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Sir John Murray on ranges of ocean temperatures. Sir John Murray's bathymetrical survey of the Scotch lochs deserves special mention. From Dr. Mill we have had the results of his researches, undertaken on behalf of the Society, on the English lakes, and of his special study of a selected area in Sussex. From Mr. Vaughan Cornish we have had communications on the formation of sand-dunes, on the formation of sea-beaches, and on ripple-marks and waves. Such papers are very instructive and suggestive. But the most important general paper that has been communicated to us is contained in Mr. Mackinder's masterly address "On the Geographical Pivot of History."

I think it very desirable that we should continue to invite the communication to us of papers of the above kind.

The time has now come to bid farewell to you as your President. Do not for a moment believe that my love for the Society and its work has waned, nor that my desire to serve the Fellows has become less ardent. This is far from being the case. My time and my best efforts have been yours during the last twelve years; and in passing I may note that during that period nearly 800 Fellows have been added to the Society. In the decade from 1880 to 1900 the addition to our numbers only amounted to 150. But recently I have been constantly prevented by illness from taking the chair at our meetings, and from transacting the ordinary business. I felt, therefore, that, in the interests of the Society, I ought to resign my place to a younger and abler successor. With many shortcomings, I have done my best to serve you well, and I wish to thank all the Fellows for their forbearance and invariable kindness.

THE ANGLO-GERMAN BOUNDARY EXPEDITION IN NIGERIA.*

By Colonel LOUIS JACKSON, R.E.

THE task of the Yola Chad Boundary Commission was to survey and delimit the Anglo-German boundary from Yola to Lake Chad. For this purpose it was necessary to fix the latitude and longitude of Yola, and to carry it up by triangulation to the southern shore of the lake and to Kukawa.

Our work lay in Adamawa and Bornu. Of the latter and its people, although it lies in Nigeria, I think not so much is known in England as of the Fulani. Bornu is the remnant of a great Mohammedan empire, which in the thirteenth century extended across the Sudan from Khartum to Timbuctu. Kukawa, the historic capital near Lake Chad, was a centre of commerce and Mohammedan enlightenment for hundreds of years, until in 1893 it was destroyed by Rabeh. At the

* Read at the Royal Geographical Society, March 13, 1905. Map, p. 128.

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beginning of the last century, when the Fulani empire arose, the sultanate of Bornu had shrunk to a mere fraction of its former extent. Still, the people, although much degenerated, retained enough of their old military spirit to resist the Fulani invasion, and they kept their country, which extended roughly about 150 miles west and south of Kukawa, and eastward to the Shari river. Thus it happened that when we entered Nigeria we found that the predominant powers of the interior were two great Mohammedan nations, who, though at peace, were not on friendly terms. In 1893, just as we were trying to enter into friendly relations with the Bornu power, it was destroyed by Rabeh, a former follower of Zubeir Pacha, who had wandered and fought his way westward from Egypt. He established himself at Dikoa, and ruled with considerable success for some years, until he came into collision with the French, who sent a force from Fort Lamy on the Shari and destroyed him in his turn. After this a British force went up to occupy the country up to the limit which had been reserved to us by the arrangement with Germany in 1893; and shortly afterwards a German expedition came up from the Kameruns to occupy their country. The result of this was that Bornu was cut in two as Adamawa had been, with this difference—that the greater part of Bornu was British, while most of Adamawa became German. Both the British and German Governments proceeded to restore the old Bornu rulers, and Shehu Garbai, the direct heir to the throne, is now the Sultan of British Bornu, while his cousin, Shehu Sanda, is Sultan of German Bornu.

The Bornu people, like the Fulani, are horsemen, and probably owed their early successes to this. The Berebere, who were the seed of the Bornu nation, came from the north-west, from Barbary.

The origin of the Fulani is also assigned by some to Barbary; others have supposed that they came from Egypt. A reference to the map at p. 247 in Dr. Keltie's 'Partition of Africa' will show how the physical conditions of Africa govern racial movements. It will be observed that a great belt of bush and grass country runs right across Africa, roughly in lat. 5° to 15′ N. Movement to the south is checked by the Central African forest region, and to the north by the Sahara. It was thus natural that a pastoral people driven out from the Nile valley, perhaps, as some one has said, by the pressure of some earlier Mahdi, should have moved along this fertile belt until they found a resting-place; also that the Berebere should have drifted from the desert to a more fertile country. Rabeh's movement along the line of least resistance is also thus explained. It follows, again, that people accustomed to fight on horseback, moving in pasture country suitable for cavalry, would have a great advantage over the original Pagan owners of the soil, who probably had few horses. Thus it happens that throughout the Fulani country you find them paramount wherever

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the country is suitable for the movement of horses, while the unsubdued pagans have taken refuge in the hills or in the thick bush. Bornu country is suitable for horses almost throughout.

