laid out and very clean, situated on the bank of the River Moa (Plate XIX, fig. 2). Extensive clearings have been made for farming purposes and it says much for the way the town is looked after that only a very few specimens of *G. palpalis* were seen and no other blood-sucking flies were encountered.

Between Bandasuma and Falaba (2)* the country is forest-clad, and *Glossina fusca* was again plentiful all along the route. Falaba is a small town on a tributary of the River Moa. The following blood-sucking flies were obtained there:—*Glossina palpalis*, *Chrysops longicornis*, *Culex tigripes* var. *fuscus*, *Culex pruina*, and *Simulium damnosum*; the last-named was very troublesome.

Towards Bumpé, about half-way to Bandajuma, *Glossina fusca* was again met with, but after that point the country is much more open. Bandajuma was the old headquarters of the Sherbro District, but these are now removed to Pujehun. It will still, however, remain an important town owing to the fact that it is to be one of the new outposts of the West African Frontier Force. It is situated on the River Wanje, a tributary of the Kittam River; *G. palpalis* was the only blood-sucking fly seen there.

From Bandajuma to Sembahun the country is again well forested, and *Glossina fusca* was found at two places (see map). At Sembahun, on the River Yano, which runs into the Bum or Sewa not far from this point *G. palpalis* and *Simulium damnosum* were abundant, the latter in large numbers. The Bum River has to be crossed between Sembahun and Tikonko; there *G. palpalis* was caught; while at Tikonko the same species, *Toxorhynchites brevipalpis* and *Simulium damnosum* were also obtained. The forest in this region gives way to thick bush, while between Tikonko and Bo oil palms are frequent and extensive clearings have been made for cultivation.

(7.) Bo to Moyamba, via Tungea and Makump.

The region now to be described lies for the most part in the basin of the River Jong, but part of it also in that of the Bum or Sewa. It was traversed between the 19th and the 25th September; reference to the map will show the circuitous nature of the route.

From Bo to Dumballa the country is slightly hilly; thick bush predominates, but grassy knolls occur in many places. The only blood-sucking fly seen there was *Glossina palpalis* at the town of Dumballa on the River Tabe, which flows southward and enters the Bum north of Mafwe.

* To avoid confusion between this town and the other of the same name near Kaballa, I have added the numeral (2) after it.

Between Dumballa and Goraun the country is hilly and forms part of the watershed between the Rivers Bum and Jong. Goraun stands on the River Lia or Jaya, which flows into the Taia, which further on becomes the Jong. No blood-sucking flies were seen there. At a small town called Kennema a pony in good condition with no signs of trypanosomiasis infection was seen.

From Goraun to Jarra the road passes along the bank of the River Lia for the first part, and after that crosses numerous streams which run into the Bum. The country is composed of low rounded hills which are for the most part covered with grass with very little bush. Evidently the whole of this district is devastated annually by fire in the dry season. At Jarra *Tabanus ruficrus* and *Simulium damnosum* were caught,

Between Jarra and Gendema, a small town situated on the bank of the Sewa River, the road is undulating and numerous swamps and streams have to be crossed. At Jagbwima, where the River Sewa is first encountered, *Glossina palpalis* is common, and this species is to be found all along the river bank to Gendema. At the latter town *G. palpalis* was found along with *T. ruficrus*, *T. besti* var. *arbucklei*, and *T. postacutus*, Aust. i. l.

From Gendema to Kamboma the country consists of low rounded hills covered with grass and low bush; large granitic bosses occur in parts and there is abundant cultivation. This area is extensively burnt in the dry season. No blood-sucking insects were seen during this trek, and the only species obtained at Kamboma was *Simulium damnosum*.

Onwards from Kamboma to Tungea the country is more thickly covered with bush, and there are numerous swamps in the valleys. *Glossina fusca* was captured in the thick bush, and *Hippocentrum murphyi* in the swampy places where there was dense shade. The last-named species had not been described at the time of capture, and extended notes were made by the writer, but since then Austen has named it, and given a long specific description* from specimens caught by Dr. Murphy. It is unnecessary to quote my notes in full, but the following observations will supplement the description given by Austen. *Descriptive*:—The eyes of this species when alive are of a dull bronze green, and are traversed by four yellow horizontal zig-zag bands. *Habits*:—It is the most vicious biter yet encountered by the writer; in its mode and determination of attack it reminds one more of an infuriated wasp than a Tabanid; its dart is sudden and it seems to insert its proboscis before it actually alights. It appears to prefer shady places similar to those in which *G. palpalis* is found, but especially in the vicinity of swamps.

At Tungea in addition to *Glossina fusca*, *T. besti* var. *arbucklei* was caught. Between Tungea and Bewama the country is hilly and several swamps have to be crossed; it is covered for the most part with thick bush but is forest-like in places. In the more densely-shaded portions *Glossina fusca* is found, while in similar situations near the swamps *Hippocentrum murphyi* is common. At Bewama *G. palpalis* was caught on a small stream, a tributary of the River Taia, and in the town itself *T. besti* var. *arbucklei* and *T. postacutus*, Aust., i. l., were obtained. A species of *Amblyomma* was found on grass.

* Bull. Ent. Res. iii, pp. 135-6.

The road from Bewama to Mongheri crosses the River Taia at Jagbara and after striking across a bend re-crosses this river before Mongheri. *G. palpalis* and *H. murphyi* were found at Jagbara, and the same two species also occur at Mongheri. *Ceratopogon* sp. was also troublesome at the latter place. Between Mongheri and Yele the road skirts the southern end of the Kagnari Mountains, practically follows the right bank of the River Taia, and crosses several large tributaries of this river. *G. palpalis* was seen at several of these and also at Yele on the River Taia. Where the road runs near the mountains, which are densely clothed with thick forest, *G. fusca* was caught, while at Yele *Tabanus ruficrus* was obtained, and at a swamp near that town *H. murphyi* was captured. From Yele to Makump the road runs along the western side of the Kagnari Mountains and afterwards skirts the base of the Masamanka Hills. The whole country is densely wooded, and *Glossina fusca* is to be found almost everywhere (see map).

Between Yele and Mayeppa *G. palpalis* was caught on a stream near Dumballa, and further on again on the River Kanasi between Mayeppa and Matotaka. At the latter place *Eretmopodites chrysogaster* was bred from larvae taken from a calabash used as a "juju-" or "medicine-pot," and *Hippocentrum murphyi* were found near a swamp at the same place. The country between Matotaka and Makump is thickly covered with oil palms and there are numerous swamps. The River Pampana, or Sanden, or Taia, or Jong, is crossed not far from Matotaka. The town of Makump stands on the bank of the Rokell River, and on both these rivers *G. palpalis* occurs in large numbers, while in the heavily-forested region between them *G. fusca* is abundant. At Makump, in addition to *G. palpalis*, *Stegomyia fasciata* and a new species of *Haematopota* were obtained.

