

ENTOMOLOGICAL RESEARCH IN BRITISH WEST AFRICA.

II. NORTHERN NIGERIA.

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(*With a Map showing the distribution of Glossina and sleeping sickness, two sketch maps and 16 photographs by the author.*)

(PLATES VII.—XVI.)

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INTRODUCTORY.

The following report on recent entomological investigations in Northern Nigeria is based on a short tour made by the writer, from the 11th of August, 1910, to the 21st of January, 1911. But incorporated with my own observations

are numerous records made by several medical officers and other officials in the Protectorate. The present work deals exclusively with the blood-sucking insects and other arthropods which are, or may be, implicated in the transmission of disease in West Africa, and is therefore an extension of my previous report on the same subject in relation to the Gambia.*

Prior to the formation of the Entomological Research Committee, through whom this work is being conducted, very few specimens of insects and only a few isolated records reached England from the various Tropical African Colonies: but since that time numerous officials, and not the least in Northern Nigeria, have made systematic surveys of the districts in which they are stationed, and our knowledge of the distribution of the various species, their habits, and habitats is now gradually increasing. Only by this means can it ever be hoped to formulate any definite schemes for the abatement of the various diseases which may be transmitted by these insects.

The thanks of the Committee are due to those who have aided in this work, but it is unnecessary to enter into the various details here, as the collections have been identified and lists sent (along with named specimens where desired) to the individual collectors, and receipt has been acknowledged from time to time in the various issues of this Bulletin. In case it may not be universally known, I might take this opportunity of pointing out to any officials or others, who may be interested in this work, but who have no means of identifying the insects collected, that any collections sent to the Entomological Research Committee will be identified and recorded, and, if requested, named specimens will be returned to the collector, along with any available information which may be desired. It is hoped, therefore, that many will take this opportunity of familiarising themselves with the various noxious insects in the Protectorate, and at the same time help to extend our knowledge of their life-histories and distribution.

An account of the more simple methods of collecting and preserving insects for transmission to England was added as an appendix to my Gambian report, and separate copies of this may be obtained from the Scientific Secretary of the Committee by anyone desirous of aiding in this investigation.

The duration of my stay in the Protectorate, namely, five and a half months, precluded the possibility of my attempting to traverse anything but a limited portion, and for this reason I confined my attention to the River Niger, some of its tributaries, and the railway systems, as in those regions one would expect to find *Glossina palpalis* most universally distributed. At the request of Dr. S. W. Thompstone, C.M.G., the Principal Medical Officer, I also made a fairly exhaustive inspection of the Kateri district (p. 330), the River Garara (p. 335), and the Province of Bassa (p. 339), in all of which sleeping sickness was reported to occur. Consequently, this report deals mainly with the south-west portion of the Protectorate, or, in other words, the Niger basin, and is concerned very little with the Benue or Chad systems. For this reason it must be pointed out that

* Bull. Ent. Res. II, pt. 2, pp. 187-226.

it does not in any way aim at being exhaustive, but by showing how scanty our knowledge of this subject is, it may stimulate others to collect and make observations on the various species of insects which are harmful or beneficial to man and animals.

For a proper understanding of the distribution of not only tsetse but also other insects, several general considerations have to be taken into account; for example, the geographical position of the Protectorate, the general topography, the river systems, the nature and extent of the various types of vegetation, the climate and the rainfall. Each of these has been discussed in a very general way, only in so far as they are likely to influence the problems with which we are here more intimately concerned.

A short section has also been added on the chief tribes inhabiting the Protectorate, as, to a great extent, their distribution and mode of life have often a direct bearing upon the dissemination of disease.

Several photographs (Pl. viii.-xv.) and two sketch maps (Pl. vii. and xvi.) have also been included to illustrate some of the points emphasised in the report. The former serve to show the various types of country either associated with or free from certain species of *Glossina*. The first sketch map illustrates the general contour lines and river systems, while the second has been added as the region it depicts is uncharted on the larger map.

The most recent map (scale 1·014 inches=32 miles) of the Protectorate has been reproduced to show the distribution of the various species of *Glossina* which occur there, and in it have been inserted all available authentic records, including those in the National Collection in the Natural History Museum. In another paper in this Bulletin,* I have discussed the question of the graphic representation of the distribution of insects and disease on maps, and have suggested a scheme which has been adopted in the compilation of the present map, and which will be used in all maps published in colour in this Bulletin, and also in that of the Sleeping Sickness Bureau.

The various sections in the Narrative do not follow the order in which the different parts were traversed by the author, but are arranged so as to form a more or less complete unit, and the whole route is shown on the accompanying map.

A list of the blood-sucking insects and ticks hitherto recorded from Northern Nigeria has been drawn up as a guide to those interested in this work, and notwithstanding the fact that the number of species is already large, there is little doubt that many new species will be found to occur, chiefly in the northern part of the Protectorate.

I. GEOGRAPHY OF THE PROTECTORATE.

(a.) Position and Extent.

The Protectorate of Northern Nigeria, the largest and most recently acquired of the British West African Possessions, is roughly rectangular in shape, and

* Bull. Ent. Res. II, pt. 4, pp. 297-299.

lies approximately within the parallels of 7° and 14° North latitude, and between the meridians of 3° and 15° East longitude. It is bounded on the north by the arid regions of the French Sudan, on the west by the lofty Kameruns, on the east by the French Colony of Dahomey (or French Nigeria), and on the south by Southern Nigeria. Commercially, its position is excellent, inasmuch as it enjoys all the advantages of magnificent waterways. Its area is approximately 255,700 square miles of which the greater part lies in and north of the obtuse angle formed by the two main waterways, the Niger and the Benue. In the north-east corner is that perplexing inland sea, Lake Chad; while the north and north-west portions practically adjoin the southern limits of the Sahara. These fundamental features must be borne in mind in connection with much of the entomological matter which follows.

The headquarters of the Protectorate are situated at Zungeru, which is now joined by railway with Lagos, the capital and main seaport of Southern Nigeria, and also with Kano, an ancient and important city in the extreme north. It is, however, more a political than a commercial centre.

Lokoja, situated as it is at the junction of the Benue and Niger, must always remain an important commercial and geographical centre, though of recent years, owing to the extension of the railway from Lagos to Zungeru and the north, it is somewhat less important than formerly. All heavy transport must pass up the Niger, and the only inlet and outlet for the Southern Provinces, Kabba and Bassa, as well as for the Baro-Kano Railway and the whole Benue system, Muri, Yola, and Bornu, must therefore culminate at Lokoja, which consequently, as at present, must remain the headquarters of the river traffic and a main commercial centre of Northern Nigeria.

The Baro-Kano Railway, as the name implies, joins the towns of Baro, on the Niger near the mouth of the Bako River, and Kano near the desert region of the north, by way of Minna, where it joins the Northern Nigerian extension of the Lagos Railway. Consequently, Baro must, as trade extends, become an important commercial centre, as it is the extreme limit to which ocean-going steamers can ascend at the season of high water in the Niger.

Therefore Zungeru, as the headquarters of the Protectorate; Lokoja, as the commercial and river centre for the Southern provinces and those of the Benue system; and Baro, as the last port-of-call for ocean-going steamers and the terminus of the Baro-Kano Railway, must always be the chief centres of European activity, and, as such, must be the primary foci to which attention should be directed in preventing the dissemination of disease. If at any time any of these places should become sleeping sickness centres (as seemed likely recently in the case of Baro), the infection might spread to Europeans with disastrous results. As much, however, has already been done to prevent this, and as each locality will be considered in detail later on, it is unnecessary to enter further into this question here beyond pointing out that geographical and topographical position must be considered in the selection of sites for towns, and in the choice of routes, railway or otherwise, in opening up new country. These

points will, therefore, be kept prominently in view in this report when the writer is considering in detail the various regions visited.

(b.) **Mountain and River Systems.**

A sketch map (Pl. VII) has been added to illustrate the general contour and the river systems in the Protectorate, so that it is necessary here to draw attention only to the major features. The dotted contour lines indicate the average level of the various regions in the country, and from these it will at once be seen that the general altitude is not great.

The Bauchi plateau, the highest part of the Protectorate, is only between 4,000 and 5,000 feet above sea-level, and forms the central watershed of the Protectorate, whereas Lokoja, 337 miles, and Jebba, over 600 miles from the sea, are respectively only 300 and 500 feet above sea-level; so that the general fall of the river is only about one foot per mile.

There are two main river systems in Northern Nigeria; first the inland system which drains into Lake Chad in the north-east corner; and second, the Niger-Benue system, with its outlet to the sea through Southern Nigeria.

(1) Lake Chad is a lake only in name, and consists of nothing but an immense marsh with variable stretches of open water nowhere more than twelve feet deep.

The basin of Lake Chad lies curiously between the watersheds of the Niger and the Nile, and is supposed to be the remains of a vast shallow inland sea which covered most of the region north-east and west of the present lake, and which probably communicated with the sea along the basin of the Senegal River. A recent French expedition has shown that, at any rate in the rainy season of one particular year, there was a continuous water connection between the Benue and Lake Chad through the Tuburi marshes into the Logun river, and thus into the Shari river, which runs into the Lake. This being so, the lake was *then* nothing but a backwater of a river system in Central Africa, which sent a superfluity of its waters to the Benue and the Niger.

But, apart from this, Lake Chad merits attention here from the fact that it drains roughly one quarter of the Protectorate of Northern Nigeria (the north-east portion), and, as will be seen later, is of great interest in connection with the distribution of the various species of *Glossina*.

(2) The Niger-Benue system drains the rest of the Protectorate—the Benue the south-eastern quarter, and the Niger the western half.

There are two primary watersheds in the Protectorate itself, and these radiate from the Bauchi Plateau, the first north-west, and then north-east to the French Sudan near Katsena, the other north-east and then south-east to the Kamerun

mountains ; within the angle thus formed lies the Lake Chad system. These watersheds are indicated on the map.

West of the first lies the Niger system, which has its westerly and southerly limits in another watershed which practically forms the boundary between Northern and Southern Nigeria along the Borgu, Ilorin and Kabba frontiers, and separates it from the smaller rivers, such as the Ogun in Southern Nigeria.

South of the second watershed lies the Benue system, which is bounded on the south by a spur of the Kameruns ; this spur abuts into Southern Nigeria in the newly opened up Sonkwala country and separates the Benue from the Cross River, which flows through the Eastern Province of Southern Nigeria.

As has already been mentioned, the Bauchi Plateau, lying near the middle of the Protectorate, is the central watershed, and from it rivers radiate in all directions, but eventually join one or other of the two main systems already described.

The largest river running into Lake Chad is the Yo, which flows in a north-easterly direction and receives the waters of the Shidya, Delime, Katagum, and Hadeija Rivers, which flow from the Bauchi Plateau itself and the watershed running north from it, while from the watershed that passes eastwards come the Maiduguri and Yedseram Rivers. All the rivers running south from this last watershed drain into the Benue, which rises in the Kamerun mountains, and flows slightly south of east. The largest of these is the Gongola, which rises in the Bauchi Plateau, runs north-east and then south, and joins the Benue near Yola. From the south drain the Taraba, Katsena, etc. The Benue enters the Niger at Lokoja. Quite as erratic in its course as the Gongola is the Sokoto River, which rises near Katsena, flows north-west then south, and eventually joins the Kebbi, which in its turn enters the Niger near Illo. Other important tributaries of the Niger on the north bank are the Malenda, Kontagora, Kaduna, Bako and Garara, while on the south there are none of any great size.

Such, then, are the main physical features of the Protectorate, and a knowledge of the relative positions and directions assumed both by the watersheds and the various rivers serves to elucidate many interesting but otherwise obscure facts in insect distribution. This can most easily be understood by a study of the accompanying map.

(c.) **Vegetation.**

It is very difficult to describe in any general way the nature of the vegetation in Northern Nigeria, as there are no definite zones of afforestation, and the different types found are modified by local conditions.

Generally speaking, however, the monsoon forest type is predominant in the south ; and in the north the thorn forest, though here the savannah forest or open

deciduous forest, and the pure savannah are also more or less in evidence. Wherever the dry season is short and there is a certain amount of rainfall practically throughout the whole year, the monsoon forest is met with; while, on the other hand, when the rainy season is extremely short and the dry season is accompanied by the hot dry wind from the Sahara, the predominant feature is long grass, and few if any trees or shrubs are to be seen. Consequently, according as the climatic conditions of any particular region are nearer one or other of these types, dense forest, open forest, or savannah will be found in excess. Further, the fierce fires which are so common during the dry season have a marked influence on the vegetation, inasmuch as they materially affect the woodland growth, but not the grass, so that where these fires are prevalent savannah forest approaching pure savannah is found.

Passing from the north to the south, we find an almost regular increase in the amount of non-deciduous arboreal growth, and a consequent decrease in deciduous low scrub and grass. On the other hand, the banks of the rivers and streams, where the soil is constantly moist, are covered with a dense forest growth, and this is also found in numerous places where there is permanent telluric moisture due to local physical conditions; many of these places, if judged by the amount of rainfall and the length of the dry season, would not appear suitable for such vegetation.

These local patches are found scattered all over the southern half of the Protectorate, but do not seem to extend into the savannah region of the north. They are known by the local name of "kurimi," and as this term will be frequently used in the narrative, a short description may not be out of place here. Occasionally, these are of very limited extent, but sometimes stretch in narrow belts of 50-200 yards in width for several miles. The soil is continually moist and covered with a thick layer of leaves and decaying humus. Large non-deciduous trees are abundant, and there is a dense undergrowth of thick scrub, the whole being bound together by thick, woody and succulent lianas (Pl. XIV, figs. 1 and 2). Grass and herbs are practically absent. The larger trees have frequently well developed buttresses, and others have strong aerial roots. Such belts are very difficult to penetrate, but when an entry has been made, the dense nature of the shade, the fall in the temperature, the humidity of the atmosphere, and the almost perfect stillness are points which at once strike the intruder. As these are practically always haunts of *Glossina palpalis*, the importance of a knowledge of their origin, extent and distribution becomes evident, but this will be referred to in greater detail in the narrative.

The savannah forest is what might be termed park-like in character, and is the predominant feature in the landscape in the centre and northern parts of the Protectorate. Grass is abundant, as also are low deciduous shrubs, while scattered throughout are trees, varying in number and size in the different parts. This type of country is more suitable for *G. tachinoides* and *G. submorsitans* than for *G. palpalis*, and a survey of such a region generally shows that where trees are abundant *G. tachinoides* is found, while where low shrubs and grass predominate *G. submorsitans* is more common,

In many places throughout the Protectorate, there are extensive swamps and marshes, which are almost invariably connected with a heavy clay soil. During the rainy season, these may be covered with water several feet deep, but at the height of the dry season, elephant grass, attaining a height of 8-14 feet, generally covers these "fadamas," as they are termed locally.

This, then, may serve to give a general idea of the main types of vegetation occurring in Northern Nigeria, and in this connection it might be well to remember that when any type of tropical vegetation is devastated, it is generally replaced by a drier form, and this again, if demolished, will give way to a type of vegetation unlike its predecessor, but always diminishing in density and consequent shade and surface moisture.

II. CLIMATE AND RAINFALL.

Having discussed the general physical configuration of the Protectorate, we may briefly review the main climatic conditions which obtain in the different regions, and so form a definite basis for a study of insect distribution. In this way many points, otherwise obscure, in connection with the limits of the various species of *Glossina* and other blood-sucking flies, will be more easily grasped, as there can be little doubt that the relative duration of the wet and dry seasons, the varying degrees of humidity, and the annual range of temperature have a distinct bearing on this subject.

No review of the meteorology of Northern Nigeria has been published, nor has any attempt been made to consider the extremes of climatic conditions to be found in the Protectorate. The following observations, therefore, are based on a study of the raw meteorological data compiled during recent years at the various stations, published in the official Gazette, and supplied to the Meteorological Office. In order to avoid a lengthy discussion on this subject, several tables have been prepared, so that a glance at these will bring out in a more concrete form much of what follows.

Northern Nigeria, as has already been pointed out, lies roughly between the 7th and the 14th parallels, and the climate is therefore tropical but not equatorial. By this is meant that in contrast, for example, with Southern Nigeria, the rainfall and temperature curves show only one annual maximum and minimum. In the latter colony, except in the north-west corner, which is geographically in Northern Nigeria, the temperature curve reaches its highest maximum in March and April, after which it descends, but again reaches a secondary maximum in September and October. The curve of rainfall shows similar maxima and minima.

The prevailing wind in Northern Nigeria is the Harmattan, a dry hot wind coming from the north-east. It blows almost steadily from October to March, and modifies the temperature to an extraordinary degree. Coming direct from the Sahara, it is absolutely devoid of moisture, and consequently produces great evaporation when it meets the moist air of the Niger Valley or the inland system

of Lake Chad. The result during these months is an enormous fall of temperature, and in the extreme north, when the wind, without having absorbed any previous moisture, meets the mists and vapours of the water systems of the Northern Territories, the temperature occasionally falls nearly to freezing point.

Towards the end of the dry season, which varies in the different latitudes, the the tornados begin. These are cyclones from the north-east, accompanied by thunder-storms and torrential rains. They gradually merge into steady rains which last from July to October. During the rainy season, the atmosphere is laden with moisture, and a damp heat results, but for the rest of the year the Harmattan and a total absence of rain render the air excessively dry. Generally speaking, the nights are cool for the greater part of the year.

Owing, however, to the enormous contrast in the various climatic conditions in different regions of the Protectorate, it is impossible to make any satisfactory generalisations. Take, for example, the case of Geidam and Ankpa in 1909. At the former station, the maximum and minimum temperatures recorded were 110° Fahr. and 46° Fahr., while at the latter they were respectively 96° Fahr. and 56° Fahr. At Geidam, the total rainfall for the year was only 21·28 inches, while at Ankpa it was 66·85 inches; at the former the rainy season was practically confined to the months of May to September, but at the latter it extended from March to October. At Geidam, the maximum and minimum degrees of humidity were respectively 81 and 24 with a difference of 57, while at Ankpa they were 85 and 68 showing a difference of only 17. At the former, only during the month of August was there over 5 inches of rain (7·70 inches), while at the latter the following are the records—April 8·63 inches, May 14·02 inches, June 7·72 inches, August 8·12 inches, September 10·23 inches, October 8·80 inches.

With such an enormous difference in the climatic conditions in various parts of the Protectorate, it is not surprising to find that not only do certain species of blood-sucking flies show distinct local modifications, but there may even be a marked difference in the species which occur in the different districts.

In order to see to what extent these are correlated, the following tables have been drawn up :—

Table A :—The annual rainfall for various stations for the years 1906–1910.

Table B :—The monthly rainfall for the same stations for the years 1909 and 1910.

Table C :—The maximum and minimum humidity at these stations from 1906 to 1910.

Table D :—The monthly temperatures for the same stations for the year 1909.

As these tables show graphically the main factors with which we are here concerned, I do not propose to deal with each at any length, but only to draw attention to the major features.

TABLE A.
Annual Rainfall in Northern Nigeria (in inches).

	Katagum.	Maiduguri.	Sokoto.	Kano.	Yola.	Bauchi.	Lokoja.	Baro.	Kontagora.	Zungeru.	Zaria.	Ilorin.	Ankpa.
1906					34·60		51·83			60·39	61·05	49·00	
1907		18·11	19·86	25·62	27·55		36·68		37·28	37·16		54·74	
1908	23·70	22·30	20·44	34·86	53·77	47·88	44·12	46·46	55·15	48·78	45·48	55·46	58·77
1909	23·03	31·89	29·72	49·03	44·26	43·23	65·14	55·77	60·67	58·89	55·80	65·18	66·85
1910	18·21	19·53	23·11	26·81	38·67	38·86	45·49	47·98	53·01	53·44	53·80	51·14	56·44
Mean	21·65	22·96	23·28	34·08	39·77	43·32	48·65	50·07	51·53	51·73	54·03	55·10	60·69

The above table reveals several important facts, but none more obvious than the striking difference in the rainfall at the various stations. The maximum rainfall recorded during these five years is 66·85 inches, at Ankpa in 1909, and the minimum is 16·87 inches, at Geidam* in 1910, while the difference between the rainfall at Geidam and Ankpa in 1909 amounts to 45·57 inches, or more than twice the total rainfall at the former station.

A study of the mean annual rainfall at the various stations shows that there is an almost regular increase from the north southwards. At one end of the scale stand Sokoto, Katagum, Maiduguri and Geidam, in the extreme north, and at the other Ilorin and Ankpa in the south.

TABLE B.
Monthly Record of Rainfall in Inches for 1909 and 1910.

STATION.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Geidam ...	—	—	—	1·05	1·42	4·39	4·79	7·70	1·83	0·08	—	0·02
Katagum ...	—	—	—	0·11	3·98	4·05	4·02	6·32	4·17	0·33	—	0·05
Birnin Kebbi ...	—	—	—	2·92	3·31	3·35	2·37	12·98	2·34	0·43	—	—
Sokoto ...	—	—	—	1·55	1·52	4·34	8·72	10·61	2·52	0·40	—	—
Maiduguri ...	—	—	—	1·01	0·75	4·04	5·33	12·06	8·66	0·04	—	—
Nafada ...	—	—	—	3·59	1·29	5·12	8·66	10·82	6·89	0·90	—	—
Bauchi ...	—	—	—	3·99	2·53	5·64	10·76	11·16	8·73	0·42	—	—
Yola ...	—	—	0·35	4·33	3·90	10·13	6·23	7·56	8·23	3·35	—	0·18
Keffi ...	—	1·13	3·12	3·39	4·94	6·52	9·10	14·14	4·48	2·20	—	—
Kano ...	—	—	0·09	1·75	8·70	3·71	9·01	17·72	6·83	0·77	—	0·45
Ibi ...	—	0·70	2·75	6·40	8·48	5·23	5·01	7·57	8·89	7·49	—	0·78
Baro ...	1·06	0·80	3·00	6·74	3·49	6·73	8·19	16·92	6·60	1·88	—	0·36
Zaria ...	—	0·36	—	3·56	5·79	6·51	13·11	16·62	6·61	1·74	—	1·50
Zungeru ...	0·38	—	2·02	4·66	3·27	6·09	12·88	11·24	14·27	2·78	—	1·30
Kontagora ...	—	—	2·51	6·42	2·02	6·22	13·33	13·12	12·87	3·83	—	0·35
Lokoja ...	0·04	1·32	5·19	6·80	8·20	6·90	10·35	12·13	10·37	2·61	—	1·23
Ilorin ...	0·79	1·18	5·30	7·78	7·12	8·32	9·49	4·92	14·12	4·74	0·23	1·19
Ankpa ...	0·39	—	3·64	8·63	14·02	7·72	4·42	8·12	10·23	8·80	—	0·88

* As the records for Geidam are available only for 1909 and 1910, it has been omitted from Table A, but is included in Table B.