Comparing the people of the two countries in general terms, it may be said that those of Bornu are cheerful, indolent, fond of good food and clothes, and not very keen about their religion. They like military display, martial music, and waving of spears; but it is doubtful if there is much good fighting stuff among them. They are artistic, and display a good deal of taste in their somewhat gaudy clothes. The Fulani are inclined to be ascetic and fanatical. They wear a good deal of clothing, like other Mohammedans, but are not gaudy, affecting chiefly white, dark blue, or the grey-blue native cloth, with a certain amount of embroidery. They are not so clean as the others. When a Bornu gentleman wears a white gown, it is snow-white, and he looks like a gentleman. The Fulani are often dingy. They do not keep their horses as well as those of Bornu, but they are good horsemen. They will ride hard on rough ground, and are fond of exercises, such as spearing a lime on the ground at the gallop. They fight well against the Pagans, but have not hitherto done well against us, except at Burmi, where their fanaticism was in full swing.

The international position in the Western Sudan at present is as follows: Great Britain is in full occupation of Nigeria and British Bornu. Germany, governing from Duala, on the Kamerun seaboard, controls the Upper Kamerun or Lake Chad territories, with two or three companies posted at Garua, Dikoa, and Kussri. France, to the north of Nigeria, is on the borders of the desert, where the Tuareg problem has to be dealt with. Her country is connected by the waters of Lake Chad, across the angle of British and German territory, with Baghirmi. The projected railway across the Sahara from the Mediterranean to the lake will no doubt be given up, since there is nothing there to pay for the railway; but that across the desert by Ain Saleh to Timbuktu will probably be built. In Baghirmi, on the Shari, France is in considerable strength, watching the fanatical Moslems of Wadai. Up till now there has been great difficulty in relieving and supplying the Shari garrisons. The line of communication is extremely long, being by way of the French Congo, along the Congo and Ubanghi, over the watershed, and down to the Shari valley—a journey of four or five months. It is possible, however, that this will be altered, as a result of Commandant Lenfant's recent discovery. That officer, acting on the theory that the great Tuburi marsh might in the rainy season form a waterway between the Kebi and Logone rivers, started up the Benue in the latter part of 1903, and succeeded, under considerable difficulties and dangers, in getting a light boat through from Garua, on the Benue, by way of the Kebi, the Tuburi marsh, and the Logone, to the Shari. It was a fine piece of exploration,

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and fully earned the welcome he received when he returned to Paris.

Commandant Lenfant now suggests that the Baghirmi country should be evacuated on account of its want of resources, and that the French should be posted in the western angle of the frontier, near Lata, in the Kebi valley, where there is a rich country, and continuous water-communication by the Kebi, the Benue, and the Niger to the ocean.

We left England with the German Commission on January 17, 1903, and arrived at Lokoja on February 10. Leaving Lokoja and civilization on the 20th, we travelled 250 miles up the Benue by canoe to Ibi, and then marched another 250 miles, arriving at Yola on April 4. Four months were occupied in astronomical work and the triangulation of the Yola arc. August was spent at Yola in recording results and re-organizing the carriers, and on September 1 the headquarters of the commission crossed the Benue and started north. The survey was pushed rapidly across the hills, a distance of about 100 miles, under considerable difficulties of weather, the rainy season being at its height. Later, in the Bornu plain, a great delay was caused by the necessity of cutting avenues through the thick bush for the triangulation. By the end of the year, however, we reached Kukawa; and by the middle of February, 1904, the work was finished on the shore of the lake. Marching south, we left Yola for home on April 4, just one year after we marched in.

The Niger and the Benue are, of course, the two important waterways of Nigeria, and are to us of vital importance in facilitating communication and the supply of outlying stations. The Benue is almost as large a stream as the Niger. Its bed, for a long distance above Lokoja, is perhaps a mile wide in many places, with banks from 15 to 20 feet high, and a sandy bottom, whose shape is constantly altering. In flood time it runs bank high, and in many places overflows. At the end of the dry season there is so little water left that there is sometimes difficulty in getting passage for a canoe drawing 9 inches of water. At Yola, nearly 600 miles (as the river flows) from the confluence at Lokoja, I have forded the river in the dry season with the water no higher than my horse's girths; and on September 1, towards the end of the rains, it took me an hour to get across in a fast canoe, the stream being about three-quarters of a mile wide and very strong. In flood time the river is navigable as far as Garua, 70 miles above Yola, by river steamers drawing 4 or 5 feet. At low water one may travel very comfortably in flat-bottomed steel canoes, of which, however, there are very few available, or in large native dug-outs, about 40 feet long and 4 feet beam, with shelters built amidships to keep off the sun. We started in a steel canoe which had been fitted with engines and a stern wheel, but she broke down 30 miles above Lokoja, and we had to go on in the best canoes we could get from the river-side villages, ordinary