The region between Makump and Yonnibanna has been described by the writer when discussing the branch railway (see p.). Between Yonnibanna and Moyamba the only blood-sucking insects seen were *G. fusca*, near the town of Bambama, and *G. palpalis* at that town.

(8.) Moyamba to Bonthe, Subu, Mafwe, Mattru and Rotifunk.

Moyamba to Bonthe. This is the direct line of communication between Freetown and Bonthe and is the route by which the mails are carried. The first part, namely from Moyamba to Sembehun, is accomplished by road; the second part, Sembehun to Bonthe, by rowing boat down the Sembehun creek. A well-made road connects Moyamba and Sembehun through a densely-wooded country. *Glossina fusca* occurs at several places on this road.

Sembehun is an important town standing at the head of a long creek of the same name; its importance is due to the fact that the tidal influence ends there and canoes cannot ascend any further. Consequently it is a sort of loading and unloading inland-port for Bonthe. It is surrounded by mangrove swamp which is uncovered when the tide is out. *G. palpalis* is everywhere to be seen, and *T. besti* var. *arbucklei* is not uncommon.

The whole creek with its mangrove swamp is characteristic of all tidal reaches in West Africa. As far down as Yorke there are patches of higher land, and

there one sees small fishing villages, but beyond this town the whole area is under water at high tide in the rains, and the only signs of human habitation are a few fishing huts used during the dry season. Near Bonthe this creek is divided in two by Sherbro Island and opens into the sea east and west of this island. *G. palpalis* is everywhere abundant along the creek and *Tabanus fasciatus* and *T. besti* var. *arbucklei* are far from uncommon; *T. postacutus* was also found near Yorke.

Bonthe, as has already been stated, is an important port for ocean-going cargo steamers. It stands on Sherbro Island, is well protected from the sea, and is surrounded by mangrove swamp. A great amount of reclamation has been done and work of a sanitary nature is being constantly pushed forward. Clearing and effective sanitary measures have done much in recent years to diminish the number of *Glossina palpalis* which formerly must have swarmed over the whole area. The two most troublesome mosquitos are *Anopheles costalis* and *Stegomyia fasciata*, but according to Dr. Orpen, who was stationed there during my visit, these have also been greatly reduced in numbers in the last few years.

The journey from Bonthe to Subu was accomplished in rowing boats along the lagoon which separates Turner's Peninsula from the mainland. Owing to the large amount of fresh water which is constantly being poured into the lagoon by the Bum River, the water is brackish only for a very short distance from Bonthe, and consequently the mangrove area is very limited in this direction. This is gradually replaced by grass, palms, and generally shrubby vegetation. The shores are very low-lying and swampy (Plate XX, fig. 1). *Glossina palpalis* was caught at several places between Bonthe and Muchaj, and at the latter place *Anopheles costalis* and *Mansonioides uniformis* were troublesome.

Between Muchaj and Kattin the shores are again low-lying and swampy and are covered for the most part with grass, but here and there clusters of oil palms and bush are to be seen. *G. palpalis* was caught at Bap and Kattin and probably occurs in many more places in this reach. *Tabanus fasciatus* and *T. taeniola* were also found at Kattin, while in the bush behind this town *Anopheles mauritanus* occurred in numbers. Between Kattin and Subu there are many small villages which are high and dry during the dry season, but which are almost completely submerged in the rains (Plate XX, fig. 2); miles of grass land are similarly under water in the rainy season. The town of Subu is situated on Turner's Peninsula to the south-east of the mouth of the Bum or Sewa River. *G. palpalis* was obtained there and *T. fasciatus* was caught at several places between Kattin and Subu.

The town of Mafwe stands on the Bum River, about 50 miles from its mouth; to this point the writer ascended in a rowing boat. The banks on the lower part of the river as far up as Torma are similar to those in the lagoon and are covered with grass, with occasional stretches of overhanging bush. Near Gori the grass diminishes in amount and is eventually replaced by tall overhanging trees and dense undergrowth (Plate XXII, fig. 1). It may be taken as a fair guide to the distribution of *Glossina palpalis* in this region if one says that wherever bush occurs there that species will be found, but seldom, or never, where grass predominates. The same may be said of *Tabanus fasciatus*.

Torma will long remain a vivid memory in the mind of the writer on account of its mosquitos. His experience there was certainly the worst he ever encountered with these troublesome insects. As soon as the sun had set, they began to invade the rest-house and work was impossible. So numerous were they and so blood-thirsty that the process of undressing had to be conducted outside. By some means or other a few managed to win their way inside the mosquito net, and to remain in bed was simply courting disaster. Finally, my dog, which was chained to the bed, became restive and I had to get up and loose him. He made one rush for the door and did not return for hours, which was far from his usual habit. To return to bed was now impossible, and I was being bitten in every available spot. I counted over 300 on one side of my mosquito net at one time and in about twenty minutes I caught and chloroformed over 80 in glass-bottomed boxes. The buzzing noise emitted by the remainder could be heard many yards from the house. The rest of the night was spent in the open, and dressing in the morning was accomplished outside. The servants who were quartered in the town complained bitterly of their troubles with mosquitos during the night. On examination the following species were identified:—*Anopheles mauritanus*, *A. costalis*, *Mansoniodes uniformis*, and *M. africanus*, and it is more than probable that all these species occur in all the towns along the lagoon and on the river.

G. palpalis was caught at Gori and at several places between Demaboa and Mafwe, while *Tabanus fasciatus* was abundant all along the river. At Mafwe *T. fasciatus* and *T. besti* var. *arbucklei* were caught in a house in the town. Several specimens of *Porocephalus* sp. were obtained from a snake (*Naja albicollis*), four feet long, shot in the river.

The remainder of the journey to Rotifunk was accomplished overland. Between Mafwe and Mattru *T. fasciatus* and *T. besti* var. *arbucklei* were both caught on the road. Mattru is a large town on the Jong River at the limit of navigability for large boats from Bonthe. The following blood-sucking insects were obtained there:—*Glossina palpalis*, *Tabanus fasciatus*, *T. besti*, *T. besti* var. *arbucklei*, *Haematopota* sp. *Anopheles costalis*, *A. mauritanus*, *Mansonioides uniformis* and *M. africanus*.

The country from Mattru to Gbangbama is undulating and covered with low thick scrub (Plate XXI, figs. 1 and 2). *Tabanus fasciatus* was the only blood-sucking insect seen during this trek, but at Gbangbama *Glossina fusca* was obtained. A lizard (*Agama colonorum*) was caught there and found to be infested with a red ecto-parasite belonging to the genus *Geckobia*, of which hitherto only one species, namely, *neumannii*, has been described.