1910.

Geidam ...	—	—	—	0·11	—	0·51	5·95	7·07	3·23	—	—	—
Katagum ...	—	—	—	0·25	1·49	0·95	5·02	7·45	3·05	—	—	—
Maiduguri ...	—	—	—	—	2·80	0·65	6·64	6·44	3·00	—	—	—
Sokoto ...	—	—	—	—	3·54	3·91	6·51	6·03	3·06	0·06	—	—
Birnin Kebbi ...	—	—	—	0·22	2·32	1·91	7·78	4·60	8·21	0·06	—	—
Kano... ...	—	—	—	0·02	0·98	4·12	8·10	8·97	4·62	—	—	—
Nafada ...	—	—	—	0·43	2·52	4·73	8·89	13·04	3·53	0·10	—	—
Yola ...	—	—	—	2·36	6·97	10·19	5·21	8·06	4·08	1·80	—	—
Bauchi ...	—	—	—	0·98	3·30	4·73	12·14	8·98	7·58	1·15	—	—
Keffi ...	—	—	1·04	1·72	5·30	5·28	4·71	13·98	9·30	3·10	—	—
Lokoja ...	—	1·03	0·26	4·45	5·67	8·07	10·66	5·98	5·76	3·61	—	—
Baro ...	—	—	0·15	2·35	5·00	4·69	15·20	12·23	4·15	3·21	—	—
Ibi ...	—	—	0·02	4·39	8·83	5·56	5·35	11·24	7·57	6·67	—	—
Ilorin ...	—	0·03	1·18	4·88	5·97	7·37	6·60	6·53	14·71	3·87	—	—
Kontagora ...	—	—	1·12	0·44	4·06	4·17	13·29	16·91	10·93	2·09	—	—
Zungeru ...	—	—	0·83	1·15	6·69	5·54	7·09	19·27	10·82	2·05	—	—
Zaria ...	—	—	—	2·17	3·78	4·95	11·28	17·73	13·08	0·81	—	—
Ankpa ...	1·34	—	1·02	5·65	10·04	5·64	9·38	11·42	5·60	6·31	—	0·04

In Table B is given the monthly rainfall for eighteen stations for the years 1909 and 1910, and as these stations are scattered over the territory, it is possible to compare not only the extremes, but also the intervening portions of the country. The arrangement adopted is that of ascending annual maxima.

It will be seen from Table A that, although there was a great difference in the amount of rain which fell during these two years, the total for each station bears roughly the same proportion to the total for the colony. The curve of rainfall has only one maximum, and that occurs in July and August, which months are therefore the centre of the rainy season. A rainfall of one inch or under is practically negligible, so that, with very few exceptions (which will be referred to later), November, December, January and February constitute the height of the dry season.

Although July and August on one side, and December and January on the other, are the centres of the wet and dry seasons respectively, the duration of these seasons varies very markedly in different regions; *e.g.*, at Geidam, in 1910, the dry season might be said to extend from October to June, while in the same year at Ankpa the dry season can be reckoned only from November to March.

It will be seen from the tables that, in spite of the difference in the rainfall in 1909 and 1910, the stations are arranged in certain well-defined groups, *e.g.*, (1) Geidam, Katagum, Birnin-Kebbi, Sokoto and Maiduguri; (2) Nafada, Bauchi, Yola, Keffi and Kano; (3) Ibi and Baro; (4) Zaria, Zungeru and Kontagora; (5) Lokoja, Ilorin and Ankpa; and that these groups of ascending rainfall are disposed in order from north to south.

In the northern stations, the dry season reaches its maximum, and may be said to extend from October to April, but at the same time, the monthly rainfall is never very great. The length of the dry season diminishes in the various groups, until (5) is reached; for example, at Ilorin, in 1909, rain fell during every month, and at Ankpa, in both 1909 and 1910, the only months in which there

was no rain were November and February. At the same time, the monthly rainfall is also greater in the south than in the north.

The maximum rainfall for one day for the years 1905-1908 was as follows : In 1905, 4·04 inches at Ilorin on June 2nd ; in 1906, 7·27 inches at Zungeru ; in 1907, 4·15 inches at Ilorin on September 9th ; and in 1908, 5 inches at Ilorin in October.

Consequently no definite periods can be given for the wet and dry seasons in Northern Nigeria, but in a general way it may be said that the duration of the dry season decreases, whereas the amount of the monthly rainfall increases from the north to the south.

TABLE C.

Maximum and Minimum Humidity.

—	1906.		1907.		1908.		1909.		1910.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Geidam	—	—	—	—	26	81	24	81	29	83
Bauchi	22	73	—	—	—	—	26	82	26	77
Kano	—	—	28	81	—	—	27	83	28	75
Sokoto	—	—	22	86	—	—	27	76	25	72
Nafada	—	—	—	—	—	—	29	81	33	84
Katagum	—	—	—	—	26	86	30	76	28	70
Zaria... ..	32	80	—	—	32	80	31	79	33	86
Kontagora	24	85	30	90	—	—	32	80	27	84
Maiduguri	—	—	25	84	—	—	34	86	34	79
Birnin Kebbi	—	—	—	—	—	—	35	91	33	83
Yola	32	82	33	79	—	—	36	80	24	84
Keffi	—	—	—	—	—	—	36	80	36	85
Zungeru	31	85	38	82	39	84	44	89	33	86
Ibi	31	81	40	84	—	—	55	79	39	80
Baro	—	—	—	—	55	83	59	77	58	84
Lokoja	57	78	61	78	73	84	64	81	59	80
Ilorin	55	81	61	81	63	88	65	81	51	85
Ankpa	—	—	—	—	58	88	67	85	64	86

Another factor which must be taken into account is the degree of humidity in the various districts. Table C has been added to show the available records for the years 1906-1910. It is unnecessary to analyse these in any detail, but the following observations may bring out the salient features :—(1) The variations in the maxima are very slight as compared with the minima ; for example, in 1909, the highest and lowest maxima are 85 and 76, and the highest and lowest minima are 67 and 24, while the corresponding numbers for 1910 are 86 and 70, and 64 and 24. (2) The contrast between Geidam and Ankpa, referred to above, is again emphasised. At the former station, the difference between the maximum and minimum for one year was 57 degrees in 1909, and 54 degrees in 1910, whereas at the latter the corresponding differences were only 18 degrees and 22 degrees.

TABLE D.

Monthly Temperatures for 1909.

—		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Maiduguri	Max.	100	107	112	109	112	102	99	94	101	102	102	98
	Min.	49	53	58	66	71	69	68	67	68	65	60	54
	Mean	73	81	89	89	92	86	81	80	82	83	81	75
Geidam...	Max.	101	106	110	110	109	102	100	93	103	107	105	101
	Min.	46	51	55	64	72	70	68	67	68	63	60	53
	Mean	70	79	87	89	91	85	82	79	83	85	82	75
Sokoto ...	Max.	99	101	105	109	106	100	92	92	98	100	98	94
	Min.	54	60	75	70	70	69	70	68	68	68	64	55
	Mean	75	82	90	89	88	83	80	76	76	84	80	75
Kano ...	Max.	90	96	107	109	106	99	95	96	96	99	99	98
	Min.	47	56	60	65	67	64	67	63	67	61	52	53
	Mean	68	76	85	87	87	81	79	76	80	81	76	72
Yola ...	Max.	99	104	107	103	101	92	90	90	90	96	98	96
	Min.	58	65	72	69	69	66	66	67	67	68	63	61
	Mean	79	86	89	85	83	79	76	77	78	81	82	78
Birnin Kebbi	Max.	97	102	105	104	102	95	96	87	92	96	97	92
	Min.	48	56	70	70	60	70	72	70	70	70	62	53
	Mean	73	80	89	88	84	82	81	77	80	81	79	74
Bauchi ...	Max.	96	100	105	104	100	94	92	89	94	96	95	92
	Min.	49	67	68	64	60	35	57	59	61	66	64	62
	Mean	74	89	86	83	80	76	74	76	77	79	79	78
Baro ...	Max.	100	103	105	101	102	98	96	92	94	102	101	98
	Min.	59	71	71	71	71	67	71	68	70	71	71	65
	Mean	84	88	88	85	85	83	81	80	81	84	86	83
Zungeru	Max.	100	101	103	101	99	95	91	92	93	96	100	99
	Min.	61	66	71	70	69	69	67	68	68	67	56	60
	Mean	81	85	87	84	83	81	78	77	79	81	80	79
Lokoja ...	Max.	99	100	100	97	97	94	89	92	95	95	96	95
	Min.	58	68	72	70	70	66	69	70	68	70	70	61
	Mean	82	85	86	84	83	80	79	79	80	83	85	81
Ilorin ...	Max.	97	99	98	100	98	94	92	92	90	95	99	102
	Min.	53	71	68	67	68	66	67	68	67	65	66	52
	Mean	80	84	84	82	82	80	77	78	78	80	82	78
Ankpa ...	Max.	93	95	96	92	90	88	84	84	87	90	93	91
	Min.	57	62	67	67	63	63	65	65	64	65	64	56
	Mean	77	81	81	78	76	75	75	75	74	76	79	76

The above Table gives the monthly maximum, minimum, and mean shade temperatures for twelve stations for the year 1909, and must be taken in conjunction with the rainfall and humidity. I do not propose to analyse the data in detail, but would point out that the stations have been arranged in the order of descending maxima. It will be seen that this is also approximately the order of

ascending minima, and follows very closely the order of ascending annual rainfall. At one end of the scale are Geidam, Maiduguri, and Sokoto, and at the other Lokoja, Ilorin, and Ankpa. A study of the Table will, however, reveal many other interesting comparisons, all of which are relevant, in a minor degree, to the questions under consideration.

III. POPULATION AND TRIBES.

Politically, Northern Nigeria is divided into thirteen provinces* of very unequal size. The extent of these and the enormous difference in the density of the population in the various provinces will be seen from the following table.

Province.	Area in Square Miles.	Capital.	Population.
Sokoto	35,400	Sokoto	600,000
Kano	28,600	Kano	2,400,000
Bornu	32,800	Maiduguri	400,000
Bauchi	23,200	Bauchi	709,100
Zaria	15,800	Zaria	179,000
Niger	12,500	Zungeru†	226,800
Kontagora	27,000	Kontagora	75,500
Ilorin	6,300	Ilorin	163,600
Kabba	7,800	Lokoja‡	184,900
Bassa	7,000	Ankpa	175,000
Nassarawa	17,900	Keffi	161,100
Muri	25,600	Amar	584,000
Yola	15,800	Yola	30,000
Total	255,700	Total	5,889,000

Any discussion of the origin of the numerous tribes which inhabit the Protectorate would be out of place here, but at the same time it is essential to know something of the leading tribes, their distribution, and the differences in their pursuits and mode of living.

By far the most important race are the Hausas, who are supposed to have come from the east, and to have penetrated the Western Sudan from the North. The whole of the Northern part of the Protectorate is sometimes designated by the name of "Hausa Land." The Hausas are essentially a trading people, and as their itinerant nature has induced them to visit the remote parts of the pagan countries, they have thus created trade routes in all directions. Consequently, Hausa villages are to be found all over Northern and Southern Nigeria, for the Hausas do not necessarily bring produce from their own country for trading, but buy in one market and sell in another.

Next in importance are the Fulanis, a tribe whose origin is unknown, but who are supposed to have come from the country near the source of the Senegal

* The data here given are those of 1907.

† The headquarters of the Resident is at Minna and the area and population for the new Niger Province is really that for the old, and now abolished, Nupe Province.

‡ The headquarters of the Resident is at Kabba.

River. They are totally distinct from the negro type; their features are well-marked and fine, and they have a very light complexion, in consequence of which the negroes themselves speak of them as "the yellow men." Over a hundred years ago, this tribe conquered the greater portion of the northern states, Zaria, Kano, Katsena, Bauchi and part of Bornu, so that at one time they might be said to occupy the whole country enclosed in the angle formed by the Niger and Benue. They lead a wandering and pastoral life, grazing large herds and flocks, and continually moving from place to place according to the nature of the feeding grounds. They are closely connected with the Foulahs of the Gambia,* and the two tribes have similar habits.

The Yorubas inhabit nearly the whole of the Ilorin Province, and extend into the Western Province of Southern Nigeria. They are an agricultural people, and claim that all the pagan tribes in Hausa Land are descended from them.

The people of Borgu are probably of Berber descent, and, as at present constituted, are a very mixed tribe.

The Yauris have their centre at Yelwa on the Niger, and are an agricultural and pastoral people.

Bornu was not associated with the old Hausa and Fulani States of the Western Sudan, but may be considered a Central Sudan State. The main portion of the people came from the east of Lake Chad and expelled the Fulani, who attempted to over-run this province. The present inhabitants of Bornu are probably not aborigines, but a mixed tribe with an Arab ancestry.

The Nupes are the descendants of a very powerful tribe which inhabited the central portion of the colony, but which was over-run by the Hausas and Fulanis.

The Gwaris are a scattered race, living amongst the rocky hills and caves in the country lying to the South of Zaria (see p. 331).

The Igbaras inhabit the country surrounding the confluence of the Benue and the Niger, while further up the Benue are the Bassas on the right bank and the Akpotos on the left, followed by the Aragos and the Munchis. These latter are a very unapproachable and vindictive tribe, and their country is anything but subdued, although recent expeditions have done much to open it up. Consequently, very little is known of this part of the country.

Further up the Benue lies the Jako country, while higher still, in the upper reaches, are the numerous wild Batta tribes.

IV. NARRATIVE.

(a.) The River Niger

During my tour in Nigeria, I traversed the whole of the Niger from its mouth to Yelwa, a town not far from the point where the river enters British territory, and the following notes are based on observations made at different times. Although various parts were traversed in different directions, sometimes up-, sometimes down-stream, and some portions more than once, I have included all records and observations in one general description, and have purposely made

* Bull. Ent. Res., ii, pt. 3, p. 194.

a start at Yelwa, so that in my next report (on Southern Nigeria) the description of the Niger from Idah to the sea will form a consecutive account with this.

The River Niger rises in the Kong Mountains near the borders of Sierra Leone, about 200 mile from the coast. It first runs in a north-easterly direction to Timbuktu (in $16^{\circ} 40'$ North and $2^{\circ} 40'$ West), a distance of nearly 500 miles. It then turns eastwards for about 150 miles to Buram Island, and afterwards south-easterly to Yelwa, a distance of over 450 miles. It is on this last stretch that it enters Northern Nigeria, near the small village of Tunga, which is about 100 miles from Yelwa. From Tunga to the sea is roughly 700 miles, while from the source to Tunga is almost 1200 miles. From Yelwa it runs almost due south to Jebba, then eastwards to Baro, and from this point nearly due south to Southern Nigeria, which it enters at Idah, 289 miles from the coast. South of Abo, in Southern Nigeria, it spreads into an enormous delta with an intricate network of channels and creeks, and its various mouths extend over 200 miles of the coast. Its total length is therefore about 1900 miles, of which 1200 miles are outside British territory, 420 are in Northern, and 280 in Southern Nigeria.

Tunga to Yelwa.

This part of the river I was unable to examine, and as no blood-sucking flies have been recorded from this stretch, I shall content myself with quoting a short description* for the sake of completeness. "At Yelwa, the banks become low and swampy, the hills begin to recede from the river, and five miles further on, near the village of Sakassi, the last set of minor rapids (*i.e.*, from south to north) occurs in the channel. Beyond Sakassi, the whole aspect of the river changes, the channel becomes broad and sandy, and is obstructed by nothing more serious than sand-bars. On the north bank a broad, swampy plain, with low rising ground in the distance, bounds the river as far as the mouth of the Kebbi. From Kebbi to the swamps of Illo, an open sandy plain stretches northwards between the river and the base of the plateau. On the south bank, the gently undulating plain which bounds the river stretches westward to the Dahomey border, broken only by some scattered groups of low-topped hills."

Yelwa to Jebba.

This journey can be accomplished only in native canoes, and even by this means only during the season of highest water in the river, that is after the middle of the rains, owing to the numerous rocks which occur, and the number of rapids to be traversed. Six days were spent by the writer on this part of the river, and two at Bussa, the whole trip lasting from the 14th to the 21st of September. This method of examining a river is undoubtedly the best, as the rate of locomotion is slow, and it is possible to keep close in to the banks and land at any point which seems to merit special attention. The valley of the Niger from Yelwa to Ineku is wide and bounded by low hills with scanty forest growth; at Ineku the river divides into two and encloses a large and extensive island, which stretches to Warra, where the two channels again join into one broad slow-flowing stream, with a wide flood-plain covered with long

* From "The Geography and Geology of N. Nigeria," by J. D. Falconer.

grass and low shrubs. After Warra, a few rocks begin to appear in the river, but navigation is comparatively easy until Bussa is reached. Two days were spent on this part, and although the river bank was carefully examined, no biting flies of any sort were seen, with the exception of a species of *Simulium* at Otono, where a halt was made for the night. The day was dull, however, and this may to some extent account for the absence of insect life. At Bussa, the vegetation on the bank is very dense, and there is also abundant grass. In and around a banana plantation, close to the river, *Glossina palpulis* was caught, while nearer the Resident's house, which is situated some distance from the river, *G. tachinoides* was extremely abundant. Other blood-sucking flies obtained here were:—*Stomoxys nigra*, *Banksinella luteolateralis* and a large new species of *Tabanus*, as yet undescribed. The Resident at Bussa, Mr. P. de Putron, informed me that it is almost impossible to keep horses in this district, as they invariably die a few months after their arrival.

Southwards from Bussa, there are numerous rapids, and navigation is both difficult and dangerous. Immediately after passing the town of Malali, the channel is obstructed by projecting rocks and there is a stretch of cascades and whirlpools, which extend for about three miles to the town of Garafini; there *G. tachinoides* was caught.

After Garafini, there is a stretch of about 20 miles of smooth water; the banks are covered with low shrubs, backed by higher trees. No biting flies were seen in this part, but the fact that the morning was dull and that some rain fell about mid-day, may account for their absence. When passing the mouth of the Kontagora River* we caught one *G. tachinoides*, and another specimen of the same species, near the mouth of the River Oli. In this region are the rapids of Patassi, which are "composed of two sets of cascades each twelve to fifteen feet in height and separated by a straight reach of some two hundred and eighty yards." Following this is a stretch of two and a half miles of comparatively smooth water, after which are the Great Rapids of Wuru. "Here the river is formed of two branches with a rocky island between. The fall of forty feet between the summit and the foot of the rapid is distributed over some 1300 yards of river, giving a slope of at least 1 in 100, and a current of from fifteen to eighteen miles an hour. In the rains, the granite boulders are completely submerged under a seething flood, and even in the dry season the water is thrown up by the projecting rocks in sheets of foam, and the roar of the rapid is heard for long distances on either side."† Near these rapids *G. tachinoides* is abundant.

From Leaba to Bajibo, there are numerous rocks in the river, but though navigation is difficult, it is not very dangerous in the rains. No biting flies were seen on this stretch, but the day was again dull. Bajibo is the extreme limit to which small stern-wheelers can ascend the Niger even in the wet season, and then only with great risks. Between this town and Jebba, *G. tachinoides* simply swarms, and as many as 25 or 30 invaded the canoe at one time. The banks of the river

* It may be useful to note here that a specimen of *G. palpulis* was caught by Mr. P. de Putron, the Resident at Bussa, at Kulfu on a branch of the Kontagora River on 26. VI. 10.

† "The Geography and Geology of Northern Nigeria."

are covered with long grass and thick low shrubs close down to the water's edge, while behind this is a dense fringe of thick bush (Pl. VIII, fig. 1). I went ashore at several places, and everywhere *G. tachinoides* swarmed, while in the thick bush behind, one *G. palpalis* was caught.

For the last 800 yards before reaching Jebba, the river is enclosed in a narrow gorge with almost vertical walls; it is divided in two by the high steep-sided "Juju" rock (Pl. VIII, fig. 2), the current being both deep and swift, with numerous eddies and whirlpools.

Jebba to Mureji.

This journey was accomplished on the 11th of October in a very small steam-launch. The nature of the vegetation on the river banks is very similar to that around Bajibo. In some parts heavy bush predominates, and there *Glossina palpalis* swarmed; at other places where there is abundant grass and low shrubs, *G. tachinoides* was seen (Pl. IX, fig. 1).

At the town of Mureji itself, both *G. palpalis* and *G. tachinoides* were caught. On another occasion (August 16th) I visited this town, which is nothing more than a few houses situated on a mud bank, so that at low water it stands a few feet above the level of the river, but during the rains the various houses are separated by deep channels filled by the rising river (Pl. IX, fig. 2). Mosquitos were abundant in August and by far the most frequent were *Myzomyia costalis* and *Stegomyia fasciata*. *Tabanus taeniola* and *T. latipes* were also caught at the same time. The chief importance of this village lay in the fact that it is situated at the junction of the Kaduna and the Niger, and all launches for Barijuko, the Kaduna landing-place for Zungeru, took in fuel there; but since the opening of the Baro-Kano Railway, this route has been abandoned, and the only launches which call there now are those plying between Jebba and Baro.

On the river Kaduna, between Mureji and Barijuko, *Tabanus taeniola* and *T. latipes* were the only blood-sucking flies seen during my trip, but both *G. palpalis* and *G. tachinoides* have been caught in this region, and these records are shown on the accompanying map.