Gbangbama is the headquarters of a sub-district of Sherbro where an Assistant District Commissioner is permanently stationed. At the time of my visit a company of the West African Frontier Force was quartered there and considerable clearing had been effected for the erection of military lines and a large prison (Plate XXI, fig. 2).

The road from Gbangbama to Sembahun crosses numerous rivers and creeks at the limit of tidal influence, or in other words, at the extreme northern limit of mangrove swamp. At all these places *G. palpalis* was found. It is unnecessary to give these localities in detail, as all are recorded on the map. *Tabanus besti* was the only other blood-sucking insect seen during this trek.

Between Sembehun and Senahu the country is fairly level, swampy in places, and covered with low bush. At Senahu the following were caught:—*G. palpalis*, *T. fasciatus*, *T. besti* var. *arbucklei*, and a new species of *Haematopota*.

From Senahu to Rotifunk (on the railway) the country is undulating and is covered with low bush with abundant oil-palms. *G. palpalis* was caught at the River Male, and *T. besti* var. *arbucklei* not far from Rotifunk. At this town one male specimen of *Thaumastocera akwa*, a very rare species, was obtained. The following note on the colour of the eyes in the fresh specimen was made at the time of capture. "The upper two-thirds of the eyes is yellow with irregular bronze spots, while in the lower third the pattern is the same but the colours are reversed; in both cases the spots are irregularly disposed."

(9.) Rotifunk to Waterloo via Rokell.

Rotifunk stands on a small river, the Bumpe, which joins the River Walle, on which Senahu is situated, before it enters the sea. From Rotifunk to Robarri the country is undulating and covered with low thick scrub; there are extensive clearings for cultivation and numerous swamps. All along this road *Tabanus besti* var. *arbucklei* was plentiful. At Robarri, which stands on the Ribbi River, the vegetation is much thicker and continues so to Rokell. *Glossina fusca* was caught at several places in this region, along with *T. besti* var. *arbucklei*.

Rokell is situated on the left bank of the river of the same name, opposite the town of Mabile. Large canoes ascend from the sea to this town, but although the tidal influence is felt there, it is not brackish water and consequently there are no mangroves. *G. palpalis* is to be found all along the river banks, and *T. besti* var. *arbucklei* is very common.

Between Rokell and Ropat the road follows the river for the greater part of the way at varying distances from it. The same two species mentioned above were caught there, but in addition to these *Tabanus fasciatus* was also seen. From Ropat to Songo Town the country is covered with low bush and there is abundant cultivation. *T. besti* var. *arbucklei* and *T. fasciatus* were both plentiful along this road.

At Songo Town *Rhipicephalus sanguineus* was found on dogs, and at Newton Station *Haemaphysalis leachi* was taken from a bush-shrike (*Dryoscopus turetii*) shot there. The road from Songo Town to Waterloo follows the railway; at the latter town *G. palpalis* and *T. fasciatus* were obtained.

(10.) The Peninsula:—Waterloo to Freetown, via Kent.

The road from Waterloo to Kent, which is situated at the extreme south-east point of the Peninsula, passes along the base of the mountains from which Sierra Leone takes its name. With the exception of *G. palpalis* at Kent no blood-sucking flies were seen on this trek.

A visit was made to a small group of islands known as the Banana Islands, which form a continuation of the Peninsula; there are only two towns of any size on these islands, namely, Dublin (Plate XXII, fig. 2) and Ricketts; *G. palpalis* was found to be common along the beach and in both these towns.

A road runs from Kent to Freetown along the coast, and on it are situated several large and important towns, the chief of which are York and Hamilton. Several creeks surrounded by mangrove swamp have to be crossed by canoe, and at all of these *G. palpalis* was abundant. Reference to the map will show some of the places at which captures were made.

(11.) Freetown.

Freetown has always had a bad reputation for mosquitos, but thanks to the efforts of the Sanitary Department this stigma may now be partly withdrawn. In 1911, Dr. D. Alexander took over the duties of Sanitary Officer for Freetown and directed all his energies to the almost herculean task of abolishing these insect pests. By means of a careful and systematic examination of the various compounds and by a rigorous application of the mosquito ordinance, which makes the presence of mosquito larvae in any compound a punishable offence, the natives have been made more careful as to the water-containing receptacles in their preserves. This work was carried on in the face of great opposition on the part of the natives, and it will have to be continued in the same stringent manner for some time to come if the benefit already achieved is to be maintained and augmented.

At my suggestion, Dr. Alexander kept and bred out some of the larvae taken during his inspection, and also preserved many other sets of larvae which he had collected as evidence in criminal charges. It is unnecessary to give the details of the nature of the various receptacles in which these larvae were found, as the most of them are now well known, nor would it serve any useful purpose to give the exact localities where these were found, but it might be well to point out the types of mosquito found in Freetown.

By far the commonest and most widely distributed is *Stegomyia fasciata*; it may safely be said that this species bred out from over 90 per cent. of the samples taken. The other species found include:—*Stegomyia sugens*, *Anopheles costalis*, *A. funestus*, *Culex duttoni*, *C. invidiosus*, *C. decens*, and *Culicomyia nebulosa*.

An examination of the area at Cline Town, which belongs to the Government Railway, made by the writer along with Dr. Alexander, revealed a most deplorable state of affairs. Lying about all over the compound were iron and other utensils not in use, which served to hold small quantities of water. In every collection of water examined mosquito larvae were found, and in every case *Stegomyia fasciata* bred out from these. It should be borne in mind that all water-holding vessels should be examined and emptied regularly, as one can never be sure under what conditions *Stegomyia* may breed, *e.g.*, the water which was kept in the barrels used in the blacksmith's shop for cooling red-hot iron, and which must necessarily become fairly warm at times, was found to contain larvae. Materials used in railway construction, when piled up, in most cases formed suitable places for the breeding of mosquitos, and if such is to be avoided there is only one solution, namely, the storing of these under water-tight roofs.

Apart from mosquitos, blood-sucking flies are practically unknown in Freetown. *Glossina palpalis* occurs around Wilberforce and Hill Station and I have also

seen this species at Mirimar and Cline Town. One specimen of *Thaumastocera akwa* was caught by Dr. Kennan, in March, 1909, near a lamp at night in a house in Freetown.

IV. RECORDS OF BLOOD-SUCKING INSECTS AND OTHER ARTHROPODS FROM SIERRA LEONE.

The various blood-sucking insects and other arthropods which have been found in Sierra Leone have been referred to in different places in the Narrative, but it has been thought advisable to collect these and place them in tabular form. This list, however, cannot be regarded as complete, as a large number of specimens collected by the author still await identification, and a considerable number of these will undoubtedly prove to be new. It will be seen from the following list that quite a number of species have been recently recorded from Sierra Leone for the first time, and there can be little doubt that several more still remain to be discovered.