Although I traversed the river between Mureji and Baro on two occasions, I was unable to form any opinion of this part, as both trips were done by night. Both *G. palpalis* and *G. tachinoides* have, however, been recorded from this region (see map). The town of Baro has been discussed elsewhere, so requires no mention here. The journey from Baro to Idah was made in a large stern-wheeler, which is not nearly so satisfactory for entomological purposes, as it seldom approaches close enough to the banks for flies to come aboard, and the rate is also a deterrent to such intrusions. With the exception of several *Tabanus latipes* and *T. taeniola* caught south of Baro and *T. fasciatus* near Itobe, no blood-sucking flies were seen on the steamer. Both *Glossina palpalis* and *G. tachinoides*, however, have been found on this stretch, and the localities of these are also shown on the map.

(b) Lokoja.

The town of Lokoja is, and always must be a very important commercial centre, inasmuch as it is situated at the junction of the two large rivers, the Benue and the Niger, and therefore commands the whole of the trade of the

eastern half of the Protectorate. It is also an important political centre, and all officers stationed on the Chad and Benue systems must pass through Lokoja going to and from their stations. Here also is situated one of the three large European hospitals of the Protectorate, under the charge of a Senior Medical Officer. Further, it is the headquarters of the 2nd Battalion of the West African Frontier Force. All these combined together ensure a large permanent European population as well as a continual ingress and egress of officials and others passing north and south.

The town stands on the right bank of the Niger, at the base of a large flat-topped hill, Mount Patti, which is covered with moderately thick bush. On the left bank is a large, flat, alluvial plain formed by the confluence of the two rivers. Close to the river are several trading factories, the Marine Headquarters, and the stores of the Public Works Department, and, owing to the nature of the bank and the varying level of the river, pools of stagnant water are far from infrequent, in many of which mosquito larvae were found. Mosquitos are very troublesome all over this part, and swarms of them come from the banks and invade the steamers lying alongside. In four buildings occupied by Europeans, as well as on a launch tied up to the bank, I found *Stegomyia fasciata* and *Myzomyia costalis*. The majority of the European houses are on much higher ground, and at some distance from the river; but in the Post Office, some five hundred yards from the river bank, *S. fasciata* was seen. Throughout the town, the most prevalent mosquito was *M. costalis*.

Glossina palpalis has been recorded from Lokoja, but although I visited this town on two different occasions, first in August, during the rains, and afterwards in January, in the dry season, I saw none, and from the nature of the clearings so efficiently carried out by the political and medical officers, I do not think that this species actually breeds within the limits of the settlement, but it may occasionally follow natives or others from the bush on Mount Patti. During my second visit, Dr. E. A. Chartres, the Senior Medical Officer, was clearing a small banana grove which existed in a low-lying, damp situation, but careful search failed to reveal either the insects or pupal cases. In June, 1911, Dr. Chartres caught a specimen of *G. tachinoides* near his house, and in August of the same year one *G. palpalis* inside a ward of the European Hospital.

Ticks are said to be very troublesome at certain seasons of the year; both *Amblyomma variegatum* and *Rhipicephalus sanguineus* have been recorded from the district. *Culicoides* sp., and *Simulium* sp. are abundant. *Myzomyia costalis*, as has been mentioned, is the most prevalent mosquito, but apart from this species and *Stegomyia fasciata* near the river, the only others seen during my visit were *Mansonioides uniformis*, *Mucidus mucidus* and *Nyssorhynchus pharonsis*. Dr. Chartres has, however, collected the following species since that time:—*Culex decens*, *C. grahamsi*, *C. guiarti*, *C. invidiosus* and *Myzomyia umbrusa*. *Hippocentrum versicolor* has been recorded from Lokoja, but is far from common, while in and near the stables *Stomoxys nigra*, *S. calcitrans* and *Hippobosca maculata* simply swarm in hundreds.

The number of horses in Lokoja is necessarily large, and the rate of mortality is excessively high. Capt. Manuk, late I.M.S., who has made a special study of

this subject extending over a long period, informed me that of the horses brought into Lokoja over 60 per cent. developed trypanosomiasis within a year, and of these 50 per cent. died within the same period. The question naturally arises. What is the carrier? It must be remembered that these horses are very seldom taken out of the station, and consequently must be infected within that area. As has been mentioned, *Hippocentrum versicolor* does occur, though in small numbers, but the most prevalent horse-biting flies are *Stomoxys nigra* and *S. calcitrans*, whereas *Glossina submorsitans* has never been seen in Lokoja.

These facts apparently point to *Stomoxys* as the carrier, and since we have no direct evidence, experiments should certainly be made to prove or disprove this possibility. But, apart from this, the fact remains that at present two out of every three horses brought into Lokoja are incapacitated for work within a year of their arrival, and it is almost superfluous to emphasise the necessity of trying so far as possible, to reduce the chances of infection by instituting a segregation camp and making the stables mosquito-proof. To this subject, as well as to the question of launches as agents in the dissemination of mosquitos, I shall refer later on.

(c.) Offa to Zungeru.

The greater part of this journey was made by railway, and as by this means it is possible to examine only the chief towns "en route" I shall here content myself with giving a few general notes and the records of blood-sucking insects so far available. The town of Offa is situated on the boundary of Southern and Northern Nigeria and is connected with Lagos in the south and Jebba in the north by the Lagos Government Railway. The biting flies recorded from this station are:—*Myzomyia funesta*, *M. costalis*, *Hippocentrum versicolor*, *Tabanus secedens*, *T. subangustus* and *Tabanus sp. nov. near kingsleyi*. The only ticks recorded are *Aponomma exornatum* and *Amblyomma nuttalli*, of which Dr. R. C. Hiscock obtained specimens from a large monitor lizard (locally called an iguana) captured near the European quarters.

Northwards the next important town is Ilorin, and here the following insects were obtained:—*Myzomyia costalis*, *Myzorhynchus paludis*, *Trichorhynchus (Culicomyia) nebulosus*, *Reedomyia annulata* and *Culex sp. indet.*

At Jebba the only blood-suckers seen were *Myzomyia funesta*, *M. costalis*, *Glossina palpalis* and *Tabanus taeniola*. The town of Jebba is now connected with Zungeru by what is known as the Northern Extension of the Lagos Railway, but at the time of my visit this line was under construction. Through the kindness of the Director I was, however, enabled to examine this area as far as Charati, the terminus at that time, and the following records were made during several excursions by trolley.

At Gana, on the left bank of the Niger, from which the photograph shown in Plate VII, figure 2, was taken, *G. palpalis* was far from uncommon, and this species occurs at several places before reaching Mokwa. The railway skirts for a considerable distance a large expanse of water known as Lake Tatabu, which is not surrounded by much dense shade, but everywhere high grass is predominant. Throughout this whole region *G. tachinoides* is extremely abundant.

At Bokani the only blood-sucking flies seen during my visit in October were *G. tachinoides* and *Haematopota lacessens*, but *Rhipicephalus simus* and *Ctenocephalus canis* were very abundant on dogs. *G. tachinoides* was also obtained at Gudu Gudu. Dr. J. W. Archibald, who was stationed at Bokani and afterwards at Jebba, sent in a number of species, but as the only data accompanying them were "Jebba and Bokani 1910" it is impossible to determine the precise locality of each. It may be advisable, however, to enumerate them here:—*Myzomyia funesta*, *M. costalis*, *Mansonioides uniformis*, *Glossina palpalis*, *G. tachinoides*, *G. submorsitans*, *Tabanus biguttatus croceus*, *T. fasciatus*, *T. latipes*, *T. ditaeniatus*, *T. par*, *Tabanus sp. nov.* and *Hippobosca maculata*.

(d.) Zungeru and its Environs.

The town of Zungeru (locally known as the cantonment) is situated on the right bank of the River Kaduna, and is the seat of administration of Northern Nigeria. I do not propose to enter into a lengthy description of this town, but shall draw attention to only a few of the most important points in connection with the blood-sucking insects which occur there, and the possible causes of their existence and abundance. It might be well, therefore, to enumerate these at this stage.

Family TABANIDAE.

<i>Tabanus biguttatus croceus.</i>	<i>Tabanus par.</i>
„ <i>ditaeniatus.</i>	„ <i>thoracinus.</i>
„ <i>gratus.</i>	<i>Haematopota decora.</i>
„ <i>pertinens.*</i>	„ <i>pallidipennis.</i>
„ <i>nyasae.</i>	„ <i>tennicrus.</i>
„ <i>taeniola.</i>	<i>Chrysops distinctipennis.</i>

Family MUSCIDAE.

<i>Stomoxys calcitrans.</i>	<i>Glossina palpalis.</i>
„ <i>nigra.</i>	„ <i>tachinoides.</i>
<i>Lyperosia minuta.</i>	„ <i>submorsitans.</i>

Family CULICIDAE.

Section Anophelina.

<i>Myzomyia umbrosa.</i>	<i>Myzomyia funesta.</i>
„ <i>costalis.</i>	<i>Myzorrhynchus mauritanus.</i>

Section Culicina.

<i>Culex tigripes</i> var. <i>fusca.</i>	<i>Stegomyia sugens.</i>
„ <i>quasigelidus.</i>	<i>Mansonioides uniformis.</i>
„ <i>invidiosus.</i>	<i>Toxorhynchites brevipalpis.</i>
<i>Trichorhynchus (Culiciomyia) nebulosus.</i>	

* Described by Mr. E. E. Austen on page 286 of this volume.

Family HIPPOBOSCIDAE.

Hippobosca maculata.

Family PULICIDAE.

Ctenocephalus canis.

Family IXODIDAE.

*Amblyomma variegatum.**Rhipicephalus simus.**Haemaphysalis leachi.*,, *appendiculatus*,, *sanguineus.*

Zungeru is situated in the valley of the Dago River, near its confluence with the Kaduna. These two rivers are separated by a high ridge, on which is situated the European Hospital and the medical quarters, the area between this ridge and the Kaduna being covered with dense bush. From the ridge to the River Dago the whole area is cleared, and here are situated several bungalows and the Prison. The European military quarters are on the right bank of the Dago River and the Government Offices on the left bank, the latter in the most low-lying part of the cantonment. Over some of these offices there are European residential quarters, while on the ascending ground of the left bank stand the remaining bungalows, culminating in Government House near the top of the ridge. The polo ground is situated near Government House on a small plateau, and on the other side towards the River Dago lies the Prison farm.

The site of the cantonment is therefore such as to make the work of the sanitary officer a very arduous one, when he has to undertake clearing measures, and, for this reason, in spite of almost continual work, tsetse (*G. palpalis*, *G. tachinoides* and *G. submorsitans*) are nearly always present within the limits of the cantonment, but more numerous during the rains. The proximity to the Kaduna, which swarms with tsetse in its lower reaches, renders the task of preventing these insects from invading the town a very difficult one, but in addition to this the River Dago must be taken into account, along with the surrounding bush, through which roads radiate in all directions. Again, the railway now enters Zungeru across the Kaduna from Jebba, and, passing along the side of the cantonment, continues onwards to Minna and the north. This latter fact constitutes an additional danger, and must not be overlooked.

As has been said, the cantonment itself is very efficiently cleared, but the sanitary gang as at present constituted can do little more than look after this part, while what is urgently required is an extensive clearing between the medical lines and the Kaduna, a similar clearing on the banks of the Kaduna on both sides of the new railway bridge, and a continuation of the clearing on the Dago River; in fact, a clear belt around the whole cantonment, and this can be done only by systematic and continued work carried on by a large supplementary sanitary gang. This is perfectly well recognised by the Medical and Sanitary Departments, but owing to the small number of men assigned to this work no action can be taken. Now that Zungeru is linked up by railway with Lagos and Kano, the number of Europeans passing through it will be greater than ever,

and the dangers are therefore accentuated ; some such measures as those suggested should immediately be put into effect.

During my own stay in Zungeru I caught several *Glossina palpalis* at various places within the cantonment, in some cases within a few yards of European bungalows, and several medical officers have obtained the same species at other places. It is more than probable that these do not actually breed in the town, but come in from the surrounding bush. Mosquitos are far from uncommon in Zungeru, but are more abundant along the valley of the Dago River than on the higher ground. If at all possible, the residential quarters over the Government Offices in Ike Square should for this reason be abolished. Two species of *Stomoxys*, namely *calcitrans* and *nigra*, are omnipresent, and are a perfect pest and a probable source of danger to ponies, while the number of species, as well as of individuals, of the smaller TABANIDAE, is excessively large, especially near the polo ground. The clearing already suggested should tend to reduce these to a minimum.

Trypanosomiasis is very common amongst horses in Zungeru, and there can be little doubt that many become infected within the cantonment. Not long ago a camp was started near the polo ground for transport cattle, but this had to be abandoned owing to the high rate of mortality. There is at present a trypanosomiasis camp for ponies, but it is situated too close to the Kaduna, and might with advantage be removed to higher well-cleared ground. In the interest of the Protectorate such camps ought to be officially recognised and aided.

Piroplasmosis also is known to occur in dogs, but no records are available to show whether or not this disease accounted for any of the deaths in the cattle transport lines.

I should like here to draw attention to one of the regulations of the cantonment, namely, that prohibiting the shooting of any game, large or small, within three miles of Zungeru. In consequence of this, small antelopes may often be seen within the bungalow enclosures. The question as to whether or not this regulation should be continued must necessarily depend on whether these animals are or are not a source of danger. For the present we are not in a position to make any definite statement, but the blood of these animals should be examined for protozoal parasites, and in view of the high mortality amongst horses, inoculation experiments with *Stomoxys* and TABANIDAE should also be carried out. It is not at all improbable that such game may act as protozoal reservoirs, and that their presence around the cantonment may to a great extent account for the infection of the ponies. Should this be proved to be the case, it is obvious that such a regulation should be at once withdrawn.

The following extracts from a letter sent me by Dr. W. Morrison will give some idea of the country immediately surrounding Zungeru :—"Konoko is a small village of about 30 huts, situated near Wushishi, about 8 miles from Zungeru [see map]. The general bush is more open than one finds elsewhere, but there are a number of kurimis [p. 307, *supra*], usually with a collection of pools of water along the whole extent, and thick dense bush and trees on either side, while the lowest parts are swampy. Near these places tsetse were more numerous than in any other place I have seen, and I have counted over a dozen

on my boy's back at one time. Besides tsetse, *Hippocentrum*, *Tabanus*, *Haematopota* and also *Hippobosca*, absolutely covered my pony's belly, and in a short time hundreds of these could have been caught. Needless to say, my pony developed trypanosomiasis; I examined his blood daily, and on the sixth day found trypanosomes. Harnessed antelope, bush-cow, hartebeeste, water-buck, duiker, oribi and pig, are abundant." The insects collected by Dr. Morrison during his stay there include *Mansonioides uniformis*, *Tabanus taeniola*, *T. fasciatus*, *T. biguttatus croceus*, *T. ditaeniatus*, *T. par*, *Hippocentrum versicolor*, *Haematopota gracilis*, *H. lacessens*, *H. bullatifrons*, *Glossina submorsitans* and *Hippobosca maculata*.

The presence of these in close proximity to Zungeru more than ever emphasises the necessity of having an extensive clearing separating such haunts from the cantonment.

(c.) Zungeru to Yelwa.

This part of my tour was accomplished between August 30th and September 11th under somewhat trying conditions. It being the height of the rainy season, the rivers were much swollen, and many of the swamps were almost impassable. Rain fell persistently the whole day during four marches, and thus rendered work practically impossible.

The country varies slightly in character at different parts, but the general altitude may be taken roughly at 1000-1300 feet above sea level. Immediately after one leaves Zungeru, the River Kaduna is crossed, but with this exception the road to Garan Gabbas, about 7 miles from Zungeru, is practically level and runs through thin, open bush country. Bush-fowl and guinea-fowl are everywhere abundant on the route, and near Garan Gabbas itself a considerable troop of large red monkeys was seen. The following blood-sucking insects were captured on the pony between 4 and 6 p.m.:—*Hippobosca maculata*, *Stomoxys nigra*, *S. calcitrans*, *Haematopota bullatifrons* and *Hippocentrum versicolor*. The first four species were abundant, but of the last only one specimen was seen. Heavy rain fell during the night and up to 9 a.m. The following day was dull and very few insects were seen. Between Garan Gabbas and Tegna, *Hippobosca maculata*, *Stomoxys nigra* and *S. calcitrans* were found on the pony, while at Tegna itself two *Hippocentrum versicolor* were captured, along with one *Haematopota bullatifrons*. This last species is a most voracious feeder. It darts down and immediately sets to work; the puncture made by the proboscis is very large, and if the insect be disturbed while feeding, a stream of blood generally oozes out. A species of *Simulium* and a *Culicoides* occur at Tegna. The native dogs were almost covered with ticks, and the following species were found:—*Rhipicephalus sanguineus*, *R. simus* and *Haemaphysalis leachi*; while one species of flea, *Ctenocephalus canis*, was also obtained from the same source.

Before we left Tegna in the morning, one specimen of *Tabanus subangustus* was caught flying around the lamp on the table at 5 a.m. The journey from Tegna to Mariga was far from good at this season of the year. Practically half of the road was under water, and some parts were very swampy and

in many places the pony extricated itself from the mud only with difficulty. In such swamps *H. versicolor* is practically always found. The River Mariga is crossed in canoes, but no blood-sucking flies were seen here, although two hours were spent in transferring loads and carriers. Plate X. illustrates the type of vegetation on the banks of the rivers in this part of the Protectorate. About half a mile further on is Mariga, a small town of about 200 inhabitants. Around the houses in the native town large pools of water were everywhere seen. These contained innumerable mosquito larvae and pupae, but careful search failed to reveal any imagines in the houses themselves. The larvae and pupae collected here have not yet been identified. One *Tabanus subangustus* was captured flying around the lamp on the table in the rest-house at 8 p.m.

While we were encamped at Mariga, it rained heavily and persistently throughout the whole night and up to about 9 a.m. The road to Bobi is very similar to that between Tegna and Mariga. There are numerous swamps and running streams, and two fairly large rivers have to be crossed. One, about a mile from Bobi, is very swift and deep, but not broad; here one specimen of *T. subangustus*, was captured at noon. Three species of *Haematopota* were caught at Bobi: *H. bullatifrons*, *H. lacessens*, and two specimens of a species not yet described.

The country from Bobi to Baeri is covered with moderately thick bush, but towards Baeri it is hilly. The road passes through numerous swamps, but there are no large rivers to be crossed. During the journey, *H. bullatifrons* and another specimen of the new species referred to above were caught. At Baeri *Tabanus albipalpus* and *T. subangustus* were secured. In the rest-house book the following note, dated 17. v. 07, appears: "Tsetse-fly is found here"; but none was seen during my visit on 3. ix. 10. On my horse were found several *Amblyomma variegatum*.

The road from Baeri to Kontagora (20 miles) is through thin bush country and practically level; four miles from Baeri, the Igberi River has to be crossed by means of calabashes. No blood-sucking insects of any description were seen during this journey.

Kontagora is a large town of over 4000 inhabitants and is the headquarters of the Province of the same name. It stands about 1300 feet above sea-level, and is probably the highest point between Zungeru and Yelwa. Rivers to the west of this point, e.g., the Kontagora River, flow in a south-westerly direction directly into the Niger, while those to the east, e.g., the Igberi River, flow south-easterly into the Kaduna, which itself is a large tributary of the Niger. The Residency is situated about two miles from the native town, and the surrounding district, though swampy in parts, is well cleared. The only blood-sucking fly seen was *Hippobosca maculata*, and this occurred in numbers around horses; numerous *Rhipicephalus simus* were also found on these. A jigger, *Dermatophilus penetrans*, was obtained from the foot of a native. In the hospital, however, numerous flies, collected some time previously by medical officers and residents in this province, were examined and the data of these ought to be recorded here. From Kontagora itself, the only species were *Tabanus biguttatus croceus*, collected by Dr. McKinney in August, 1910, and *Myzomyia costalis*, collected

by Dr. W. D. Inness. The following species from the surrounding districts were also collected by Dr. W. D. Inness :—

<i>Glossina palpalis</i>	at	“Yelwa Ford on the Kontagora River”	(5. x. 09).
<i>Glossina tachinoides</i>	„	“Kontagora River, 1 mile S.W. of town”	(26. viii. 09).
„	„	“Valley of Kontagora R., between Mudangi and Adala”	(7. viii. 09).
„	„	“Banana plantation at Adala, on Kontagora R.”	(8. viii. 09).
„	„	“Yelwa Ford, Kontagora R.”	(5. x. 09).
<i>Glossina submorsitans</i>	„	the first three localities cited for <i>G. tachinoides</i> ,	on the same dates.

Mr. P. de Putron, the Assistant Resident at Bussa, also collected specimens of *G. palpalis* at Kulfu, and *Tabanus par* at Jeri. Both these places are in the Bussa District of the Kontagora Province. All the above records have been included on the map.

From Kontagora to Yelwa, the country varies in character at different parts, and is much more hilly than the previous section, especially when nearing the valley of the Niger. The first part of the road, namely to Osubu,* is fairly level and swampy, with a considerable amount of scrub. One specimen of *Glossina palpalis*, the first on this trip, was caught close to one of the swamps, in a cluster of dense bush. The headquarters of the Kontagora Province used to be at Osubu, but were removed in 1905 for various reasons, one of which, according to the Resident, being the enormous mortality of horses in the station. The roads, grass and bushes were swarming with small ticks, and a walk in the grass resulted in one's legs being simply covered with them; it is often stated that these will not bite man, but the writer's experience does not in any way bear this out. The species found were *Rhipicephalus sanguineus*, *R. simus* and *Haemaphysalis leachi*. *G. palpalis* occurs in numbers in Osubu.

The road to Massamabu passes through open country with abundant high grass and thin scrub. About half-way, the River Kontagora, which runs south-west and joins the Niger nearly opposite the junction of the River Oli with the latter, has to be crossed by means of rafts. While waiting here, I secured one specimen of *G. palpalis*. At and around Massamabu the following blood-sucking insects were caught :—*Tabanus subangustus*, *Haematopota bullatifrons*, *H. lacessens*, *H. puniens*, *Glossina palpalis*, *G. tachinoides* and *Simulium sp.* *Simulium* was especially troublesome between 4 and 6 in the evening. When this insect has finished feeding, a small drop of blood is generally left adhering to the wound. The position of the bite is afterwards indicated by a bright red spot, surrounded by an irregular discoloured purplish area which remains for several days.

Heavy rain fell throughout the night, but early in the morning it cleared up. No sooner, however, had we started for Anaba than a downpour commenced, and continued the whole day. Work was impossible, so a halt was made at Ibeto. No flies of any description were seen. About 10 o'clock next morning, the rain having partially stopped after 39 hours' continuous downpour, a start was again

* Osubu is not marked on the map, but lies about four miles from Kontagora.

made for Anaba. The road in this part is rocky, and trekking was difficult owing to numerous streams which were considerably augmented by the recent rain. There is also a large amount of thick scrub in this region. When crossing the River Watta about a mile from Ibeto at 10.30 a.m., I secured a specimen of *T. subangustus*, and one of *H. bullatifrons*. From 11 a.m. to 3 p.m. another tropical shower was experienced, but after that it cleared up sufficiently for outdoor work to be recommenced.

At Anaba the following were captured:—*Stomoxys nigra*, *S. calcitrans*, *Haematopota decora*, *H. bullatifrons*, and one specimen of a new species of *Haematopota* (near *decora*), not yet described. These were all caught late in the afternoon, while *Tabanus subangustus* was captured flying around the lamp in the kitchen at 7 p.m.

The road from Anaba to Ipana* passes through Lebelli; it is very rocky and there is an abundance of thick scrub. There are numerous nullahs and hills and several small streams, which make travelling very arduous. During this march, the following flies were taken, chiefly around the pony:—*Tabanus albipalpus*, *H. bullatifrons*, *H. decora* and *Haematopota sp. nov.* At Ipana, *Hippocentrum versicolor* and another specimen of the new species of *Haematopota* were obtained.

From Ibana to Yauri, the old capital of this district, the road passes through extensive swamps, and at the town of Lafia, the river of that name, sometimes called the Malendo River, is crossed by canoe; it is here 150 yards wide, being deep and with high banks. The first part of the road from Yauri to Yelwa is moderately level, but the latter part is over high rocky hills with loose stones. At Yauri, there is a large number of horses, and this is one of the chief breeding places in this Province, so that it is highly improbable that tsetse occur here; in fact, one would hardly expect to find any owing to the extensive level plain on which the old town was situated, and which is practically devoid of bush or scrub of any sort. At Yelwa, the only two blood-sucking flies seen were *Tabanus taeniola*, caught during the day in the open, and *T. subangustus*, caught around the light in the early morning and late evening.

(f.) Baro-Kano Railway.

The town of Baro is situated on the left bank of the Niger, 407 miles from its mouth, and has recently become a very important centre owing to its being the southern terminus of the Baro-Kano Railway, which runs in the valley of the Bako River to Shapa, thence to Kano, *via* Minna. Plate XI gives a general view of the railway terminus and one half of the town, so that it is unnecessary to enter into a lengthy description.

The town itself is situated in an area enclosed by a crescent-shaped plateau, which is generally known as "the Horse-Shoe." On the top of the plateau on the south side are situated the European hospital and several railway bungalows, while on the side of the hill on the north are the quarters of the political department, and the native hospital. These latter may be seen in Plate XI,

* The town of Ipana does not figure on the map, but is situated on the main road about 6 miles from Lebelli.

which also shows the general type of the vegetation. On the side of the railway remote from the town is a large pestilential swamp which is an ideal mosquito-breeding area, and serves to keep up a regular supply of these insects in the town. The authorities are quite alive to the necessity of having this swamp filled in, but have experienced considerable difficulty in the matter, owing to the high position it holds in the local fetish or "ju-ju." It is to be hoped, however, that this difficulty may be overcome in the near future.

I visited this town on two different occasions, and as my own experiences coincide exactly with those of Drs. Ingram, Morrison and Macfie, I shall content myself with giving a list of the blood-sucking flies found at Baro, and an extract from their report to show the nature of things as they exist at this place.

Family CULICIDAE.

Section Anophelina.

<i>Anopheles wellcomei.</i>	<i>Myzorrhynchus mauritanus.</i>
<i>Myzomyia funesta.</i>	" <i>puludis.</i>
" <i>umbrosa.</i>	<i>Nyssorrhynchus pharoensis.</i>
" <i>costalis.</i>	" <i>squamosus.</i>
" <i>flavicosta.</i>	

Section Culicina.

<i>Culex quasigelidus.</i>	<i>Stegomyia fasciata.</i>
" <i>decens.</i>	" <i>gebeleinensis.</i>
<i>Trichorhynchus nebulosus.</i>	" <i>sugens.</i>
<i>Mansonioides uniformis.</i>	

Family MUSCIDAE.

<i>Glossina palpalis.</i>	<i>Glossina submorsitans.</i>
" <i>tachinoides.</i>	" <i>longipalpis.</i>

Family TABANIDAE.

<i>Tabanus biguttatus croceus.</i>	<i>Tabanus latipes.</i>
" <i>subangustus.</i>	" <i>taeniola.</i>

Family IXODIDAE.

Rhipicephalus simus.

Drs. Ingram, Morrison and Macfie in reporting on an outbreak of sleeping sickness at Baro, in which five cases were found, say: "We are of opinion that the occurrence of trypanosomiasis is sporadic in Baro. There is, however, to judge from the prevalence of *G. palpalis* at this season of the year (August), no reason why it should not become epidemic.

"An attempt was made to determine the areas in which the different species of *Glossina* occurred. No tsetse-flies were found along the narrow belt of land between the river and the base of the cliff, which is traversed by the road from Sabon Gidda to Baro. This strip of ground is kept fairly well cleared. While very few were encountered on the level ground enclosed by the horse-shoe-shaped plateau where Baro itself is situated, on ascending from this level to the plateau, specimens of *G. palpalis* and *G. tachinoides* are readily found on

the top of the hill, and for about one mile inland the same flies have been frequently taken. Further inland these species are gradually replaced by *G. morsitans* [*submorsitans*], this latter species being found in considerable numbers all over the plateau surrounding Baro. The belt is in places at least 4 miles wide. Hartebeeste is known to occur on the plateau, and buffalo has been shot within recent times. It may be of interest to note that the tsetse-flies appeared to be attracted by grey flannel or sandy-coloured homespun cloth.

“An interesting fact emerges from the above observations, namely that at Baro *G. palpalis* is plentiful at a considerable distance from the river. As regards the relative prevalence of *G. palpalis* and *G. tachinoides*, the former was more frequently met with in the month of August, the latter in September, the number of *G. palpalis* having apparently diminished.”

Since the above was written, Dr. Morrison caught one specimen of *Glossina longipalpis* on the top of the plateau.

The new native town of Baro is situated about two miles up the line from the railway headquarters, on the side of the railway remote from the river. Close to the railway there runs a creek for a few miles; the country is thickly wooded and *G. palpalis* is abundant. Onward from the creek the country is much more open, while near Katcha (about 14 miles) there is a large plain which extends



Fig. 1.—Typical open grass country of the savannah type.

for several miles on the left. Towards and around Egga (68 miles), the bush is only moderately thick, while in the vicinity of Kateregi (72 miles) it becomes much thinner, and the soil is sandy. At 79 miles the railway passes within a hundred yards of the river and here *G. palpalis* occurs. This region I traversed

on a trolley from Minna, on November 23rd and 24th. At 84 miles the line runs at a considerable distance from the river, but numerous *G. submorsitans* alighted on the natives on the trolley. No water exists anywhere in this vicinity, and the bush is fairly open, and gets gradually thinner, until at Minna there are only a few stunted trees scattered about (Plate XII, fig. 1 and text-fig. 1). At 98 $\frac{3}{4}$ miles there is a large river, on the banks of which the bush is very dense; no tsetse were seen there, but in all probability they exist; while at 103 miles there is a small stream, 20 feet deep during the rains, but reduced to isolated pools in the dry season. There *Glossina submorsitans* was caught, and it is noteworthy that at this point one of the construction camps was situated, and practically every horse brought there died of trypanosomiasis. Dr. Morrison, who did a considerable amount of travelling on this line, writing to me about this region, says: "*Hippocentrum versicolor* and *Tabanus biguttatus* var. *croceus* I have caught at Katcha station, and the former along with *Tabanus taeniola* in the van all along the line. These species enter the vans and carriages, and are thus carried from place to place all along the Baro-Kano Railway."

At Minna, blood-sucking flies of any description are seldom met with. The following species were, however, obtained: *Hippobosca maculata*, *Stomoxys calcitrans*, *Myzomyia costalis*, *Anopheles watsoni*, *Myzorhynchus paludis* and *Mansonioides uniformis*; while the ticks comprised *Hyalomma aegyptium*, *Amblyomma variegatum* and *Rhipicephalus falcatus*. Dr. Macfie informed me that the only Tabanid he had seen during a three months' stay at this station was *T. taeniola*, and it is more than probable that this was carried to Minna in some railway vehicle. There is a large herd of Fulani cattle at Minna, and the death rate is extremely low, which in itself gives an indication of the paucity of such insects as may be implicated in the transmission of disease.

North of Minna, the country through which the railway runs is fairly open, with the exception of a few isolated kurimis. Near Guni, where the River Dinia is crossed, *Haematopota pallidipennis* and a species of *Tabanus*, not yet identified and probably new, entered the van in which I was travelling. Further on, at Kogin Sirikin Pawa, on the river of that name, numerous *Hippobosca maculata* and *Haematopota pallidipennis* swarmed around the ponies, and one specimen of the *Tabanus* mentioned above was caught; but although I carefully examined about a mile of the banks of the river itself, no tsetse were seen. In the small pools left by the falling river were numerous mosquito egg-rafts, and also large numbers of both Anopheline and Culicine larvae and pupae. One small specimen of *Tabanus*, probably *T. gratus*, was seen but not caught. At the River Kaduna, the terminus of the railway at the time of my visit (Pl. XIII, fig. 2), only *H. pallidipennis*, *T. gratus* and *T. pertinens* were seen.

(g) Kateri.

Prior to my visit to Northern Nigeria, reports had been received by the Principal Medical Officer, Dr. S. W. Thompstone, C.M.G., that sleeping sickness was very prevalent in and around Kateri in the Zaria Province—a very inaccessible region seldom visited by Europeans. At the request of Dr. Thompstone, I visited this district in December. A start was made from Kugo on the Baro-Kano Railway on November 29th; Kateri was reached on December 1st; two

days were spent in this vicinity, and the return journey was made, by a different route, to Kogin Sirikin Pawa (also on the railway), which was reached on December 7th—the total distance covered being about ninety-seven miles.

This part of the country is very imperfectly known, and several of the towns mentioned here are not given on any map, but their approximate position may be gauged from the text of the report and the route shown on the appended map. The first day's journey brought us to Wuye, a distance estimated at about nine miles, but very difficult trekking owing to the extremely hilly and rocky nature of the country. The route was very sinuous, and numerous streams were crossed. The vegetation as a whole was fairly open, but a few dense kurimi-like patches were traversed. No blood-sucking flies, however, were seen during the journey. Wuye is a small Gwari town on the top of an extremely steep hill, and it is noteworthy that the majority of the Gwari towns are so situated for purposes of defence; thus the probability of *Glossina* occurring in them is very remote. At and around this town the following species of Tabanids were caught, *Haematopota decora*, *H. pallidipennis* and two species of *Tabanus*, both probably new.

The next town at which we camped was Doka (shown on the map), distant about seventeen miles. The first part of the road is very rocky and similar to that between Kugo and Wuye, but mostly down-hill. When that part is passed, the road is good, and there is abundant low scrub and long grass. A tributary of the Kogin Sirikin Pawa had to be crossed, and later that river itself. Several kurimis were passed through, and, although there is dense vegetation along the banks of both the streams mentioned, and all seemed likely haunts for tsetse, none was seen; the only blood-sucking flies caught being *Haematopota pallidipennis*, and one specimen of the new *Tabanus* obtained at Wuye.

Doka is a Kadara town of moderate size situated on the edge of an extensive kurimi. The camp was pitched in a clearing in this kurimi, the vegetation of which was so dense that the sun's rays hardly penetrated and the air was damp and musty. Numerous *Glossina palpalis* occur at all parts of the kurimi and in the town itself.

From Doka to Kateri is roughly about eighteen miles. The country is covered with open bush, but this is intersected in every direction, at varying intervals, by long stretches of dense bush. In several of these *G. palpalis* was seen, and doubtless occurs in all. At the River Dinia, which was crossed on this march, *G. palpalis* is also abundant.

Kateri is a Kadara town situated in a small open clearing in the centre of a dense kurimi, which extends for several hundred yards all round, while radiating from it are several moderately wide strips of bush of a similar nature (Pl. XIV, figs. 1 and 2). The Kadaras are a very primitive and shy people; the women are absolutely devoid of clothing, and the children are supported on their backs by skins, chiefly those of a species of monkey and the harnessed antelope. The importance of this fact is seen when one remembers that the women are the water-carriers, and that the water-pools stand in thick bush swarming with tsetse, so that they have no protection from the attacks of these insects. One case of sleeping sickness was found in this village, and though there was no evidence of

anything approaching what might be termed an epidemic, either at present or in the past, still the importance of the existence of such a focus is a serious menace to non-immunes, such as Europeans, who may come within range of it. The blood-sucking flies caught in and around the town were *G. palpalis* (in great abundance), *Haematopota pallidipennis*, *Tabanus* sp. (near *gratus*), *T. pertinens*, and two species of mosquitos. Trypanosomiasis in horses is responsible for a heavy annually mortality in this region, but this disease the natives attribute to two plants, one a species of *Pandanus*, and the other a liana-like leguminous creeper, which are supposed to contaminate or poison the drinking water.

Just outside the kurimi in which the town is situated is a large area of open ground, covered with long grass and thin bush or isolated trees, similar to that shown on page 328. There we camped, at a distance of about 150 yards from the kurimi, and only an occasional tsetse was seen, these having followed the women bringing water and firewood to the camp, although within the kurimi itself they swarmed around one constantly.

In view of all these facts:—(1) the position of the town in the centre of a kurimi, (2) the prevalence of sleeping sickness, (3) the abundance of *Glossina palpalis*, and (4) the existence of a large area of open ground in the immediate vicinity—some measures ought to be adopted to minimise the risks attendant on such a focus of sleeping sickness. Every endeavour should be made to have the town removed into the open clearing and the area around it denuded of all bush. The presence of individuals with trypanosomiasis is of necessity a source of danger, as they serve as reservoirs and tend to increase the number of infective tsetse; it is highly desirable that all such cases should be at once removed to a segregation camp.

The return journey from Kateri was made by way of Kurimi-n-Iya, Kwakou, Kumbaku to Kogin Sirikin Pawa. The road from Kateri to Kurimi-n-Iya passes through the two small Kadara villages of Bini and Adana. The vegetation may be described as thin open bush, intersected by a succession of kurimis. Less than 500 yards from Kurimi-n-Iya, a small river was crossed, and there *Glossina palpalis* was caught. The town itself is situated in a kurimi, as the name would suggest, and swarms with *G. palpalis* (Pl. XV, figs. 1 and 2). It was impossible to find near this town a piece of open ground suitable for a camp which would be a safe retreat from tsetse, and we had consequently to camp between two dense kurimis. Both *G. palpalis* and *G. tachinoides* were caught in the camp, and the tents were invaded by swarms of *Haematopota pallidipennis*, forty of this species being captured between 2 and 3 p.m.

About six miles from Kurimi-n-Iya is situated the town of Bichi, a very flourishing place, extensively cultivated. Three miles further on is the village of Goda, while Kwakou is distant about six miles from the latter. This route passes through several kurimis and numerous extensive "fadamas" or swamps, which would be practically impassable in the wet season. It is very rocky in places, and the grass in the marshes is between eight and nine feet high. *G. palpalis* was seen in a kurimi between Goda and Kwakou, and also at the latter place.

Kumbaku is about twelve miles from Kwakou. Immediately after leaving Kwakou, the river Dinia is crossed, and from this the road is practically level,

and passes through open bush country, beyond which is a range of hills composed of a large number of huge granitic bosses. Between two of these is a narrow sinuous pass, in which is the Hausa town of Kumbaku. In this valley there is a deep narrow ravine, in which runs a small stream which contains water during the whole year. Near it were caught the following blood-sucking flies :— *Glossina palpalis*, *Stomoxys calcitrans*, *Haematopota pallidipennis*, *Tabanus pertinens*, and another species of *Tabanus* similar to those already mentioned.

The road from Kumbaku to Kogin Sirikin Pawa is very hilly and rocky for about the first ten miles, after which point there is a sudden descent into the valley of the river of this name. Onwards, for about five miles, the country is covered with thin open bush. No biting flies were seen during this trek, but at the river itself *Chrysops distinctipennis* and *Haematopota decora* were caught around the horses and cattle crossing the ford.

A few outstanding features in connection with this trip call for comment. Geographically, the route may be considered thus. Leaving the valley of the Kogin Sirikin Pawa, we crossed the watershed separating this river from the River Dinia; the valley of the Dinia was then traversed until at Kateri one reached the watershed separating the Dinia from the Garara River, a tributary of which, the Mahabei, runs southwards from Kateri. The return route followed the valley of the Dinia River, and then crossed the watershed into the valley of the Kogin Sirikin Pawa. Kateri, therefore, standing between the Rivers Dinia and Garara, is subject to the influences of both, at any rate in so far as its *Glossina* supply is concerned.

The whole of this part of the country may be described as kurimi-bearing, and it may safely be said that where the country has this character strongly accentuated, *G. palpalis* will be found. *G. tachinoides* was caught at only one place, namely, Kurimi-n-Iya, while *Haematopota pallidipennis* occurs throughout this whole region.

Sleeping sickness was found at Kateri, but doubtless occurs in other villages in similar situations. The removal of such villages to open ground and the clearing of the dense bush which surrounds the wells, is strongly to be recommended.

(h) Minna to Izon.

In order to make as complete a survey as possible of the Garara River, I first proposed to continue southwards from Kateri, but owing to the unsettled condition of this part of the country, on the advice of the Resident, I returned to Minna by rail, and following the main Abuja road, struck the Garara River at Izon. This road passes through Paiko, Shaku and Tufa.*

The first part of the journey is through gently undulating country and thick bush. About half-way to Paiko, the Bako River has to be crossed. This river was very low in December, but in the height of the rains is about 50 yards wide,

* Neither Shaku nor Tufa is shown on the map, but a study of the text will give their approximate position.

and a canoe has to be used. *Haematopota decora* and *H. pallidipennis* were caught hovering around the pony, while one tick was also found on him. Around the town of Paiko, which stands at the base of a commanding hill, is an extensive fertile plain, where the Fulani graze large herds of cattle. No biting flies were seen, nor are there likely to be any in this district, owing to the almost complete absence of any form of shade. The fact that cattle live well in this vicinity and that horses are bred here also points to the absence of tsetse or other biting flies.

About five miles beyond Paiko, there is a small river, where *G. palpalis* occurred in swarms; while again before Shaku, the river Jatto or Ebba has to be crossed. At the latter river only *Haematopota pallidipennis* was found. Shaku is a small town at the base of a large hill. No cattle are kept here, but a few mares were seen. The chief, however, complained of a sickness which killed off the horses, and his description of the disease was extremely suggestive of trypanosomiasis. The only blood-sucking flies caught or seen were *H. decora*, *H. pallidipennis* and *Tabanus* sp.

About eleven or twelve miles from Shaku is the village of Tufa, a beautiful small Gwari town situated on the edge of a kurimi. The road for the greater part of the way is through open orchard-like country and high grass. It is not at all improbable that *G. palpalis* occurs at Tufa, though none was seen.

From Tufa to Izon is about six or seven miles. The road passes through long grass and several fadamas. There are small hills on all sides, but the road itself runs through a plain, and in the dry season is fairly good. Outside Izon there are numerous large farms with rice, millet, guinea-corn, beans, cotton, etc. The town of Izon consists of several small sub-villages, and is a very important centre for agricultural produce; it is situated in the Nassarawa Province, on the left bank of the river Garara. The river at this part is from three to six feet deep in the dry season, but over twenty in the rainy season; the banks are steep, and the width varies but little at the different times of the year, being always from forty to fifty yards. Crossing is effected in canoes. It is a slow-flowing stream, of which the bed and banks are composed of sand; the banks are covered with dense vegetation and high shady trees. At the crossing itself, which is sandy, *G. palpalis* is abundant, as also are *Tabanus gratus* and *H. pallidipennis*. Further removed from the river, *G. tachinoides*, *H. pallidipennis* and *T. pertinens* were caught, while in the town itself both *G. palpalis* and *G. tachinoides* were found; these last may, however, have followed the natives from the river crossing.

As has been already mentioned, this ford is on the main Zungeru-Abuja road, and is consequently very important. There is a continual stream of natives passing to and fro, and numbers may be seen at almost any hour of the day waiting to be transferred in the canoe. The clearing in the bush is a few yards in width, only sufficient for the canoe to be brought alongside for loading. High shady trees overhang, and tsetse swarm all around. A distance of at least fifty yards on each side of the actual crossing could, with little difficulty, be denuded of all bush and shade-trees. The same ought certainly to be done at the crossings of the Bako river, the river near Paiko, and the river Jatto.

(i) **The River Garara.**

From Izon I followed the river Garara as closely as possible to its mouth, near the village of Derri. This part is very imperfectly known and mapped, and there is no direct route. Consequently I had to rely on native information at the various towns visited, and by careful questioning tried to include all the towns and villages situated on or near the river; a sketch map (Pl. XVI) is given to show the route followed. To enter into the full details of this trip would occupy more space than is available at present; so I shall content myself with giving in broad outline the most noteworthy features pertinent to the investigation in hand. On this journey I was accompanied by Dr. J. W. S. Macfie.