The distribution records of the various species are very scanty, and it is to be hoped that those whose inclinations turn that way will collect each and every species, and by keeping exact data help in mapping out the distribution areas of the different genera and species.

Order DIPTERA.

Family CULICIDAE.

<i>Anopheles costalis</i> , Lw.	<i>Eretmopodites chrysogaster</i> , Grah.
" <i>funestus</i> , Giles.	<i>Mansonioides africanus</i> , Theo.
" <i>mauritanus</i> , Grp.	" <i>uniformis</i> , Theo.
<i>Culex decens</i> , Theo.	<i>Ochlerotatus cumminsi</i> , Theo.
" <i>duttoni</i> , Theo.	<i>Stegomyia apicoargentea</i> , Theo.
" <i>invidiosus</i> , Theo.	" <i>fasciata</i> , F.
" <i>pruina</i> , Theo.	" <i>sugens</i> , Wied.
" <i>tigripes</i> , Gr. var. <i>fuscus</i> , Theo.	<i>Toxorhynchites brevipalpis</i> , Theo.
<i>Culicomyia nebulosa</i> , Theo.	

Family TABANIDAE.

<i>Chrysops longicornis</i> , Macq.	<i>Tabanus marmorosus</i> , Surc.
<i>Haematopota cordigera</i> , Bigot.	" <i>obscurifumatus</i> , Surc.
" <i>grahami</i> , Aust.	" <i>obscurissimus</i> , Ric.
" <i>laccessens</i> , Aust.	" <i>par</i> , Walk.
<i>Hippocentrum trimaculatum</i> , Newst.	" <i>pertinens</i> , Aust.
" <i>murphyi</i> , Aust.	" <i>pluto</i> , Walk.
<i>Rhinomyza stimulans</i> , Aust.	" <i>postacutus</i> , Aust. i.l.
<i>Tabanus argenteus</i> , Surc.	" <i>quadrisignatus</i> , Ric.
" <i>besti</i> , Surc.	" <i>ruficrus</i> , P. de B.
" " var. <i>arbutcklei</i> , Aust.	" <i>secedens</i> , Walk.
" <i>brumpti</i> , Surc.	" <i>socialis</i> , Walk.
" <i>congoiensis</i> , Ric.	" <i>subangustus</i> , Ric.
" <i>fasciatus</i> , F.	" <i>taeniola</i> , P. de B.
" <i>kingsleyi</i> , Ric.	" <i>thoracinus</i> , P. de B.
" <i>laverani</i> , Surc.	<i>Thaumastocera akwa</i> , Grünb.

Family MUSCIDAE.

<i>Glossina fusca</i> , Walk.	<i>Stomoxys calcitrans</i> , L.
" <i>longipalpis</i> , Wied.	" <i>nigra</i> , Macq.
" <i>palpalis</i> , Rob. Desv.	

Family CHIRONOMIDAE.

Ceratopogon sp.

Family SIMULIIDAE.

Simulium damnosum, Theo.

Order SIPHONAPTERA.

Family PULICIDAE.

Ctenocephalus canis, Curtis.

| *Ctenocephalus felis*, Bouché.

Family SARCOPSYLLIDAE.

Dermatophilus penetrans, L.

Order ACARI.

Family IXODIDAE.

Amblyomma splendidum, Giebel.

„ *tholloni*, Neum.

„ *variegatum*, F.

Boophilus australis, Fuller.

Dermacentor circumguttatus, Neum.

| *Haemaphysalis leachi*, Aud.

„ *parmata*, Neum.

| *Ixodes* sp.

| *Rhipicephalus sanguineus*, Latr.

„ *simus*, Koch.

V. VOCABULARY OF NATIVE NAMES FOR INSECTS.

The compilation of a vocabulary of native names for any group of animals is beset with many difficulties, and in the case of insects this is still more pronounced, inasmuch as these names are seldom or never given to the insects after handling or examination, but nearly always during their flight or when they have settled down and are biting or have already bitten. Consequently, one often finds that a single name may be applied to very diverse species or even genera of insects.

On the other hand, native names often give a clue to the bionomics of certain insects based on the observations of the natives. Consequently, I tried to obtain as many names as possible from the various tribes with whom I came in contact in Sierra Leone. By so doing the interest of the natives themselves was aroused, and one was able to make a start at instruction as to the dangerous nature of such insects, their methods of breeding, their habitats, and so on—a subject which is well worthy of the attention of the travelling medical officer.

It is not claimed for the following table that it is complete or correct in every detail, and the author will be grateful for any additions or corrections. The explanations given in the footnotes to the table are set down just as given to me by my interpreter in his own quaint manner of speaking; the identification of the genera and the species was made from an examination of actual specimens of these by the natives.

Name of Tribe.	MENDI.	TIMMANI.	KONNOH.	LIMBA.	KORANKO.	SUSU.	YALLUNKA.	F'ULA.
Sandfly...	Moie	{ Mutumut ³ Mapulut ⁴ .	{ Muri	{ Mumuti ³ Bono	Tumfia	{ Murumun- tangi. Moriki ...	{ Tumfia...	—
Mosquito.	Pundi ...	Emis ⁵ ...	Pundi ...	Sumusi ⁵ ...	Susi ⁵ ...	Sasi ...	Sasina ⁵ ...	Susuli.
Tsetse ...	Folleli ¹ ...	Kapup ...	Yoli ...	Folloi ⁷ ...	Joli ...	Heri ...	Chairena..	Luli.
Large Tabanid.	Kalloi ² ...	Obuk ...	Site ⁶ ...	Nakaba- riki. ⁸	Sigitega...	Siki ...	Sigitegina ⁹	Kuru- babi.
Small Tabanid.	Kalloi ...	Fott ...	Ywalli...	Mapetu ...	Sigitega...	Siki ...	Sigitegina	—
Flea ...	Bavi	{ Rusum ... Atur ...	{ Bafi ...	Merentem	Mure ...	Kari ...	Merentem	—
Jigger ...	Jigger ..	Jigger ...	Jigger ...	Jigger ...	Tumbe ...	Kuli ...	Jigger ...	Jigger.
Tick ...	Nyari ...	Amof ...	Doe ...	Dani ...	Doe ...	Doi ...	Duena ...	Koti.
Bed bug..	Bingbe- yaw.	Trolong...	Pamba- tala.	Bubuduni	Samba- kori.	Kuguri ...	—	—

(1) = "Black fly"; (2) = "Cut like a knife"; (3) = *Ceratopogon*; (4) = *Simulium*; (5) = "No let sleep"; (6) = *Tabanus pluto*; (7) = "Softly-softly biter"; (8) = "Quick Biter"; (9) = "Follow bush-cow" (Sigi = bush-cow).