The river was crossed at a point about two miles south of Izon, near the village of Chini, and although it was only 6.30 a.m. *G. palpalis* was caught. The bank of the river is everywhere covered with dense shady bush overhanging the water. From this point, the route diverged considerably from the river in the direction of Lapai. The first day's halt was made at the village of Gau, an almost impregnable mountain fortress, accessible only after a very arduous climb, and ensconced on a small plateau surrounded by enormous granite boulders. No biting flies were seen here, nor would one expect any. Horses bred in this town showed no evidence of trypanosomiasis, nor did natives complain of any high mortality or give any history of a disease which at all resembled trypanosomiasis. According to the Siriki (or headman), sleeping sickness was unknown here.

The descent from Gau is more gradual towards Lapai; the road skirts the base of a hill and passes through fairly open country. About a quarter of a mile from Lapai, there is a small stream where the natives obtain their water, and here both *G. palpalis* and *G. tachinoides* were caught. The town of Lapai stands on a rocky hill and is surrounded by an extensive plain, on which there are large herds of Fulani cattle. These, as well as horses, seem to thrive quite well.

From Lapai, we were again able to strike the Garara at the village of Dagou, and from this point the road runs practically parallel with the river the whole way to Derri. The country between Lapai and Dagou is hilly and the path is very rocky in places. The village of Dagou stands in dense bush and there both *G. palpalis* and *G. tachinoides* invaded the tent in considerable numbers.

From Dagou we proceeded to Wopa, a small town in kurimi-country, having passed through several small villages (Chakun, Kuka, Nimbo Gwari and Yelwa). No tsetse were seen here, but they may exist, at any rate in the wet season. After Wopa the next important town we touched at was Guredi. This part of the road is good and the surrounding country is covered with thin open bush.

Through the kindness of the Resident at Lapai, the Emir of that district sent a mounted messenger to accompany us to Derri. When we reached the town of Guredi, however, the latter strongly advised us not to attempt to take ponies further, as he assured us they would certainly die on the way. He supported his opinion by sending his own pony back to Lapai, and walking the remainder of the journey. This was certainly strong proof that he was convinced that ponies could not live in this region, owing, according to him, to the poisonous nature of the drinking water. He cited a case, which I have every reason to believe was

true, as it was several times corroborated, to the effect that when the Emir of Lapai, with nearly a hundred mounted attendants, visited this region, either during the trip or immediately after returning to Lapai, every single horse died, in all probability from trypanosomiasis. We continued to administer large doses of mercury and arsenic daily to our ponies; and much to the messenger's surprise and, to some extent, dismay, they arrived in Derri in good condition, showing no symptoms whatever of infection.

From Guredi the road passes through numerous kurimis to the village of Zago, where *G. palpalis* was seen around the ponies. The next village examined was Adagba, and between it and Lafian Yabba the River Uri, a small stream running through a kurimi, was crossed. Here also *G. palpalis* occurs. After Lafian Yabba, the road crosses a deep ravine by a small bridge. It being impossible to take the ponies over this bridge, a detour had to be made through a pestilential swamp of a very treacherous nature, in which the water, of a tomato-soup colour and consistency, in numerous places was over three feet deep. This part would be absolutely impassable in the rains. While leading the ponies through this region we saw numerous tsetse, but for obvious reasons none were caught. At the town of Yabba, *G. palpalis* was obtained.

The trek from Yabba to Mama (near Eki) was a very important one, inasmuch as three species of *Glossina* were caught. From Yabba to Chapa the country is very hilly, and there are numerous laterite outcrops, but onwards to Eji (also parallel with the river) the road is more level but very rocky. At Wada and Eji, *G. palpalis* was caught. From this point the road diverges from the river bank in the direction of Edzu.* Shortly after we had left the riverside, *G. tachinoides* was captured in more open country, while further on *G. longipalpis* was found (cf. the conditions obtaining at Baro, p. 329). At the town of Mama, *G. palpalis* again occurred, while here also were obtained several specimens of *Mansonioides uniformis* in the bush around the village.

The next halt was made at the town of Evua. The country is much more open, and both *G. tachinoides* and *G. longipalpis* were caught, while near Evua itself, which stands practically on the river, *G. palpalis* was obtained. Between Evua and Derri are situated the villages of Egba and Gerinya. The road from Evua to Egba passes over high hills and through deep steep-sided ravines. Some of these are very rocky and nearly 600 feet in depth, and are all but impassable for ponies. Before Egba can be reached, about two miles of open plain with an extensive marsh has to be traversed. The town of Egba stands in the centre of this marsh, and is a very important market-place. It is on one of the main Kano-Lokoja trade routes, and produce is brought here from Derri, Baro, Lapai, etc. The road from Egba to Derri is practically level; first it passes through a kurimi alongside a large lake, which is probably a backwater in the wet season; then towards the Garara it skirts the end of the range of hills already mentioned, and meets the river at Gerinya. This town is on the main route to Kotonkerifi, and from it the road runs along the bank of the Garara to Derri. In the kurimi referred to, *G. palpalis* was caught. At this part the river is wide, shallow and slow-running, and several sandbanks appear in the dry season. The sandy banks are covered with long grass and only occasional clusters of

* Mis-spelt Edza on the map.

bush. At this part of the river *G. tachinoïdes* are fairly abundant, but no *G. palpilis* were seen; this is due, no doubt, to the nature of the vegetation. The town of Derri is situated at the confluence of the Garara and the Niger. In the dry season it stands high and dry, and is surrounded by marshes and pools left by the falling river, but in the wet season it is an island on which water rises to the floors of the houses. In every respect it resembles Mureji at the confluence of the Kaduna and the Niger (Pl. IX, fig. 2). The following mosquitos were obtained during my stay at this town:—*Culex invidiosus*, *Myzomyia funesta*, *Mansonioides uniformis*, *Banksinella luteolateralis* and *Ludlowia mimomyiaformis*.

It might be well to summarise briefly a few of the outstanding results of this trip:—

(1.) The journey was made at the height of the dry season—from December 17th to December 25th.

(2.) The banks of the River Garara, wherever seen, were covered with dense vegetation, and numerous kurimis occur everywhere in the vicinity of the river. In such situations *G. palpilis* was almost invariably found.

(3.) The only other species of tsetse seen were *G. tachinoïdes* and *G. longipalpis*. The former was found at Dagu, near Wada, Evua, and between Gerinya and Derri. In all these places the bush was open and removed some distance from the river. *G. longipalpis* was caught at Evua, and between Wada and Edzu, in both cases in open country and still further removed from water.

(4.) No TABANIDÆ were seen during the trip.

(5.) Mosquitos: *Mansonioides uniformis* was caught at both Mama and Derri; while at the latter town *Culex invidiosus*, *Myzomyia funesta*, *Banksinella luteolateralis* and *Ludlowia mimomyiaformis* were also obtained.

(6.) Ticks were seen only at Mama.

(7.) The whole region along the Garara has a bad reputation for horses, so that none are kept in the vicinity of the river, every attempt having met with failure.

(8.) At towns more remote, such as Lapai and those situated on high ground, e.g., Gau, horses and cattle are kept with impunity.

(j) Derri to Bagana.

Having thus completed the examination of the Garara River, I decided to visit the Province of Bassa, as sleeping sickness had been reported from this region, and little or nothing had been done from an entomological standpoint. For this purpose, it was necessary to go to Bagana on the south bank of the Benue River. The journey was made in three stages: (1) to Kotonkerifi on the Niger, by canoe; (2) Kotonkerifi to Umaisha, by road; and (3) Umaisha to Bagana, by canoe.

The trip from Derri to Kotonkerifi occupies only about five hours, and is accomplished in native dug-out canoes. The river bank is mostly overgrown by dense shade-trees, but there are numerous sand-banks, which are partially covered with long xerophilous grass. Only one tsetse was seen, apparently *G. tachinoïdes*. Numerous crocodiles were observed basking on the sand-banks. The native town of Kotonkerifi is about three miles distant from the point of disembarking,

and is separated from it by a dense kurimi, more than a mile in breadth. In this kurimi there are numerous pools of considerable size. At the height of the rains, it is more than probable that these connect with the Niger.

The town is moderately large and is an important market-place for the surrounding district. Five hundred people were examined for sleeping sickness, but no case was found. Cattle are bred there, and seem to thrive quite well, but horses have been brought at different times from Keffi and Abuja, and, according to reports by the natives, all have died within a few weeks of their arrival. Seven horses died thus during one season. The interpreter, kindly lent to me by Major Blakeney, the Resident at Keffi, informed me that on one occasion Major Blakeney, while on trek, brought two horses to Kotonkerifi both of which died of trypanosomiasis on their return to Keffi, although they were to all appearance perfectly sound before setting out. The natives there, as elsewhere, attribute this to the drinking water. The country around Kotonkerifi is covered with dense bush and abundant undergrowth. This is intersected by numerous backwaters from the Niger, and at the time of my visit (December), there was a large number of pools isolated by the falling river. *Glossina palpalis* and *G. tachinoides* were everywhere abundant.

The road from Kotonkerifi to Umaisha, which are both in Nassarawa Province, passes through numerous towns, none of which are indicated on the small scale map, and as most of them are not shown on the larger scale map, it has been considered advisable to include them here so as to make the individual records more precise. Their relative position may be gauged by the *Glossina*-localities shown, in order, on the accompanying map.

The country between Kotonkerifi and Ikpariki is covered with high grass and thin low bush, and is eminently suitable for *G. submorsitans*. Between Ikpariki and Ibefu, there is a large amount of cultivated land, and the bush is therefore considerably reduced in amount. After Ibefu the road is very stony and hilly owing to a rocky outcrop, but towards Denjiri it again becomes level, and everywhere there are extensive farms of yams and guinea-corn. At Denjiri, both *G. palpalis* and *G. tachinoides* were caught.

According to the natives, a short time after horses are brought to this region, they show marked oedema of the legs, belly and scrotum, micturate in small quantities, lose their appetite, and finally die in five to eight days. This is clearly indicative of trypanosomiasis, but although *G. submorsitans* was specially sought for in likely places, none was seen.

From Denjiri to Ogusu the road passes through numerous kurimis, between which are extensive farms. About half-way is the town of Utu and here *G. palpalis* occurs. Ogusu is simply a collection of scattered farm hamlets; *G. tachinoides* was the only blood-sucking insect obtained in this region.

The country from Ogusu to Umaisha is fairly open and extensively farmed. In and around the town of Umaisha, which is practically on the banks of the River Benue, both *G. palpalis* and *G. tachinoides* were obtained. The siriki (or local chief) complained bitterly of the loss of horses from a disease which he called "chiwon aguna" (or swelling sickness), and which is almost certainly trypanosomiasis, but no *G. submorsitans* were seen. As elsewhere, this disease is attributed to the drinking-water.

From Umaisha, on the left bank of the River Benue, to Bagana, about 40 miles further up, on the right bank, the journey was made in native canoes (Pl. XIV, fig. 1). The banks of the river are covered for the most part with thick dense bush overhanging the water, but at several places where they are composed entirely of sand, only xerophytic grass is seen. At the time of my visit (December 31st), the river was practically at its lowest level and was studded with numerous sand-banks, which bore no vegetation and which would be under water several feet in depth in the wet season (Pl. XII, fig. 1). On these, the natives passing up or down the river make temporary encampments, and at one of them we saw a horse which was suffering badly from trypanosomiasis. A specimen of *Tabanus taeniola* was obtained feeding on this pony.

Poling up-river in canoes being extremely slow, it was found necessary to camp on one of these sand-banks near Amara. A strong harmattan was blowing throughout the day, and in the evening there was a heavy drenching mist, which persisted through the night and until about 8 a.m. In spite of this, however, thousands of small flies, no doubt attracted by the lights, swarmed from the neighbouring banks and helped to make things even more uncomfortable. The next day (January 1st) we arrived at Bagana. *G. palpalis* was caught half-way between Amara and Amageddi, and also at Amageddi. Crocodiles abound on all the sand-banks, and one hippopotamus was seen near Amageddi. A new species of *Tabanus*, near *T. africanus*, was obtained by Dr. Foy at Amageddi and is described above by Mr. E. E. Austen under the name of *Tabanus necopinus* (p. 279).

(k) Bassa Province.

This province is one of the most southerly in Northern Nigeria. It is bounded on the north by the Benue River, on the west by the Niger, on the south by Southern Nigeria, and on the east by the Muri Province. The capital is Ankpa, and from it there are two main routes, one to Bagana on the Benue, and the other to Ghebe on the Niger, opposite Lokoja. For my purpose I considered it advisable to make a start at Bagana, proceed to Ankpa, and thence to Ghebe, thus traversing the province from Ankpa towards both rivers.

The town of Bagana, in addition to its being the Benue port for the province, is also an important trading centre, and consists of about 400 huts. It stands close to the river bank, which is densely covered with thick vegetation. Not far from the town, a small stream enters the Benue, and there *G. palpalis* and *G. tachinoides* swarm in large numbers, while along the banks of the Benue itself the same two species were everywhere found. One case of advanced sleeping sickness was seen here, and this emphasises the danger of having in the vicinity of the town and of the European factory thick bush which harbours large numbers of *G. palpalis*, even in the height of the dry season. Mortality amongst horses is very high; one agent of the Niger Company lost three from trypanosomiasis in one year. No *Glosina submorsitans* were seen.

Bagana to Ankpa.

The road from Bagana to Abajikoro* passes through several small villages, over three small streams, and one moderately large river, the Amara. Up to

* Shown on the map as Abajikolo.

Giddan Idrezu the country is open, with a few large trees, numerous clusters of dwarf shrubs, and abundant high grass. The village of Barkumi is on the bank of a small stream, while the town of Igandum stands on another, the Uge. The latter is crossed by means of a large fallen tree and is surrounded by a dense kurimi and here *G. palpalis* occurs in large numbers. The River Amara is spanned by a bridge about 60 feet in length, which is situated in thick bush, where *G. palpalis* was seen. The town of Abajikoro also stands on a small stream, the banks of which are overhung with dense bush as in the case of the others; there also *G. palpalis* swarmed. No horses are ever kept in this locality, except a few in transit to Ankpa. The natives state that any horse brought to one of these villages would certainly die within a few months.

The town of Akwacha is about 15 miles due south of Abajikoro. Shortly after leaving the latter town the road crosses the River Amara, while towards Akwacha are two other small streams, probably tributaries of the Akwacha River, which runs into the River Amara, and this in its turn, flows into the Benue. All these streams are fringed by dense forest growth which more than probably harbours *G. palpalis*, although only at a small river half a mile from Akwacha were specimens actually caught. The village of Egga stands in a thick kurimi near this river, and at the watering place of this town, *G. palpalis* was seen. Akwacha is a large town on the bank of a river of the same name; there also *G. palpalis* were taken in numbers, while even at the rest-house, more than half a mile from the town, and in an open clearing, one specimen was caught biting the writer at 5.30 p.m.

The people inhabiting this region are known as Igaras, but there are also numerous Hausa trading settlements. The Siriki, or headman, of Akwacha being extremely intelligent, an attempt was made to verify and add to the names of flies previously obtained at the various villages. This tribe does not seem to differentiate between the various types of biting flies, as do some of the others. Any fly which bites they term "unu," but beyond that the only distinction they draw is with regard to the animal attacked, for example, "unuanya" is the fly which bites the horse (anya=horse), while "unuefa" denotes any fly which bites the "efa," or "bush cow." On being shown large Tabanids, small Tabanids and tsetse, the Igaras used any of these three terms to denote one and all of them indiscriminately. They, however, distinguish mosquitos under the name "imu." Sleeping sickness they term "ogaulu" (oga=sickness, ulu=sleep), while enlarged cervical glands they style "atalahu." No horses are kept at Akwacha owing to the high rate of mortality.

Immediately outside Akwacha three deep ravines have to be crossed. These were practically dry in January, but in the wet season they hold streams of considerable depth. Beyond these is the village of Uriwa, and a little further on a fairly large river, the Urito, has to be crossed. The nature of the country up to this point may be described as thin open bush, but beyond the Urito there is an extensive kurimi, which stretches for nearly four miles to the town of Auru. This is probably the densest kurimi seen during my tour in Northern Nigeria. Apart from the main road, which runs through it, it is practically impenetrable

without the use of axes and matchets. On entering it one is conscious of a fall of several degrees in the temperature, and except in a few places the sun's rays hardly penetrate, so that the shade afforded renders the use of a helmet almost unnecessary. It was a veritable haunt of tsetse, which simply swarmed around the ponies and carriers, and were extremely persistent in their attacks, but at the same time very wary and difficult to catch. Both *G. palpalis* and *G. longipalpis* occur there. One of these, a *G. longipalpis*, was observed on the pony's neck after it had been feeding for some time. On being disturbed, it fell to the ground less than a yard away, and so gorged with blood was it that it could not cross its wings, nor was it able to fly. Although only about three feet away from the bush, which it endeavoured to reach, it managed to cover this distance only after four abortive attempts to fly, which resulted only in a series of long jumps. After entering the bush, it settled on the under side of a leaf, and remained there for some ten minutes, during which time I watched it and then without any difficulty caught it by means of its wings. It hardly made any effort to escape, but sat on my hand in a comatose condition.

At the town of Auru, *G. palpalis* was caught, and the same species was found at Oda. The road from Auru to Oda is excellent, and passes through open bush country. Near the town of Oda, two specimens of *Chrysops silacea* were secured. From Oda to Ankpa there are numerous long stretches of dense bush, but, although tsetse no doubt exist all along the road, none was actually seen on this journey. The latter town has lately been made the headquarters of the province. The European settlement is situated on the side of a steep hill leading down to the valley of the River Mabolo, but the site has been condemned by Dr. M. Cameron Blair, the Senior Sanitary Officer for Northern Nigeria. During the rains, the water coursing down the hillside practically floods all the houses, and drains several feet deep are hardly sufficient to carry it off. The military quarters at the foot of the hill, and the parade ground are frequently under water during this season.

The rivers and streams which have been hitherto mentioned in this province all drain into the Benue, but the Mabolo in the Ankpa valley runs into the River Anambra, which is a tributary of the Niger, and enters it near Onitsha, in Southern Nigeria.

The bed of the Mabolo is composed in this region of beautiful white sand, and the river itself is surrounded by dense kurimi. *G. palpalis* is everywhere abundant, and specimens were seen in the European military quarters, and also in the house in which I was stationed, about half-way up the hill. Apart therefore from the question of flooding during the rains, the site of the European quarters at Ankpa must be condemned owing to its too close proximity to the *palpalis*-bearing kurimi in the Mabolo valley. A new site has been selected on the high plateau, and although there is a certain amount of clearing already accomplished in this part, considerably more will have to be done in order to minimise the possibility of *G. palpalis* actually invading the European enclosure.

Trypanosomiasis in horses is extremely prevalent at Ankpa. Seldom do any live for more than three or four months after their arrival. One medical officer who was stationed here kept a horse alive for seven months,

but this constituted a record. Two political officers arrived at Ankpa several days before my visit. They left Lokoja, each having a pony, on the 25th of December. These ponies were examined at Lokoja before leaving, and were pronounced as evidently free from trypanosomiasis; yet within ten days of their arrival in Bassa Province both showed distinct symptoms of this disease. The only part of the Province traversed during this time was the main road from Ghebe to Ankpa. One of them had been sent away before my visit to Ankpa, but, on January 7th, the blood of the other was found to be swarming with trypanosomes. Through the kindness of the owner (Mr. Smith), this pony was lent to me for my interpreter, who was unable to walk, and it accompanied me to Ghebe. Prior to this, nothing had been done in the way of treatment, but during the journey to Ghebe it received full doses of arsenic and mercury daily. Owing, perhaps, to the advanced stage of the disease, the animal showed no signs of improvement, but rather the reverse, and although I was unable to follow up the case I am of the opinion that it also fell a victim to trypanosomiasis in Bassa.

It may be worthy of note here that my own pony, which accompanied me from the middle of November throughout my tour to Kateri, down the Garara River and through Bassa, and which was dosed three times a day with mercury and arsenic, showed no trace of trypanosomiasis when I sent him back to Zungeru from Lokoja in the middle of January.

Ankpa to Ghebe.

The distance from Ankpa to Lafia is about twenty-one miles. The road runs through very thick bush practically the whole way. At Amakutu, about nine miles from Ankpa, there is a small stream, and there *G. palpalis* occurs. From Amakutu to Lafia no water is crossed until about a mile from the rest-house, where a stream of considerable size, the Okura, about 40 yards wide and 2 feet deep in the dry season, flows to the Anambra. The town of Lafia practically commences here, and is scattered in groups of about a dozen huts over an area of more than 2 miles in diameter. The bed of the river Okura is very sandy, and the road for over half a mile from the ford is composed of very fine sand. The rest-house is situated on the edge of a kurimi, where there is a ford, and where the natives wash and obtain their water. One *G. palpalis* was caught at 7.30 a.m. in the rest-house, a distance of 100 yards from the kurimi. It would be well when this camp has to be rebuilt if it were removed some considerable distance further from the kurimi. I spent several hours at the ford of the River Okura, a tributary of the Anambra, in the kurimi where there was a continuous procession of women coming and going, and at all times *G. palpalis* and *Chrysops silacea* were abundant. The bush was very high and dense and the sun's rays hardly penetrated to the watering place. When no women were actually at the water, the majority of the tsetse retreated to the bush, and only an isolated specimen or two could be seen, but as soon as any women came to draw water they were immediately attacked. Never did I see any woman come and go without a tsetse alighting on her. This part of the native women's work consequently renders them much more liable to infection by tsetse than is the case with the men, whose duties keep them more on the farms and further from tsetse-haunts.

The country from Lafia to Ogumi, a distance of about 12 miles, is covered with moderately thick bush which in a few places resembles the kurimi type of growth. No streams are crossed on this trek. For about half-way, the River Okura runs practically parallel with the road at about 300–400 yards from it. About 3 miles from the town of Ogumi in a kurimi, where the natives obtain their water, several *G. palpalis* were caught in the afternoon. From Ogumi to Aiyangba, the road passes through the same type of country as that described between Lafia and Ogumi, but there are more kurimis.

The town of Aiyangba is large but scattered, as is the case in nearly all the towns in Bassa; it stands near the top of a slight elevation. The natives obtain their water from a pool in a very dense kurimi some two miles distant from the town. There is no running stream, but the pool, which must have its origin in a spring, contains water more than sufficient for the town throughout the whole of the dry season. The shade at this pool is very dense, and the temperature is several degrees lower than in the open. *G. palpalis* and *Chrysops silacea* swarm around the women drawing water; of the latter species forty were caught in one hour. The notes made with regard to the ford at Ogumi were still further emphasised at Aiyangba. One *G. palpalis* was caught in the rest-house at Aiyangba, and, as has been recommended for Lafia, this camp should be removed further from the kurimi towards the town. The only advantage of having it in its present position is the proximity of the water supply, but this must essentially be considered as secondary to the avoidance of tsetse.

After leaving Aiyangba no further water is seen until Dekina is reached. The first part of the road passes through dense bush immediately followed by a long stretch over a bare laterite outcrop, while towards Dekina the country is more park-like in character, and the road is very uneven and undulating. The bush around the river at Dekina is very similar to that at Aiyangba, but tsetse are not nearly so abundant. At the river itself, *G. palpalis* was found, and further removed, in the more open park-like country, *G. tachinoides* occurs. The town of Dekina contains three separate settlements, Hausa, Igbara and Bassa Como, comprising in all between 300 and 400 huts. It was the headquarters of the province before Ankpa.

The country towards Taketti continues park-like or wooded, but there is a considerable amount of rocky ground. Two streams occur on this road, one at the village of Olowa about four miles from Dekina, and another at Ajebela, five miles further on. About two and a half miles from Taketti, there is a very steep sinuous rocky descent into the valley of the Niger, but the river itself is distant some fifteen miles. The town of Taketti stands on a stream of considerable size which is bridged. No tsetse or other biting flies were seen at any of the streams crossed on this journey.

The road from Taketti to Ghebe is good and passes through undulating park-like country, but not far from Ghebe a deep broad river, probably a creek from the Benue, with outlet into the Niger, has to be crossed by canoe. There is considerable cultivation around this region.

Ghebe is a large town of over 1,200 inhabitants, and from its situation, almost opposite Lokoja, with which there is considerable trade, is probably the most

important in the province. No tsetse were seen at Ghebe, but this is not surprising, as the bush is very thin. It is highly probable that they occur during wet season.

The foregoing notes on my journey through the Province of Bassa, embracing as it did about 140 miles, and covering the two main routes from Ankpa, the capital, to Bagana on the Benue in the north, and westward to Ghebe on the Niger, may serve to indicate the general types of country which occur in this province. The rivers and streams between Bagana and Ankpa run into the Benue system, while those between Ankpa and Ghebe drain directly into the Niger.

The only blood-sucking flies caught or seen were *Glossina palpalis*, *G. tachinoides*, *G. longipalpis* and *Chrysops silacea*. *C. silacea* was found at Oda, Lafia and Aiyangba; *G. tachinoides* at Bagana and Dekina; *G. longipalpis* only at Auru; while *Glossina palpalis* occurred at practically every stream or pool examined, where there was a dense growth of shady bush (*vide* Map). With regard to *G. longipalpis*, it may be noted that this species had previously been recorded from Akwacha by Dr. G. J. Pirie, who found them "in the denser bush patches along the small watercourses." He added "trypanosomiasis both of animals (horses and dogs) and of man exists at Akwacha, especially in the rainy season, from May to October." It is somewhat strange that he found this species "rather numerous," but caught no *G. palpalis*, whereas at the time of my visit *G. palpalis* was much more abundant, and also much more widely distributed.

In such a type of country as occurs in Bassa Province it is very difficult to indicate how the chances of attack from tsetse may be abolished or even diminished without involving enormous labour and expense. At the same time villages such as Egga, which are situated in the centre of a dense kurimi ought certainly to be removed into more open country; the fords on the main routes from Bagana and Ghebe might with great advantage be cleared of the surrounding bush; and the wells and streams where water is drawn for the villages ought to be cleared in a similar manner. Several of the rest-camps are too close to the neighbouring kurimis, and, when being rebuilt, should be moved further away. As these improvements could be carried out by the inhabitants of the province through the various headmen with very little trouble, some attempt should be made to have them effected. The European settlement at Ankpa is much too near the Mabolo kurimi and, even if for no other reason, ought to be removed to a site on higher ground, and separated from the surrounding bush by at least 200 yards of clearing.

Mention has been made of the enormous amount of trypanosomiasis which occurs, and the impossibility of keeping horses almost anywhere in this province. When it is remembered that the only three species of *Glossina* which have been found are *palpalis*, *tachinoides*, and *longipalpis*, and that the last-named is confined, so far as one can judge, to the Akwacha region, and that the only locality where *tachinoides* has been found away from the river Benue is Dekina, the question naturally arises:—What is the carrier? The evidence seems to point to *Glossina palpalis*, but even were this proved to be the case, the problem would not end there. The further question would arise:—Where does the infection

come from? When we take into consideration the small number of horses which are brought to this province annually, and the extremely short interval which elapses before these show symptoms of trypanosomiasis and die, we must conclude that, whatever be the carrier, the percentage infected must be large. It seems hardly possible that the infection could be carried, in the circumstances quoted, from horse to horse, but if this be so the infected insect must remain infective for a very long time. More probable, however, is the hypothesis that the insects become infective from some other source, such as game, but as this has been neither proved nor disproved it opens up a fruitful line of research.

V. RECORDS OF BLOOD-SUCKING INSECTS AND OTHER ARTHROPODS FROM NORTHERN NIGERIA.

The majority of the insects mentioned in the following list have already been referred to in the preceding pages, but it might be well to tabulate these for the sake of completeness. The table will also form a guide to any who may be interested in this work and serve to show what species may be expected, but it must be borne in mind that in all probability this list is very far from complete, especially as regards the more northerly parts of the Protectorate.

In the majority of the species the records are far too scanty to admit of any discussion of their distribution, so that I propose to leave this over until more data are forthcoming. I may also add that several new species from Northern Nigeria await description and these have not been included in the following list.

Order DIPTERA.

Family CULICIDAE.

Section *Anophelina*.

Anopheles wellcomei, Theo.
Myzomyia costalis, Loew.
 " *funesta*, Giles.
 " *umbrosa*, Theo.
 " *marshalli*, Theo.
 " *flavicosta*, Edw.

Myzorhynchus mauritanus, Gr.
 " *paludis*, Theo.
Nyssorhynchus maculipalpis, Giles.
 " *pharoensis*, Theo.
 " *squamosus*, Theo.
 " *watsoni*, Edw.

Section *Culicina*.

Aedomyia catasticta, Knab.
Banksinella luteolateralis, Theo.
Culex decens, Theo.
 " *duttoni*, Theo.
 " *fatigans*, Wied.
 " *grahami*, Theo.
 " *guiarti*, Blanch.
 " *invidiosus*, Theo.
 " *quasigelidus*, Theo.
 " *tigripes*, Gr. var. *fusca*, Theo.
 " *univittatus*, Theo.

Trichorhynchus (Culiciomyia) nebulosus, Theo.
Ludlowia mimomyiaformis, Newst.
Mansonioides uniformis, Theo.
Mucidus mucidus, Theo.
Reedomyia biannulata, Theo.
Stegomyia africana, Theo.
 " *fasciata*, Theo.
 " *gebeleinensis*, Theo.
 " *sugens*, Theo.
Taeniorhynchus cristatus, Theo.
Toxorhynchites brevipalpis, Theo.

Family TABANIDAE.

<i>Chrysops distinctipennis</i> , Aust.	<i>Tabanus ditaeniatus</i> , Macq.
„ <i>silacea</i> , Aust.	„ <i>fasciatus</i> , Fabr.
<i>Haematopota bullatifrons</i> , Aust.	„ „ var. <i>niloticus</i> , Aust.
„ <i>cordigera</i> , Aust.	„ <i>fuscipes</i> , Ric.
„ <i>decora</i> , Walk.	„ <i>gratus</i> , Loew.
„ <i>gracilis</i> , Aust.	„ <i>latipes</i> , Macq.
„ <i>laccessens</i> , Aust.	„ <i>laverani</i> , Surc.
„ <i>pallidipennis</i> , Aust.	„ <i>nyasae</i> , Ric.
„ <i>pertinens</i> , Aust.	„ <i>par</i> , Walk.
„ <i>puniens</i> , Aust.	„ <i>pertinens</i> , Aust.
„ <i>tenuicrus</i> , Aust.	„ <i>pluto</i> , Wied.
„ <i>vittata</i> , Loew.	„ <i>ruficrus</i> , P. de B.
<i>Hippocentrum trimaculatum</i> , Newst.	„ <i>secedens</i> , Walk.
„ <i>versicolor</i> , Aust.	„ <i>subangustus</i> , Ric.
<i>Pangonia ruppellii</i> , Jaenn.	„ <i>sufis</i> , Jaen.
<i>Rhinomyza stimulans</i> , Aust.	„ <i>taeniola</i> , P. de B.
<i>Tabanus africanus</i> , Gray	„ <i>thoracinus</i> , P. de B.
„ <i>albipalpus</i> , Walk.	„ <i>williamsii</i> , Aust.
„ <i>biguttatus croceus</i> , Surc.	

Family MUSCIDAE.

<i>Stomoxys brunnipes</i> , Grünb.	<i>Glossina fusca</i> , Walk.
„ <i>calcitrans</i> , L.	„ <i>longipalpis</i> , Wied.
„ <i>inornata</i> , Grünb.	„ <i>palpalis</i> , R.-D.
„ <i>nigra</i> , Macq.	„ <i>submorsitans</i> , Newst.
<i>Lyperosia minuta</i> , Bezzi.	„ <i>tachinoides</i> , Westw.

Family HIPPOBOSCIDAE.

<i>Hippobosca camelina</i> , Leach.	<i>Hippobosca maculata</i> , Leach.
„ <i>francilloni</i> , Leach.	

Order SIPHONAPTERA.

Family PULICIDAE.

Ctenocephalus canis, Dugès.

Family SARCOPSYLLIDAE.

Dermatophilus penetrans, L.

Order ACARI.

Family IXODIDAE.

<i>Amblyomma nuttalli</i> , Dönitz.	<i>Rhipicephalus appendiculatus</i> , Neum.
„ <i>variegatum</i> , F.	„ <i>sanguineus</i> , Latr.
<i>Aponomma exornatum</i> , Koch	„ <i>simus</i> , Koch.
<i>Haemaphysalis leachi</i> , Aud.	„ <i>falcatius</i> , Neum.
<i>Hyalomma aegyptium</i> , L.	

Family ARGASIDAE.

Ornithodoros savignyi, Aud.

VI. NATIVE NAMES FOR INSECTS AND DISEASES CARRIED BY THEM.

The study of the native names of blood-sucking insects is fraught with many difficulties, as, more often than not, one name is used to include insects of very different groups, while again in some places different species have special names and these names do not always coincide.

So far as I was able to gather, the Hausa names are as follows:—

Mosquito = Soro.

Tsetse = Barabaji.

Small Tabanids (sometimes also Tsetse) = Gudanchiza (*i.e.* biting flies).

In Igara:—

Mosquito = Imu.

Any biting fly = Unu.

Large Tabanids = Unuefa (efa = bush cow).

According to Dr. J. M. Dalziel, the native names in the Sokoto Province, where he has spent a considerable time, are:—

“*Glossina* spp., Tsande or Cheda (Zamfara).

Tabanus spp., Bobua or Kujen-giwa (generally the larger species such as *T. biguttatus*, but commonly used for any *Tabanus*).

Haematopota spp. (and *Chrysops*), recognised by the natives by their dappled wings, Kujen bauna or Sambaliko (Zamfara).

N.B.—The name Barabaji is correctly used only for *Hippobosca*, but is sometimes applied to practically every different species of biting fly, even the tiny *Lyperosia minuta*.”

Just as in the Gambia,* most of the tribes in Northern Nigeria distinguish the *lethargic* stage of trypanosomiasis from the earlier stage, which is characterised by the presence of “bumps in the neck” or enlarged cervical glands, thus:—

Tribe.	“Bumps.”	Sleeping Sickness.
Hausa	Chiwon wia (sick neck)...	Chiwon berichi.
Nupe	Patugi (patu = neck) ...	Bata elle.
Ikoto	Atogbe	Uku wara.
Igara	Atalahu	Oga ulu.

In the above names for sleeping sickness the first word in every case signifies “sick,” and the second word “sleep.”

Trypanosomiasis in horses is known at Umaisha by the name of Chiwon-aguna which is literally “sick-swelling.”

VII.—THE GENUS GLOSSINA.

Five species of this genus have been found in Northern Nigeria, namely, *G. palpalis*, *G. tachinoides*, *G. longipalpis*, *G. fusca*† and one other, which for the

* Bull. Ent. Res. II, pt. 3, p. 219.

† *G. fusca* has been recorded from Ife and between Poinia and Allu in Kabba Province, but none of these places have I been able to locate.

present must remain doubtful. Professor Newstead in a recent paper differentiated between *G. morsitans*, Westw., and *G. submorsitans*, Newst., on the strength of structural differences in the male genitalia, but further added that these two species could be distinguished by the abdominal markings, as follows :—*

In *G. submorsitans* "the transverse black abdominal bands are :—

- (a) much more clearly and sharply defined ;
- (b) equally and more narrowly interrupted in the median line on the third, fourth, and fifth segments ;
- (c) slightly rounded medially and suddenly tapering towards the lateral margins.

"In *G. morsitans* the bands are :—

- (a) not so sharply defined medially ;
- (b) unequally interrupted in the middle line, the space between the two divisions of the band on the third being much greater than the space between those of the fifth segment ; and the dark colour gradually shading off into the pale colour forming the median line ;
- (c) broadly rounded medially and very gradually tapering towards the lateral margins."

It is noteworthy that the types of this species were obtained at Katagum in Northern Nigeria, co-types in Northern Ashanti, and additional specimens in Ashanti and at Baro in Northern Nigeria. Numerous specimens from these localities are now in the possession of the Entomological Research Committee, but although a careful examination of these reveals that the majority of them undoubtedly present the abdominal markings ascribed to the species *submorsitans*, many also show the characteristic markings of *G. morsitans*, while all intermediate gradations may be found. The specimens in the National Collection in the British Museum from other West African Colonies also emphasise this point.

Consequently, it is not premature to say that, should this species be distinct, it cannot be separated from *G. morsitans* by these external characters, nor for the present are any others available. But, on the other hand, we may take account of the male genitalia, which must, as in other groups of insects, be regarded as characters of taxonomic importance.

Professor Newstead has separated these two species on the form of the "superior claspers," and the distinctions as shown by him, *provided they are found to be constant* and not linked up by intermediate forms, as in the case of the abdominal markings, certainly justify the establishment of distinct species.

In order to see if such a grouping were possible, I dissected the male genitalia of a large number of specimens from both West and East Africa, including specimens from the same localities as those examined by Newstead. This examination revealed the fact that it was possible to divide them into two distinct groups, and further, these groups corresponded with the geographical distribution ; in other words, the *submorsitans* type of genitalia (as defined by Newstead) was found only in the Nigerian, Gold Coast, Gambian, Senegambian and

* Bull. Ent. Res. II, pt. 1, p. 33.

Congolese specimens, and the *morsitans* type only in the East African specimens. It is quite possible that if a larger number be examined intermediate forms may be found, but in default of this, and for the reason given in a previous paper (*supra*, p. 297), I have decided to regard the Nigerian form as *submorsitans*, and as such they are recorded in this report and shown on the accompanying map. It may be, and probably is, the case that *G. submorsitans* is the western form of the eastern *G. morsitans*, just as *G. longipalpis* is the western form of the eastern *G. pallidipes*.

As already stated, all authentic records, including those in the National Collection, have been incorporated in the accompanying map, but several localities given on the labels attached to some of the specimens are so vague as to defy localisation by means of the published maps, and these are now added in the hope that those better acquainted with the districts mentioned may be able to furnish fuller information with regard to their precise position.

G. palpalis.—Kabba Province: Gbeliko, Oso, Akumbu, Ipesi, Obuni, Otun, Oshi R., Poinia, Ife, between Isua and Ifera, between Ibillo and Ate, Ekon, between Opepe and Edoaka, between Opepe and Imiakebu; Bebuia, Bade R., Bauchi Province, N. Nigeria 2000 ft.; Zugabutu, Nassarawa Province; Epa, Nupe Province; Glendenne; Zuguleba, Jega? District.

G. tachinoides.—Adiale, Bassa Province; Niger River between Yantalah and Borgu; Bebuia, Bade River, Bauchi Province; Wolu R., near Siram; Ebuni, Kabba Province; half-mile S.E. of Alanjo, Haideija; in swamp W. of Kugeru; Marama; Kabuk; Kontagora R., between Mudangi and Adala; Adala, Kontagora R.; Pakim, Kilege R.; Nairanewa, Benue R.; Shari R. delta, Lake Chad; Goulfei on Shari R.; Shodu R.; Sokwa; Alo R., W. Marghi District, Bornu.

G. submorsitans.—Gwayo, Ilorin Province; half-mile S.E. of Alanjo, Haideija; swamp W. of Kugeru; Marama; Kabuk; Kontagora River, between Mudangi and Adala; Adala on the Kontagora River; near Daraja, Kontagora Province.

G. longipalpis.—Dokaro, Kabba Province.

I do not propose, in the present paper, to discuss the distribution of the various species of *Glossina* as I have already dealt, in chapters I and II, with the factors which influence such distribution; and further, because our knowledge of this subject is not yet complete enough for any generalisations. At the same time, I should like to point out a few of the outstanding deductions to be drawn from the present study.

(a) *G. palpalis* is confined to the Niger-Benue River system, and has not yet been found in the region of the Lake Chad system. This species also diminishes in numbers in the drier regions.

(b) *G. tachinoides* is found all over the Protectorate, but is more especially the predominant species in the north.

(c) *G. submorsitans* is also scattered all over the Protectorate, but is more intimately associated with *G. tachinoides* than with *G. palpalis*.

(d) *G. longipalpis* is essentially a Southern Nigerian form, and is found only in the provinces bordering that Colony.

(e) *G. fusca* is also a Southern Nigerian species, and so far has been seen only in the Kabba Province.

(f) In the various species of *Glossina*, as also in nearly all other species of insects, there is a gradual diminution in size and a gradual tendency to become paler in the northern parts of the Protectorate, where the country is more open, the dry season is of greater duration, and the influence of the dry hot harmattan is more intensive.

I hope to deal at greater length with the question of the distribution of the various species of *Glossina* as shown in this Protectorate, after my report on Southern Nigeria, when both Colonies may be regarded as one geographical unit. The same applies to the bionomics of tsetse and the other blood-sucking flies mentioned in this report.

I have added the following extracts from reports by medical officers in the Protectorate as these extend our knowledge of the distribution of *Glossina* in regions I was unable to visit.

Dr. J. M. Dalziel, reporting on a trip made in December, 1910, in the Sokoto Province with a view to "making inquiries in regard to the distribution and prevalence of tsetse in that neighbourhood," draws the following conclusions* :—

- (1) On the main road between Anka and Banaga tsetse-flies are found at the following localities :—(a) Byassa, 15 miles south of Anka and 2 from Bajega—*G. morsitans* ; (b) In the three-mile belt of high woods beginning at 6 miles south of Bajega and ending at 3 miles north of Banaga—*G. morsitans* ; (c) Fassa, a tributary of the Banaga River, $2\frac{1}{2}$ miles north of Banaga—*G. morsitans* and *G. tachinoides* ; (d) Matakwri ravine near Daraga—*G. morsitans*.
- (2) They are found in streams or in the bush away from the main road at :—(a) Korammar Beji, near Bajega—*G. morsitans* and *G. tachinoides* ; (b) Korammar Karawai, near Bajega—*G. morsitans* ; (c) west of Banaga, from the stream Fulani through the bush to Kainkenni, 4 miles from the town—*G. morsitans*, and in places *G. tachinoides*.

He adds, "No native admits that tsetse-flies are found north of Anka, 75 miles by road from Sokoto, and I think they are right" but some of the smaller TABANIDAE are found as far north as Sokoto.

Dr. C. W. McLeay, writing to the Principal Medical Officer (18.1.10), says with regard to the Ilorin Province :—

"*G. tachinoides* are plentiful on the Niger between Ogudu and Jebba—at Jebba itself *G. morsitans* is found. *Morsitans* occurs also at Ilorin and Pategi and a main belt crosses the Ilorin-Pategi road at Zambagu. At Orimope, Omu, Awtun and Osi *G. tachinoides* were caught by Asst. Resident Bryant. I think this fly must be very generally distributed over the southern portion of the Province and towards the Kabba country."

Capt. F. E. Bissell, R.A.M.C., writing from Bauchi on Dec. 7th, 1910, reports that he visited Bebuwa, altitude 2,200 ft., two days' march from Bauchi,

* Where possible, these records have been included on the accompanying map.

on November 30th, and in the vicinity of the stream which passes this town caught ten *G. tachinoides* and three *G. palpalis*. He further adds:—"If sleeping sickness did exist in Bebuia it has disappeared now. Cattle trypanosomiasis does still exist to a certain extent. Bebuia, for some reason which it is not easy to explain, is apparently an isolated patch of the district infested with *Glossina*."

VIII. PROTOZOAL DISEASES IN MAN AND OTHER ANIMALS.

Malaria.

As in the other West African Colonies, this is by far the most prevalent insect-borne disease in Northern Nigeria, but of recent years the number of cases has been gradually diminishing, owing in part to the extensive use of quinine as a prophylactic, and further to the measures adopted to effect a diminution in the number of mosquitos. The importance of the latter is now universally recognised, and much effective work has been done in this direction by the Medical Department. In order to strengthen its position in this matter, legislation is necessary, so that when once the sanitary officer has directed attention to any deficiency it should be made a punishable offence if this is not remedied within a reasonable time.

Yellow Fever.