VI. INSECT-BORNE DISEASES IN MAN AND OTHER ANIMALS.

Malaria.

As in all West African Colonies, this is by far the most prevalent insect-borne disease. Sub-tertian infections are most frequent, but benign tertian and quartan are far from uncommon. Of recent years, however, the number of cases has been gradually diminishing, owing in great part to the almost universal use of quinine as a prophylactic, the more prevalent use of mosquito nets and mosquito-proof rooms, the segregation of European quarters, and the sanitary measures adopted for the diminution of the number of mosquitos.

Practically nothing is known with regard to the species of mosquitos which are implicated in the transmission of the disease, but it is more than probable that *Anopheles funestus* and *A. costalis* are the principal culprits.

The number of recorded deaths from malaria from 1906-1909 are as follows:—1906, 118; 1907, 202; 1908, 150; 1909, 119.

The malarial index has been worked out for a number of towns in the colony, and the following are the percentages found:—Kent, 80; Tombo, 76; Waterloo, 69; Hastings, 64; York, 60; Dublin, 50; Ricketts, 41.

These figures taken in conjunction with the recorded number of deaths (which, of course, represents only a small proportion of the actual number) shows that malaria is still a factor to be reckoned with in the economic and social development of West Africa.

Yellow Fever.

In 1910, 13 diagnosed cases of this disease occurred in Freetown; these were not confined to one locality but were distributed over the town, some in the European part, some in the quarter where the Syrians congregate, and some in the purely native quarter. Ten deaths were recorded; these were as follows:—Europeans 5, Syrians 3, natives 2. In addition to these there were 11 suspicious cases, with one death. As has already been pointed out, *Stegomyia fasciata* is ubiquitous in Freetown, but stringent measures are being adopted for its diminution. A special Commission is also studying this disease in Freetown, as well as in all the other large coast towns.

Sleeping Sickness.

Only one diagnosed case of this disease has been recorded from the Protectorate, for though several other suspicious cases have been examined, no trypanosomes were found. During my tour in the Protectorate I came across two natives, a man and a woman, at Kamatoto, in the Kaballa district, both showing symptoms which seemed to indicate trypanosomiasis. Blood films were taken from each, but no trypanosomes could be detected.

The Principal Medical Officer in his annual report for 1910 says: "From the reports of Medical Officers I am inclined to think that human trypanosomiasis is at least not on the increase in Sierra Leone."

Trypanosomiasis of Stock.

This disease has been referred to in several parts of the report, but more especially on p. 164 with regard to Kamatoto and Yiraia Sokurella. There can be no doubt that this disease is very prevalent, but so far as one can gather it does not seem to account for anything like a heavy mortality, if we exclude the two exceptional cases mentioned.

In the Koinadugu district, cattle form a large source of the wealth of the natives, especially the Limbas, and an examination of the map shows that *Glossina palpalis* and *G. longipalpis* are very abundantly distributed in this region. The Timanis are great cattle breeders and reference has already been made to the large cattle towns, e.g., Rowerrri and Resorse, in the Karene District. In fact, it may be said that, with few exceptions, cattle are to be found all over the Protectorate. In most places they look exceedingly healthy (Plate XVIII, fig. 1).

It is very difficult to say how far immunity may have been acquired, but one thing is certain, namely that, despite all the conditions for infection being present, the rate of mortality is low.

On the other hand, Sierra Leone has a bad reputation for horses. Of seven examined between Port Lokko and Kaballa, near the Great Skarsies River, trypanosomes were found in the blood of three. The infection was very scanty and it is very difficult to say what the species was, but morphologically they appeared to belong to *Trypanosoma evansi*.

Some years ago, several donkeys were brought from the Gambia to Sierra Leone and quartered at Port Lokko—perhaps the most unfortunate selection of a camp that could have been made. In a short time nearly all died, but, so far as I could find out, no data or history of the cases is available for any definite conclusions to be drawn as to the cause of death. When I was at Port Lokko in 1912, I saw a foal belonging to one of these donkeys, and it looked in perfect condition and showed no signs of trypanosomiasis. This experiment is well worth repeating because, so far as one can see, the conditions are quite as favourable for donkeys in Sierra Leone as in the Gambia. The original experiment should be disregarded, as it proves absolutely nothing. If such an experiment be undertaken, it must be done under proper supervision and a detailed history, both clinical and microscopic, of every case should be kept.

The two epidemics referred to on p. 164 call for attention at this point. The history of these as given by the natives is certainly suggestive of trypanosomiasis, and one is immediately confronted by the question of the source of infection. I have nothing further to add to what has already been said, but I would once more point out the desirability of a systematic examination of the blood of all game, large and small. The solution of this problem and the introduction of animal transport to Sierra Leone would mean a material increase in the prosperity of the Colony.

VII. THE GENUS GLOSSINA.

This genus is represented in Sierra Leone by five species, namely:—*G. palpalis*, *G. fusca*, *G. longipalpis*, *G. pallicera*, and *G. nigrofusca*.

Of these, however, only the first three require to be taken into account in a discussion on distribution, as our knowledge of *G. pallicera* and *G. nigrofusca* is based on a single record in each case.

In my report on Southern Nigeria, I dealt at considerable length with the factors influencing the distribution of *G. palpalis*, *G. tachinoides*, *G. submorsitans*, *G. longipalpis*, and *G. fusca* in Nigeria, and the conclusions arrived at for that region are equally applicable to Sierra Leone. Briefly stated, it may be said that Southern Nigeria and Sierra Leone are almost identical in the conditions which tend to support the existence of the three species of *Glossina* to be discussed here.

In the report mentioned the following occurs: "This species (*Glossina palpalis*) is ubiquitous along the coast region and follows the course of all the rivers. It exists wherever the rainfall is great, where the dry season is not of long duration, where the vegetation is dense, and always along the basins of rivers. Where any or all of these factors are less accentuated, the number of individuals tends to decrease."

Reference to the chapters on Geography and Climate in this report will show that these conditions are fulfilled throughout the whole of Sierra Leone, and a glance at the map will be sufficient to indicate that this species is ubiquitous but follows more closely the river courses.

In the same report a comparison was made between the conditions most favourable to *G. submorsitans* and *G. longipalpis*, and it was pointed out that *G. submorsitans* inhabited the drier regions where savannah forest was predominant, while *G. longipalpis* was associated with a moister climate and a slightly denser type of vegetation. In no part of Sierra Leone are the conditions favourable for *G. submorsitans*, but in the Koinadugu district conditions similar to those in which *G. longipalpis* occurs in Southern Nigeria are to be found, and there, as the map will show, do we find this species widely distributed.