So far as I could ascertain, no actual case of yellow fever has been reported from Northern Nigeria. But in view of the fact that it has recently been admitted that yellow fever is endemic in West Africa and has been reported from Southern Nigeria, and also that *Stegomyia fasciata* has been recorded from Lokoja, Baro, Geidam and Sokoto, in Northern Nigeria, stringent measures ought to be adopted to try if possible to exterminate this pest. It is now well known that this mosquito does not breed in large expanses of water or swamps but prefers small collections of water, such as one finds in tin cans and other small vessels. For this reason the disposal of the inevitable empty tins and such like is a matter for serious consideration, and it is to the individual houses and compounds that attention must be directed. Unfortunately in many cases the compounds around European bungalows are very often not free from such small receptacles. Some attempt should therefore be made to have these collected regularly and buried, and to aid the sanitary officer in this work it should be made a punishable offence to have any such receptacle lying within a compound, and that even in the dry season. The gutters on the bungalows retaining, as they do, the collected moisture from the evening dew on the roofs, when not carefully supervised, often hold sufficient water for *Stegomyia* to breed. These ought to be properly sloped and regularly cleaned so that such collections of water would be impossible.

It is unnecessary here to enter further into this matter as an instructive article by the late Sir Rubert Boyce on this subject has already appeared in this Bulletin.*

* Bull. Ent. Res. I, pt. 4, pp. 233-263.

Sleeping Sickness.

There can be little doubt that sleeping sickness is endemic in many parts of Northern Nigeria, but the actual delimitation of these areas is a very difficult matter. The occurrence of one or two cases in any village or town does not in itself justify the conclusion that that place is an endemic focus. For example, a case of sleeping sickness was discovered at Maiduguri, but after careful enquiry it was practically proved that the infection was obtained near Loko on the Benue. To regard Maiduguri, therefore, as a sleeping sickness area on this account would be erroneous and misleading.

Apart from this, however, one European died of sleeping sickness contracted either on the Garara River or in Bassa or Kabba Province, and cases have been recorded in persons who have never left their native district. Of course it is possible that the infection might have come from another locality, but in default of any definite information on this point we must regard these areas at any rate as suspected foci. These have been indicated on the appended map, and the following notes may serve to show how scanty our knowledge of this subject is, and also emphasise the necessity for an extended survey being organised to ascertain the precise distribution of the disease. When this is done it will in all probability be found that sleeping sickness exists in all the southern provinces and practically throughout the Niger-Benue river system. It has been reported from Sokoto and Katagum, but if cases did occur there it is probable that they were introduced. I have purposely excluded these from the map as the likelihood of these places being endemic foci is extremely remote.

According to the Medical Report for 1906 four cases, all natives, were recorded in that year, and the following note is added:—"Trypanosomiasis is fairly common in certain parts of the Protectorate. Most cases were found on the banks of the River Benue and in the Bassa Province."

In 1909 three cases were found in natives. "There is, however, considerable evidence to show that the disease is not uncommon on the Benue, but the portion of the Protectorate where it is said to occur has not yet been thoroughly examined. It is apparently confined to small areas and has never assumed the form of epidemics such as have occurred in East Africa."

Dr. J. W. S. Macfie who accompanied me during my trip in the Garara River district, says, "As the result of the examination of 952 persons in twenty-seven villages on the Garara River no case of trypanosomiasis was discovered. 7.1 per cent. of the people were found to have a slight enlargement of the cervical glands. From the statements of the headman at Izon, which is on the Nassaraw bank of the Garara, it would appear that sleeping sickness was once prevalent there but that it has completely disappeared in recent years. From the report of the Resident it would appear possible that sleeping sickness is not uncommon in Agaie but not in epidemic form. One of the cases detected at Baro las September (1910) was a man from Agaie."

With regard to the outbreak in Baro referred to, in which five cases were found, Drs. Ingram, Morrison and Macfie say:—"We are of opinion that the occurrence of trypanosomiasis is sporadic in Baro. There is, however, to judge from the prevalence of *Glossina palpalis* at this season of the year (August), no reason why it should not become epidemic." It must be remembered, however,

that Baro is the terminus of the Baro-Kano Railway, and that large numbers of natives from all parts of the Protectorate are congregated there in connection with the railway works. Consequently it is very difficult to say whether the infection was actually contracted at Baro or before these natives ever came to this town. One of the cases was from Agaie, another from Sierra Leone.

Sleeping sickness has been reported from Bebuia about 30 miles from Bauchi, but Capt. Bissell, R.A.M.C., writing on a visit to that region in December 1910, says :—"If sleeping sickness did exist at Bebuia it has now disappeared." As has already been mentioned, one case of human trypanosomiasis was found at Kateri, and in another part of this report certain recommendations have been suggested.

A segregation camp has been inaugurated near Zaria, and from the point of view of transport this region is satisfactory, provided suitable mosquito-proof vehicles be used in transferring infected cases, a precaution which was adopted in the case of those found at Baro. On the other hand it might have been better if a site could have been selected in the Lake Chad area, which, so far as can be ascertained, is a *palpalis*-free region. The number of known cases is at present, however, very small, and it is not necessary to conduct such a camp on a large scale, but should at any time an epidemic break out the question of establishing a camp near Maiduguri might be considered.

An ordinance ought certainly to be promulgated empowering the Resident on advice from the Medical Officer to have patients suffering from trypanosomiasis removed to the sleeping sickness camp.

It is more than probable that the natives of West Africa have acquired a high degree of immunity in regard to this disease, but this does not in any way justify less stringent measures being adopted. In fact the reverse is the case, inasmuch as immune natives *may* act as reservoirs and thus be a positive source of danger to the European population. For this reason every effort should be made to segregate the infected and to reduce the chances of transmission by judicious clearing in order to effect a diminution in the number of *Glossina palpalis* which, so far as is known, is the only carrier in West Africa.

Trypanosomiasis of Stock.

(d) Trypanosomiasis in horses and cattle is very prevalent, and this disease accounts annually for a heavy mortality. In this connection I would draw attention to the cases cited for Lokoja, Zungeru, the lower Garara River and elsewhere in this report. In the case of Lokoja it is no exaggeration to say that sixty per cent. of the horses brought into the town develop trypanosomiasis within a year, and of these fifty per cent. die of this disease within the same period. Further, it is practically impossible to keep a horse in the Bassa Province for anything approaching a whole year.

There would appear to be two different forms of trypanosomiasis, with distinct clinical systems. I have found both *Trypanosoma vivax* and *Trypanosoma brucei* in the blood of horses, and although *T. vivax* seems to be the more common, *T. brucei* would appear to be the more virulent. But here our knowledge of the subject ends. It is practically certain that infection is not always carried from horse to horse, as has been shown in the case of Bassa, and therefore we have yet

to find the reservoir. Consequently a fruitful line of research lies open and would well repay investigation, namely, the discovery of the animal or animals which act as reservoirs of the trypanosomes which are responsible for the mortality amongst horses, and the insect or insects which convey the infection.

Piroplasmosis.

Piroplasmosis has been found in dogs in Zungeru, and it possibly also occurs in the Katagum district. No definite case of this disease in cattle has been recorded, but it must be remembered that practically nothing has been done to investigate the disease or diseases which kill off the cattle in Northern Nigeria and although it is almost certain that trypanosomiasis is the chief factor, it is not improbable that some of the deaths are due to piroplasmosis.

IX. REMEDIAL MEASURES AND RECOMMENDATIONS.

At various points in the report, when discussing individual localities, I have indicated certain lines of action which might profitably be adopted, so that it is unnecessary again to enter into these in any detail. At the same time it might be advisable to recapitulate the more important items, as some are applicable to widely different localities.

Although recognising the immense advantages accruing from the extension of railway systems in opening up such a Protectorate as Northern Nigeria, one must not overlook potential dangers, and not the least of these is the possibility of extending the range of noxious insects and the introduction of insect-borne diseases to areas previously free. The same applies, though probably to a greater extent, in the case of river transport on launches and steamers.

Consequently every effort should be made to minimise such risks, in the case of railways, by clearing large spaces in close proximity to the permanent way in areas known to harbour such insects as are proved to carry, or suspected of carrying, pathogenic organisms. Until this is done the transport of cattle and horses in open railway vehicles is attended by grave risks, and it is certainly desirable that the trucks used for conveying these animals should be rendered mosquito-proof. By this means horses and cattle might be taken from one free area to another without infection, a procedure at present impossible. In the case of passenger traffic this would be impracticable, and the only solution of the problem is extensive clearing.

The case of river transport is very different, as certain factors, such as "bilge-water," which cannot be avoided, have to be taken into account. There is no doubt that mosquitos, and amongst them *Stegomyia fasciata*, do breed in such water. Only by careful supervision and the free use of oil can this be checked, and it is pleasing to record that this has commanded considerable attention from Dr. E. A. Chartres, the Senior Medical Officer at Lokoja. The co-operation of the Marine Department has also been enlisted in this work.

Certain other factors, however, present themselves, but these are more intimately connected with the construction of the vessels. In another report I entered in some detail into the question of the mosquito-proofing of cabins

and this applies equally to the vessels which ply on the Niger. Further, in the individual cabins one usually finds the same wash-stand arrangement as is used on ocean-going steamers. Now this involves two separate receptacles for water, and on three different occasions I have found mosquito larvae in these vessels. It is difficult, if not almost impossible, when native servants are employed to ensure that these will be kept empty when not in use, and as stated above, they may thus be a source of danger. Consequently, to obviate this risk, vessels built for use on such rivers ought to have a central water supply conveyed by pipes from a mosquito-proof tank, and have also a system whereby the refuse water could be carried off *directly* in a similar manner. It is impossible to insist too strongly on the careful supervision of all water receptacles on launches and steamers.

With regard to individual localities, it is necessary to refer only to a limited number, as the suggestions here made may be applied to others with similar conditions. The following suggestions may be noted:—

Zungeru.—(1) The free use of kerosene in the pools left by the smaller streams during the dry season; (2) the proper sloping and systematic inspection of the gutters on the roofs of bungalows; (3) the removal of the residential quarters over the Government offices in Ike Square; (4) the necessity for an extensive clearing all round the cantonment; (5) the formation of a Government segregation camp for infected horses. This should be situated as far from the rivers as possible and in the centre of a large open clearing.

Lokoja.—Most of the remarks with regard to Zungeru apply equally well to Lokoja, but in addition to these the prevalence of *Stegomyia fasciata* along the river-bank area calls for special attention. The only feasible method of checking this pest seems to be the formation of a masonry or concrete wall along the river bank, more especially at those places where launches and steamers load and unload.

Baro.—Attention has already been directed to the necessity for filling up the large “ju-ju” swamp, and clearing on the lines already started should be most rigorously continued.

Kateri.—The town of Kateri and others in similar situations should be removed to the more open ground and a clearing of several hundred yards made around the watering places.

Bassa.—The rest camps at Lafia and Aiyangba might with advantage be removed further from the kurimis. Villages, such as Egga, situated in a kurimi should be abandoned and others built in the open country. The European quarters at Ankpa ought to be immediately transferred to higher ground and separated from the thick bush by a large open clearing of several hundred yards. In this province as well as in others where the conditions are similar, for example, the Zungeru-Abuja Road and the Zaria-Abuja Road, clearings ought to be made at all places where the main routes cross rivers or pass through kurimis.

Sleeping Sickness Camps.—As already stated, a sleeping sickness camp has been inaugurated near Zaria, but from the point of view of the distribution of *Glossina palpalis*, and in the event of its being necessary to establish another, some region in the vicinity of Maiduguri or at any rate in the Chad river system ought to be selected.

Legislation.—Some sort of Mosquito Ordinance ought to be promulgated in Northern Nigeria, whereby, to aid the Sanitary Department in its work, it might be made a punishable offence to have tins and such-like receptacles lying about compounds. Further, it might be enacted that when due notice was given by the sanitary officer to have any water pits, etc., where mosquitos might breed, filled in, refusal or neglect to comply with the instructions might also be made a punishable offence.

—An Ordinance ought also to be promulgated empowering the Senior Political Officer of the Province, on the advice of a Medical Officer, to have any person suffering from sleeping sickness removed to a segregation camp.

Subjects requiring further investigation.

Many profitable lines of research besides the geographical distribution of blood-sucking insects will present themselves to those interested in this subject, but I should like to draw attention to a few of these as suggested in the present report.

(1) A mosquito survey on the lines suggested in Dr. J. W. W. Stephens' paper in a former issue of this Bulletin.*

(2) The examination of the blood of all game, large and small, in the Protectorate for Protozoa.

(3) An investigation into the forms of trypanosomiasis in horses and cattle. Are there any distinct differences in the clinical symptoms in those animals infected with *Trypanosoma vivax* and those infected with *T. brucei*? Are there other species of Trypanosomes? Is there any difference in the distribution of the various forms of this disease? Which is the most virulent type? What is the relative susceptibility to treatment?

(4) Experiments to determine to what extent *Glossina*, *Stomoxys* or TABANIDAE are implicated in the transmission of trypanosomiasis.

(5) Observations to ascertain the breeding places of *Glossina* and other blood-sucking insects.

(6) An investigation into the occurrence of Piroplasmiasis in various animals.

In conclusion, I wish to take this opportunity of recording my indebtedness to His Excellency the Governor, Sir Hesketh Bell, K.C.M.G., for the many facilities afforded by him and the personal interest he took in the investigation; to Mr. M. H. de la P. Beresford, Secretary to the Administration, for the expeditious way in which all arrangements were carried out; to Dr. S. W. Thompstone, C.M.G., the Principal Medical Officer, for his kind co-operation and many suggestions based on a long experience of the Protectorate; to Dr. Cameron Blair, the Senior Sanitary Officer and Dr. J. W. S. Macfie, with whom I spent a considerable time on trek; 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 Provinces I travelled, for their kind hospitality, the whole-hearted support which was everywhere evidenced, and the many ways in which they aided in carrying through the investigation expeditiously.

* Bull. Ent. Res. II, pt. 1, pp. 1-8.

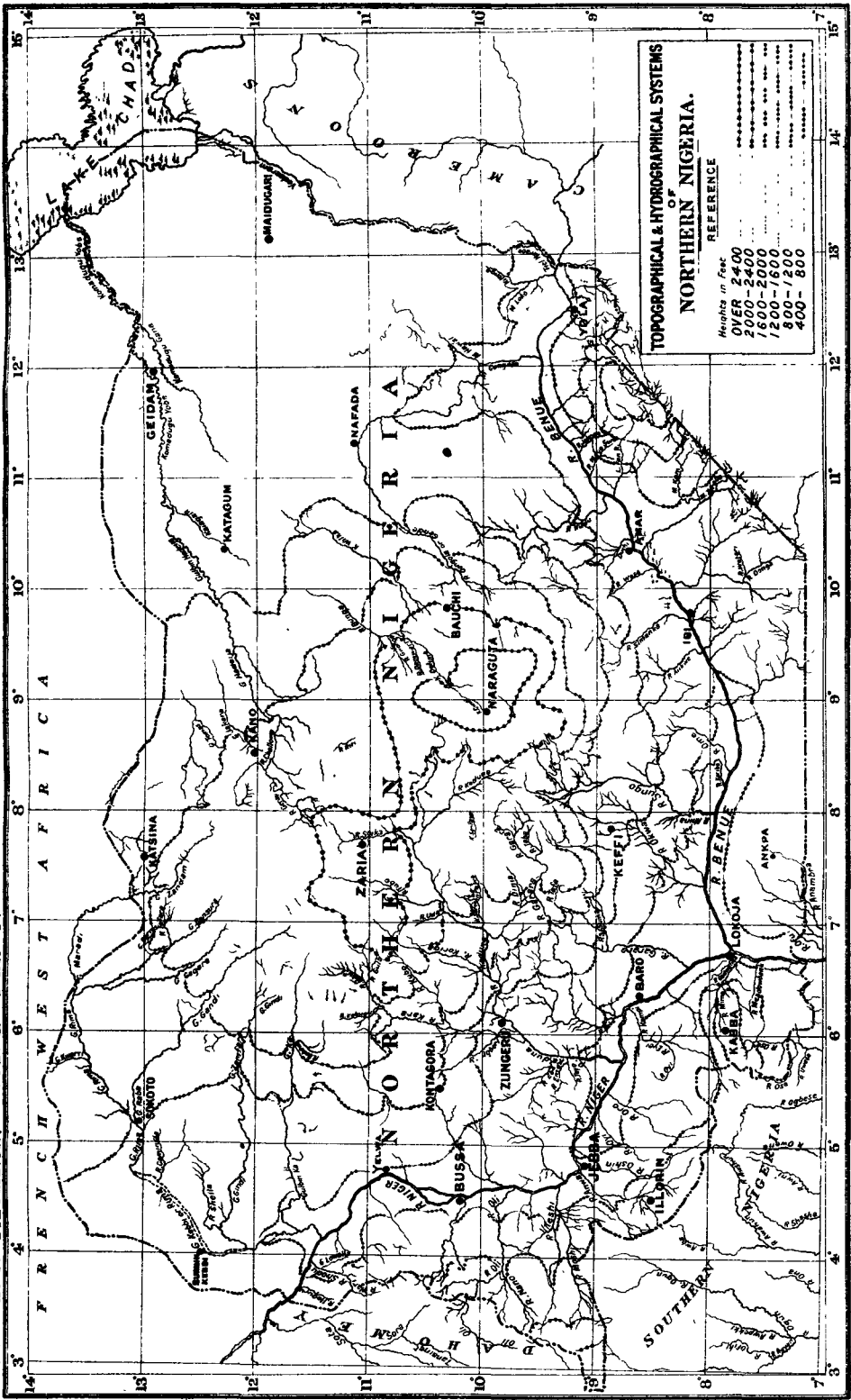




Fig. 1. View on the Niger near Bajibo, to show the nature of the vegetation on the banks.

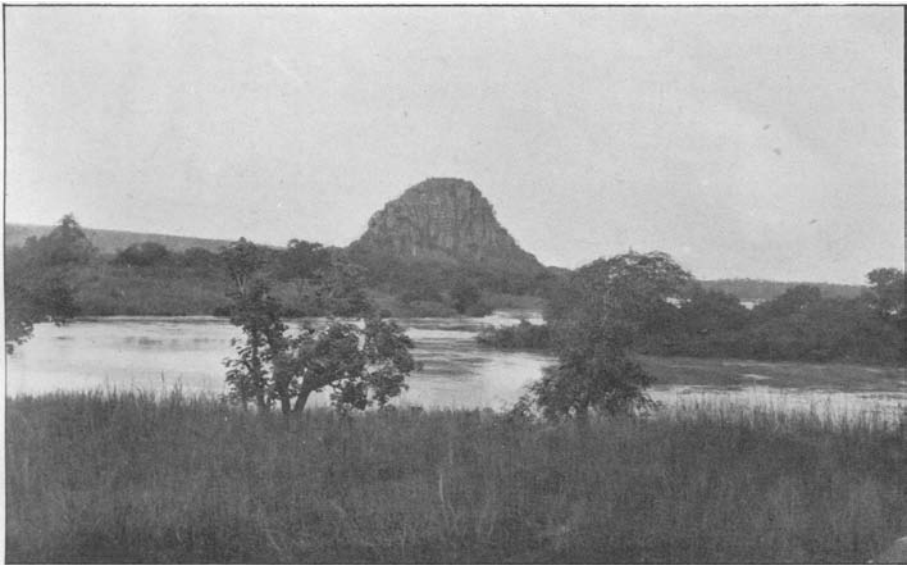


Fig. 2. On the Niger at Jebba, showing the "ju-ju" rock.



Fig. 1. The bank of the Niger near Mureji.



Fig. 2. The town of Mureji at the junction of the Kaduna and the Niger.

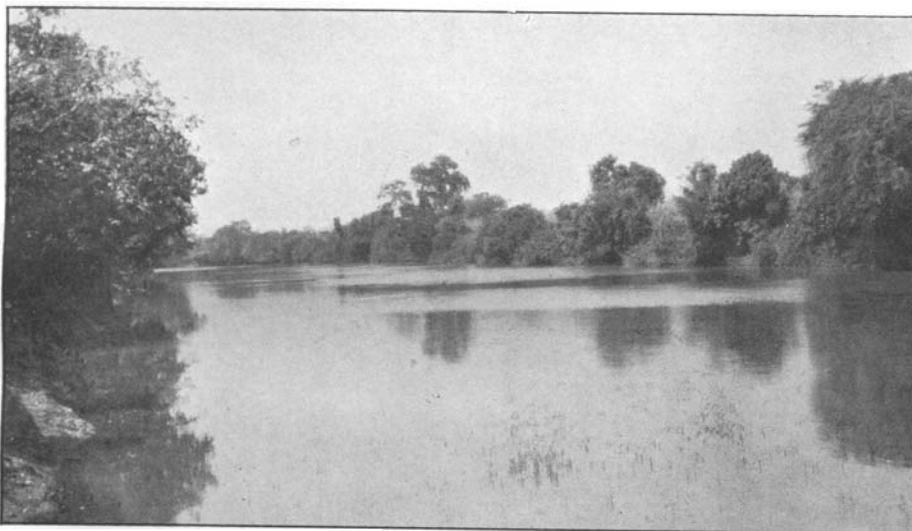


Fig. 1.