Glossina fusca favours dense vegetation and a moderately moist climate, and is to be found in Sierra Leone in the regions of densest forest growth; in fact, as the map will indicate, the delimitation of the forests (see page 155) is at the same time a delimitation of the areas where *Glossina fusca* occurs.

VIII. THE GENUS STEGOMYIA.

This genus being instrumental in the transmission of yellow fever, which is all too prevalent in West Africa, calls for some consideration. I have already referred* to two papers on this subject, the first by the late Sir Rubert Boyce, and the second by Dr. W. M. Graham, and I have also detailed the distribution of the various species of this genus in Southern Nigeria and elsewhere in West Africa.

In Sierra Leone three species are met with, namely, *S. fasciata*, *S. sugens* and *S. xpicargentea*. Reference has been made in different parts of this report to the breeding places of this genus, so that it is unnecessary to reiterate them here, and I shall content myself for the present with recording the localities in which each species has been found.

S. fasciata:—Freetown; Cline Town; Batkanu; Moyamba; Daru; Makump; Gberea; Tungea; Kondundu; near Kondita, at the River Lolo; Benikoro; Firiwa; Sandea; Jowati and Bonthe. In several places this species was found in the bush far from human habitations.

* Bull. Ent. Res., iii, p. 191.

S. sugens :—Freetown ; Kaballa ; Batkanu ; Benikoro ; Firiwa ; Sonkonja ; Tirikoro. In one case the larvae of this species were found in a pool in the river Waliki, over 5 miles from a human habitation, and again in a pool in an exposed rock near the source of the Niger, at least two miles from the nearest village.

S. apicoargentea :—Daru.

From these data it will be seen that this genus, and especially the species *fasciata*, is not restricted to any definite region but occurs at very widely separated localities in the Colony and Protectorate. In Freetown more than 90 per cent. of the samples of mosquito larvae found in the native compounds and elsewhere proved to be *S. fasciata*.

IX. PARASITES OF MAMMALS, BIRDS AND REPTILES.

Scattered throughout the report will be found records of the various ecto- and endo-parasites from mammals, birds and reptiles, examined in Sierra Leone. It might be useful, however, to collect and bring together all such records in a form more handy for reference.

The author hopes at some future time to make a more exhaustive study of the various parasites in West Africa, their hosts and distribution, but in the meantime little more can be done than to tabulate those found in the different colonies. During my tour in Sierra Leone, I made a large collection of Mallophaga and Anoplura from mammals and birds ; several of the birds were obtained by the author, but the great majority were shot by Major H. J. Kelsall, R.A., who accompanied me on a bird-collecting tour for two months. These parasites have not yet been identified and cannot be included in this list. Many worms taken from different hosts also await identification, so that the following list can be regarded only as provisional.

MAMMALS.

Cattle :—*Boophilus australis*, *Haemaphysalis leachi*, *Amblyomma variegatum*.

Dogs :—*Rhipicephalus sanguineus*, *R. simus*, *Haemaphysalis leachi*, *Ctenocephalus canis*, *Ct. felis*.

Elephant :—*Amblyomma tholloni*, *Dermacentor circumguttatus*.

Water-buck :—*Amblyomma* sp.

Bush-buck or Harnessed Antelope :—*Haemaphysalis parvata*.

Marsh Mongoose (*Mungos paludinosus*) :—*Haemaphysalis leachi* (see page 176), *Ixodes* sp. n., *Porocephalus* sp. (in lungs).

BIRDS.

Bush-Shrike (*Dryoscopus turetii*) :—*Haemaphysalis leachi*.

Bush-fowl or Francolin (*Francolinus bicalcaratus*) :—*Haemaphysalis leachi*.

REPTILES.

Black Cobra (*Naja albicollis*) :—*Porocephalus* sp.

Lizard (*Agama colonorum*) :—*Gekobia ?neumannii*.

In conclusion, I wish to take this opportunity of thanking His Excellency the Governor, Sir E. Mereweather, K.C.M.G., and all those officials with whom my

work brought me in contact. Especially should I like to express my indebtedness to Mr. E. E. Evelyn, I.S.O., through whom all arrangements were carried out in a most expeditious manner; to Dr. R. M. Forde, the Principal Medical Officer, and Dr. R. H. Kennan, the Senior Sanitary Officer, for their kind co-operation; to Dr. D. Alexander, now Senior Sanitary Officer of the Gold Coast, and Col. Newstead, the Officer Commanding the West African Frontier Force at Daru, for much kind hospitality and assistance; to all those who have sent collections and whose records are included in this report; and also to the various officials, medical and political, in whose districts I travelled, for their kind hospitality, their whole-hearted support, and the many ways in which they helped to further the investigation.

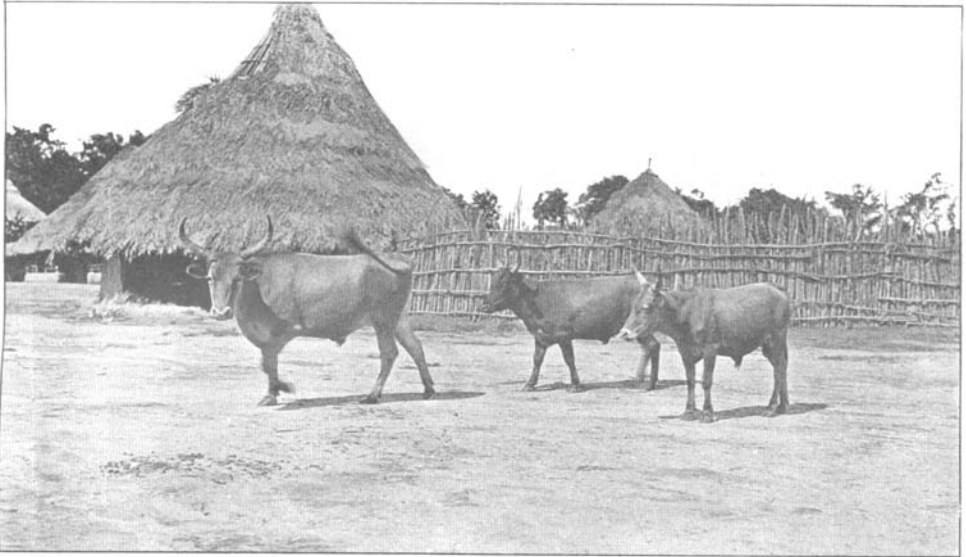


Fig. 1. Sierra Leone Cattle.

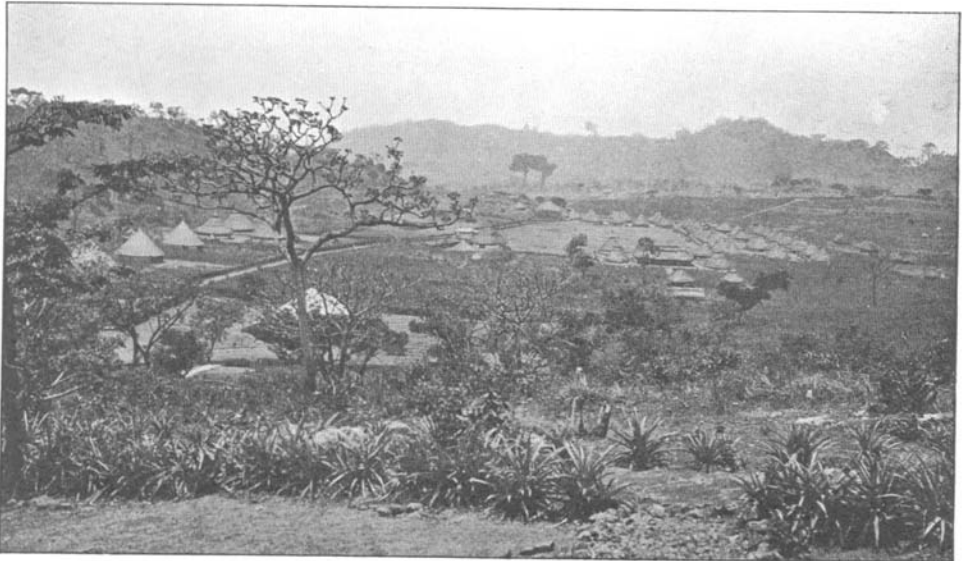


Fig. 2. View of the native lines, Kaballa.



Fig. 1. View to show the nature of the bush around Bo.

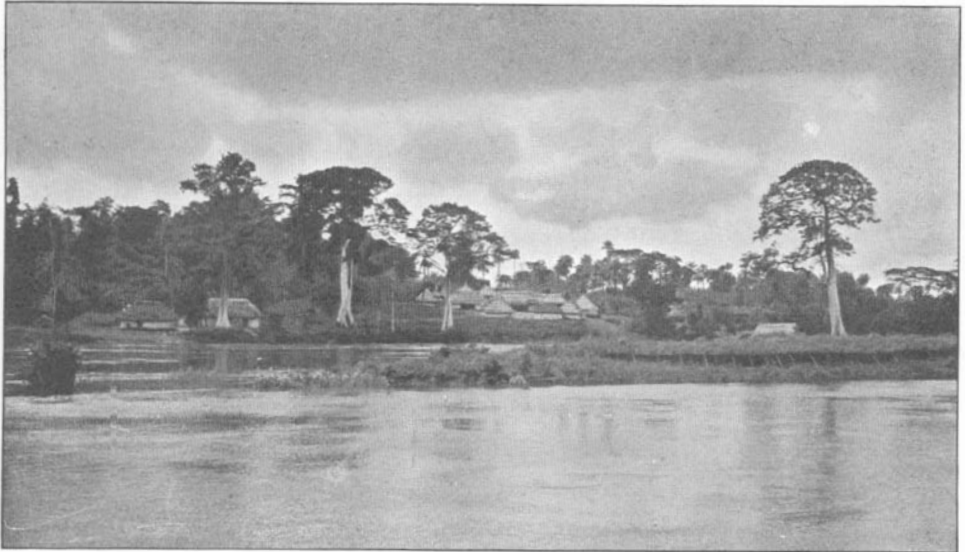


Fig. 2. View on the Moa River at Bandasuma.



Fig. 1. View on the Bum Kittam River showing the low-lying swampy nature of the banks.

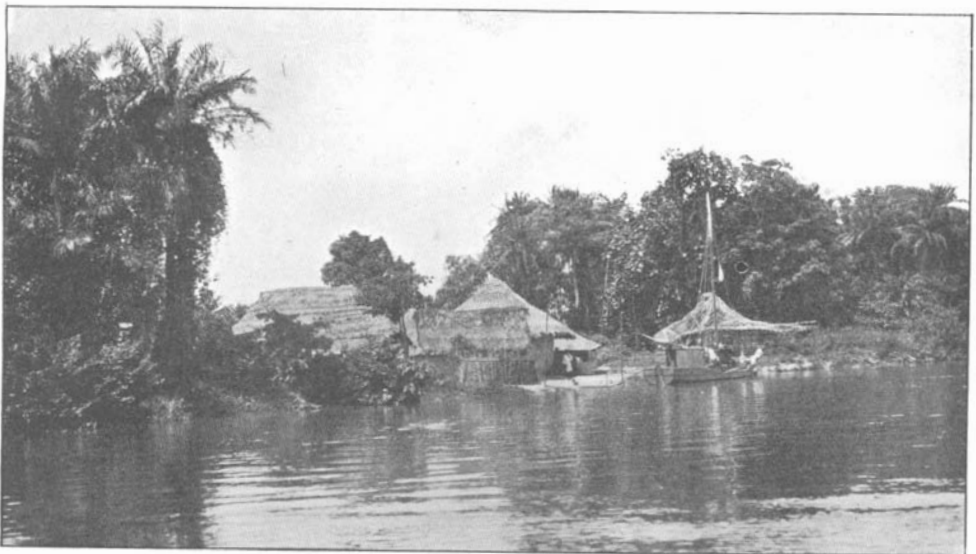


Fig. 2. Another view on the Bum Kittam River.



Fig. 1. View at Gbangbama showing the nature of the country and the position of the Commissioner's bungalow.

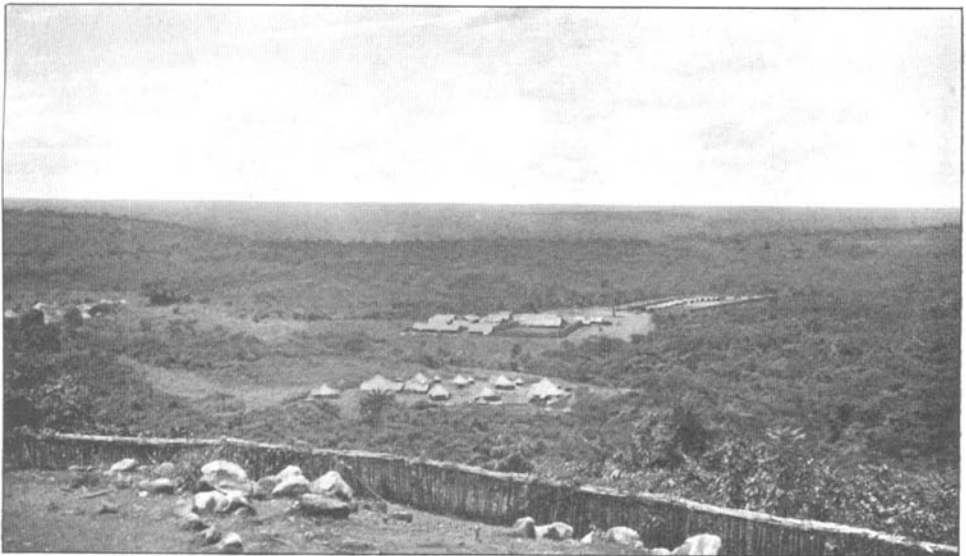


Fig. 2. View at Gbangbama, taken from the Commissioner's bungalow, showing the soldiers' lines and jail.