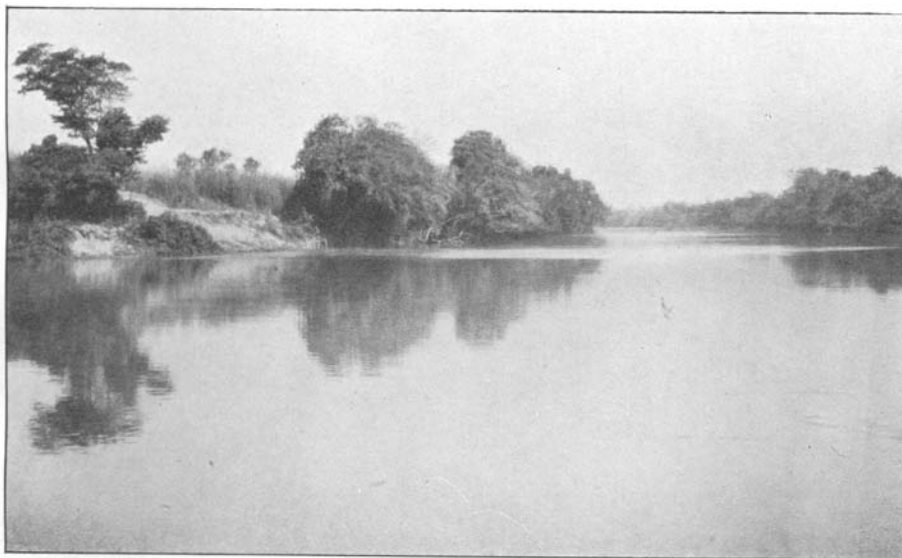
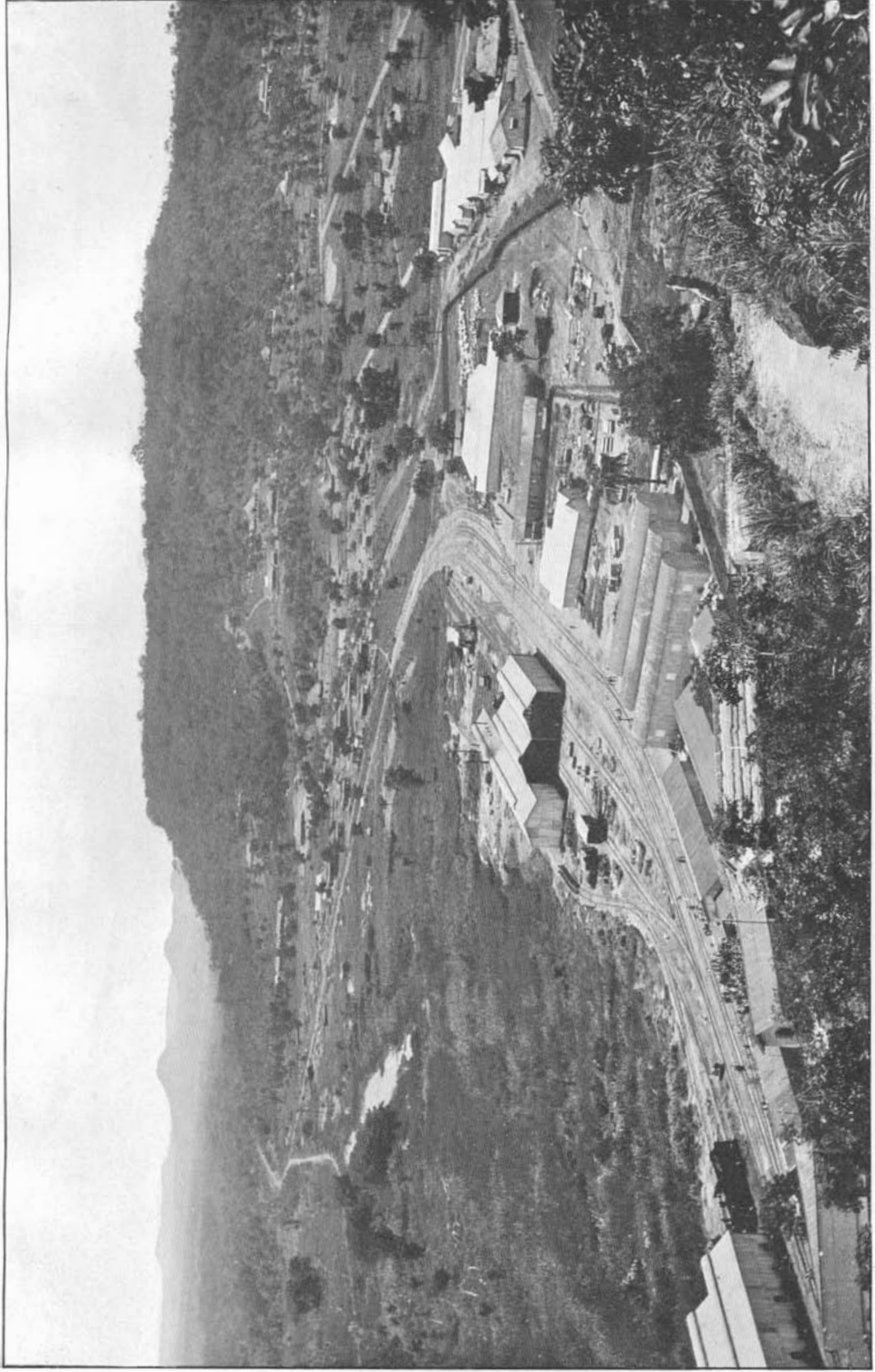


Fig. 2.

Views to show the nature of the vegetation on the banks of the rivers in the Kontagora Province.



General view of the town of Baro.



Fig. 1. View at Minna, to show the nature of the country through which the Baro-Kano Railway runs in this region.

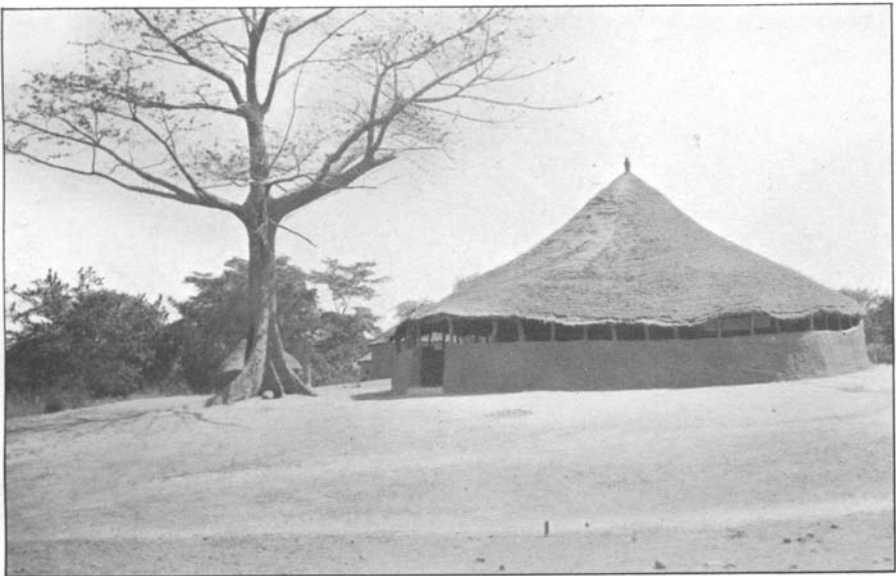


Fig. 2. Typical rest-house in the Northern Districts.



Fig. 1. View on the River Benue, during the dry season, showing the extensive sand-banks which are submerged in the rainy season.



Fig. 2. View on the River Kaduna (during the dry season) at the point where it is crossed by the Baro-Kano Railway.

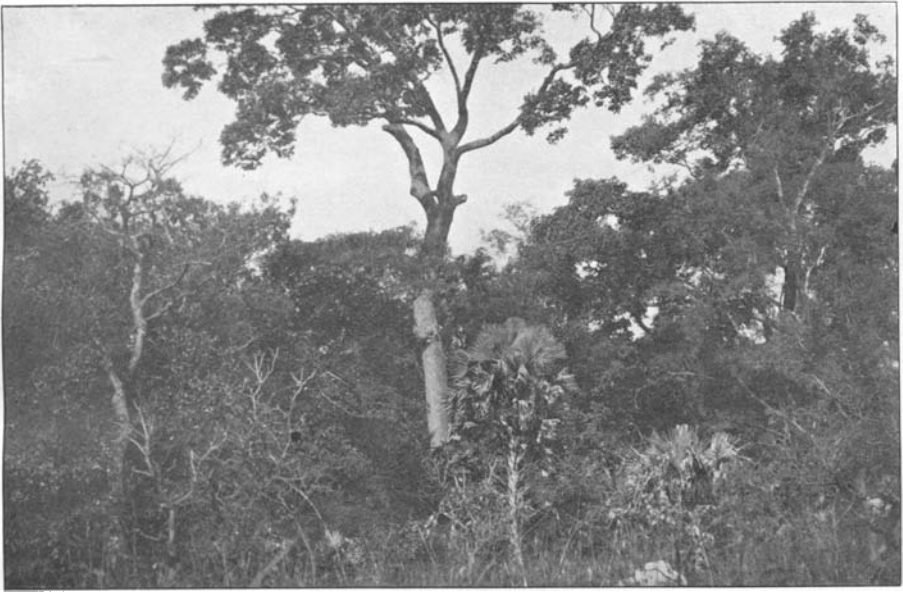


Fig. 1.



Fig. 2.
Typical vegetation of a kurimi.

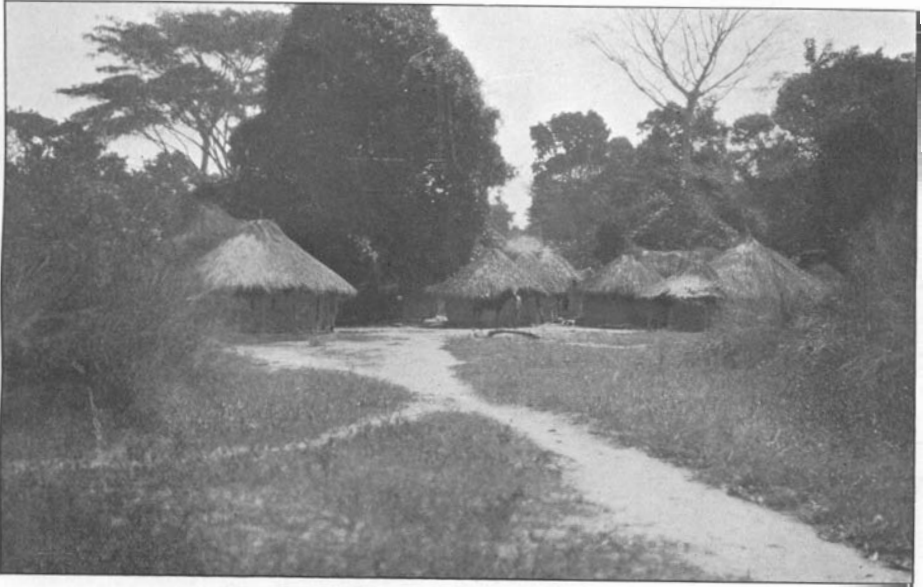


Fig. 1. Village situated at the edge of a kurimi in the Kateri District.

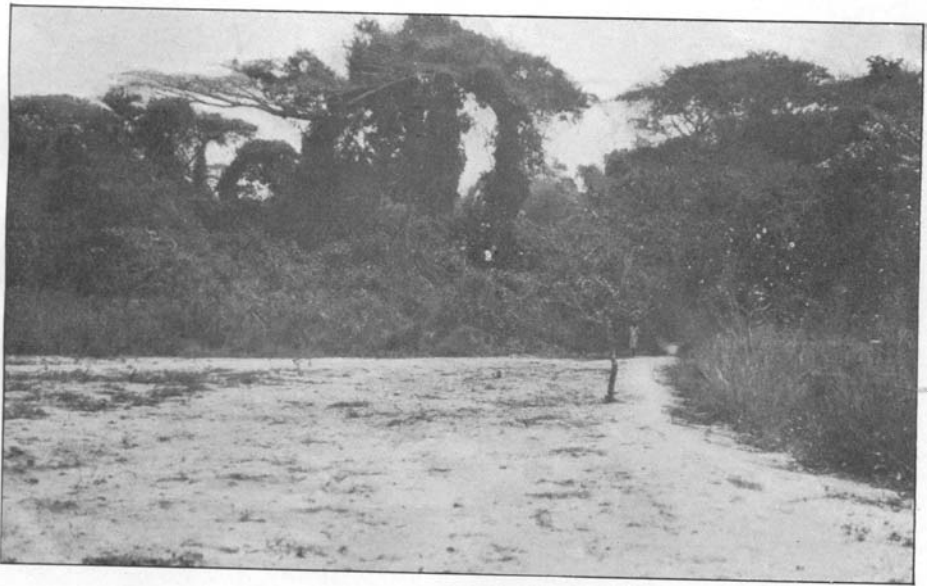
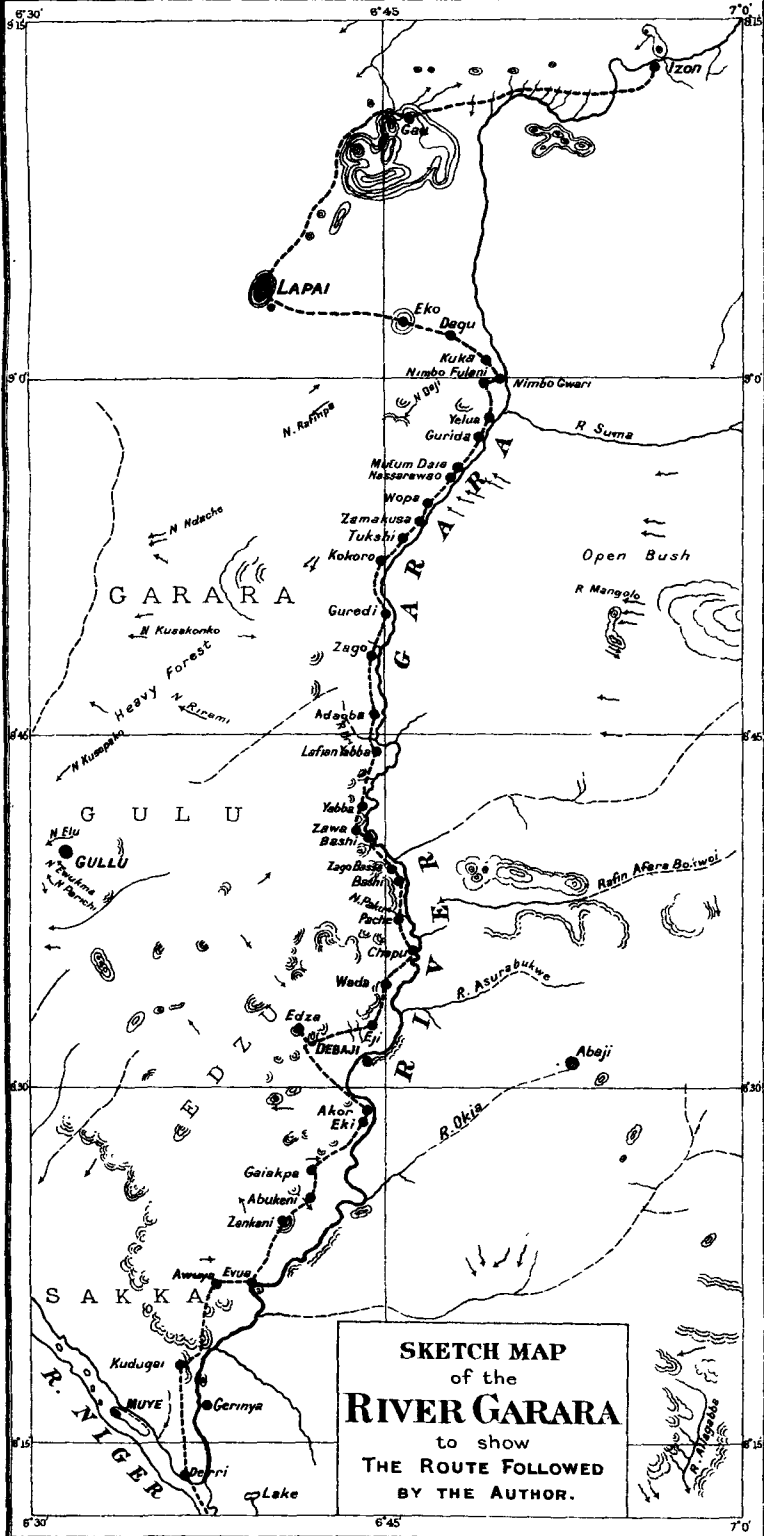
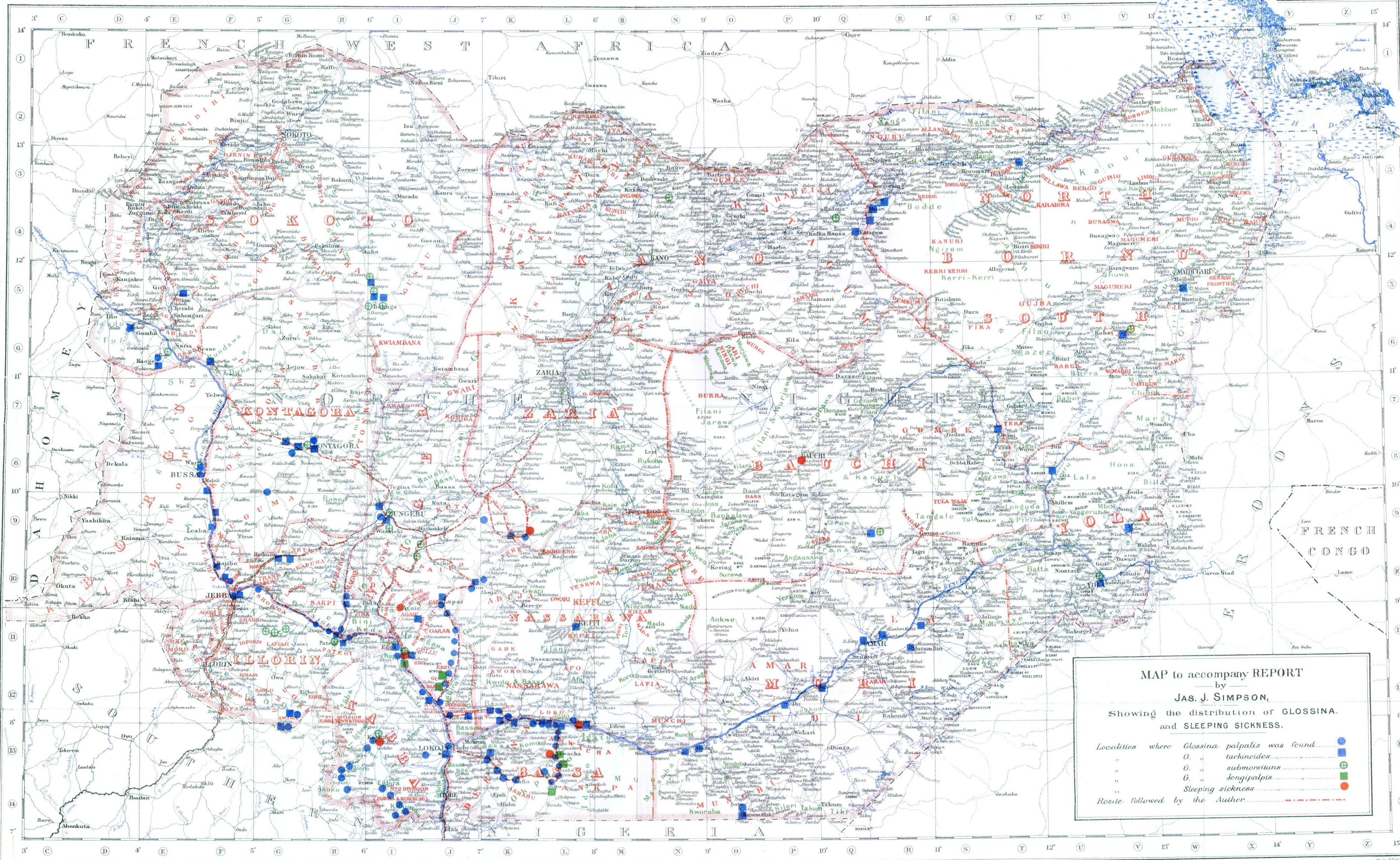


Fig. 2. Typical entrance to a village situated in a kurimi in the Kateri District.



SKETCH MAP
of the
RIVER GARARA
to show
THE ROUTE FOLLOWED
BY THE AUTHOR.

NORTHERN NIGERIA

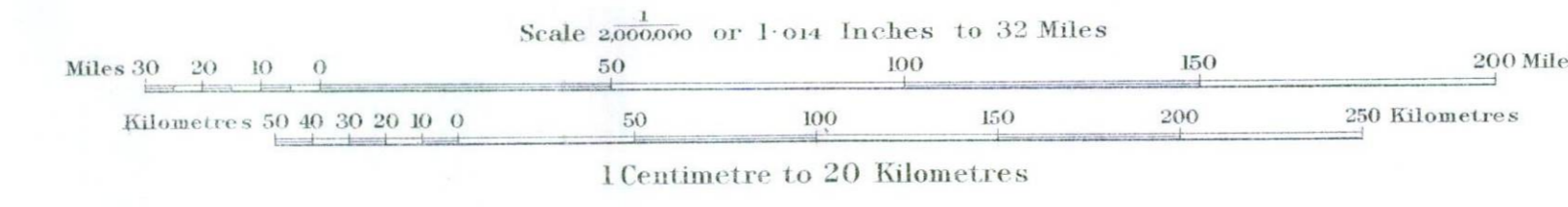


MAP to accompany REPORT
by
JAS. J. SIMPSON,
Showing the distribution of **GLOSSINA**
and **SLEEPING SICKNESS**.

Localities where *Glossina palpalis* was found..... (blue dot)
 " " *tachinoides*..... (green dot)
 " " *subimbricatus*..... (red dot)
 " " *longipalpis*..... (orange dot)
 Sleeping sickness..... (red dot)
 Route followed by the Author..... (red dashed line)

REFERENCE

Boundaries, international	— — — — —
provincial	- - - - -
Railways	—+—+—+—
proposed	---+---
Roads main	—+—+—
minor	---+---
Rest House	R
Rain	☁
Telegraphs	—+—+— (along roads)
Tramway	—+—+— (along roads)
Provincial and district names shown in red.	
Tribal names shown in green.	



Anchorage	⚓
Customs Station	C
Head Quarters of Province	HQ
Telegraph Office	T
Toll Station	T

Compiled in the War Office from boundary commission surveys and road traverses adjusted on certain towns fixed by latitude and telegraphic longitudes. Partly engraved by Messrs. Philip & Son, completed and printed in the War Office.

Available information inadequate