Fig. 1. View on the Bum or Sewa River, showing the nature of the vegetation near Mafwe.



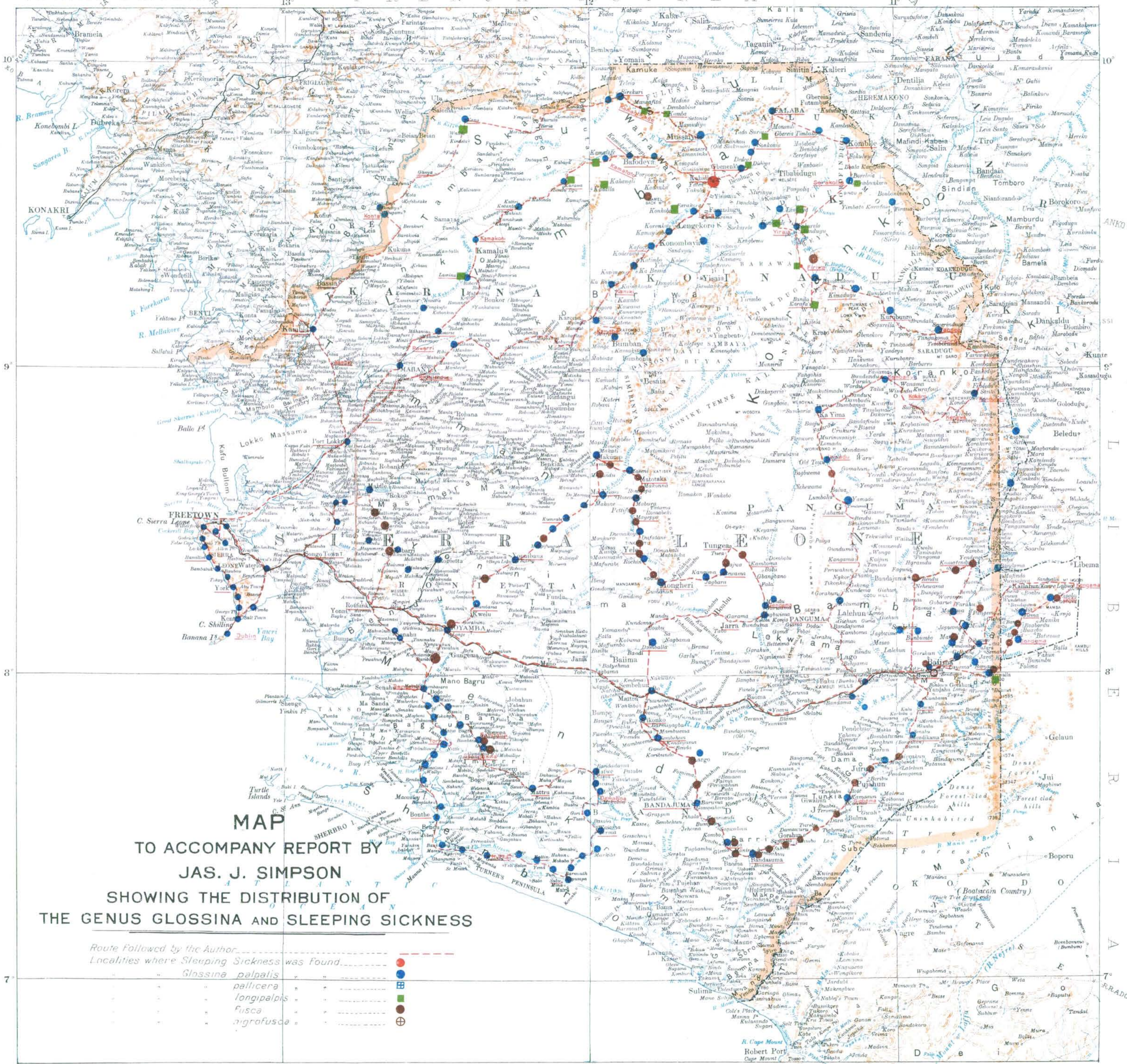
Fig. 2. View at Dublin, on the Banana Islands.

SIERRA LEONE

MAP I
AFRICA 1:1,000,000

FRENCH GUINEA

PARTS OF SHEETS 58, 59, 70 & 71



MAP
TO ACCOMPANY REPORT BY
JAS. J. SIMPSON
SHOWING THE DISTRIBUTION OF
THE GENUS *GLOSSINA* AND SLEEPING SICKNESS

Route followed by the Author	— — — — —
Localities where Sleeping Sickness was Found	●
<i>Glossina palpalis</i>	⊕
<i>Glossina pallicera</i>	⊙
<i>Glossina longipalpis</i>	⊖
<i>Glossina fusca</i>	⊗
<i>Glossina nigrofusca</i>	⊕

G.S. G.S. No 2032

International Boundary	— — — — —	Roads fit for wheeled traffic	— — — — —
Provincial	— — — — —	Well defined main tracks	— — — — —
Railways (single) with Stations	— — — — —	Other routes	— — — — —
in progress	— — — — —	Heights in feet above sea level	2000
Telegraph Stations	— — — — —	Falls, rapids and dams	— — — — —
Telegraphs	— — — — —	Wells, springs, ains, pools	— — — — —
along roads	— — — — —	Ruins	— — — — —
Observation Stations	— — — — —		

Note: With the exception of the Anglo-French and Anglo-Liberian Boundaries, no portion of the country included in this sheet has been surveyed, and the positions of villages, rivers and hills are only approximate.

Miles 10 20 30 40 50 60 70
Kilometres 10 20 30 40 50 60 70 80 90 100 110

Scale, 1:500,000 or 1-014 Inches to 16 Miles
Compiled in the Topographical Section, General Staff.
1905.

Minor Corrections Feb 1908
April 1909
July 1911.