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dugouts without shelters. We sat in these from sunrise to sunset for eighteen days, camping at night on the banks, and certainly began our African experience with a baptism of fire. We had arrived at Lokoja with somewhat trusting natures, and had been confidently assured that the steam-canoe would run us up to Ibi in three or four days, so we provisioned for a week. Of course everything ran out—flour, tinned meat, coffee, jam, whiskey, etc.—and we found the supplies in the river-side villages extraordinarily scanty. We just managed to get enough skinny goats and chickens to keep us going, with yams and guinea corn, out of which we made porridge and "bush-cakes," a sort of inferior damper. Now and then we passed some fishermen, and got fish.

After this rather tedious experience, it was a relief to get to Ibi, where we found the two officers of the escort waiting for us, and where they had collected carriers and horses. We had decided to march the rest of the way to Yola, as the river above Ibi was so low that there would be difficulty in getting through. A party of the Commission followed us by water with stores a fortnight later, but with much trouble, having to dig channels through the sand in many places.

We now had our first experience of carriers, one of the great problems of African travel. Although the construction of roads is being rapidly pushed forward now, when we were in Nigeria there were none, and wheeled transport was therefore impossible. African bush paths are the same everywhere—tracks worn by naked feet, irresponsible, infinitely devious, turning aside here to dodge a thorn branch grown across the track, there to avoid a pool of the last season's rain, but in general direction pursuing a wonderfully even course from village to village. In thick bush they are very tiring to ride over, as you must go at a walk all day, stooping and twisting constantly in the saddle to avoid trees and overhanging boughs. In the rains the tracks, which are below the surface, become channels for running water. In Bornu, where there are large open and treeless stretches, there is another difficulty, for the black earth is parched and cracked by the sun until there is hardly a clod left large enough for man or horse to put foot on. Again, in other parts, such as the Garua district, the surface skin of the earth rises up like a sort of blister, and when this is softened by the first rains, your horse is apt to put his foot through it, with possibly serious results.

Luckily, elementary road-making in Nigeria is extremely easy. It is a mere question of clearing bush, cutting down small trees and avoiding large ones; the long coarse grass can be pulled up by the roots and thrown aside, and the light soil is easily raked to a smooth surface. Anything like a metalled surface is of course out of the question, as, except in the hills, there is little stone in most parts. Rivers could be crossed by providing rafts of tree-trunks where no canoes are available. At present in the rains one must ford or swim. The most difficult

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problem is the swamps, which are very common in the rainy season, so much of the country, even the bottom of the valleys among the hills, being quite flat, and having no natural drainage. Going north from the hills into the Bornu plain at the end of the rainy season, when the whole country was water-logged, we marched for three days through practically a continuous swamp, the water being in places as much as 4 feet deep, with a soft bottom. No ordinary engineering can deal with that, and such districts must remain difficult in wet weather.

At Ibi a force of three hundred carriers had been collected, with some difficulty, as the supply is now less than the demand. These were mostly professional Hausa carriers, fine specimens many of them, who stayed with us throughout the journey. Though they gave us a good deal of trouble at the outset, they shaped wonderfully under discipline and fair treatment, and we had a real respect and liking for many of them at the end. They are irresponsible, and must be treated like children; but, like children, they have a strong sense of justice. If they have earned punishment, and it is meted out to them dispassionately, they take it without bearing a grudge. When they have a fit of the sulks, a word of chaff or a little serious reasoning brings them out of it very easily; but they like to have their grievances listened to. Their faults are mostly on the surface, but pretty well marked. They fight, drink, and gamble, and if they are not kept well in hand they are a pest to any country they pass through, sheep-stealing and robbery with violence being their natural pursuits in moments of leisure. Thanks to the experience of Captain MacCarthy Morrough, who commanded the escort, we made a practice from the outset of camping outside villages, and not allowing the men into them. If any king, as the local headmen are called, complained of theft or assault, the carriers were paraded; if the offence was proved, and the sinners identified, they were punished and the victim compensated. We thus acquired a reputation for fair dealing which preceded us, and was of great use when we got into parts where the white men and his ways were little known, and where the advent of a small army of soldiers and carriers seemed like a serious menace to the population.

With these faults they have the virtues of patience and endurance. They will do heavy marches on half or even quarter rations without a murmur if they know you are doing your best to get food for them. A full day's ration, as much as they can eat, is 3 lbs. of flour. With this they like occasionally, as a treat, a small fragment of meat. The flour is made into porridge, and with soup from the meat and a little of a vegetable like spinach to flavour it, they have a feast, but usually they live on the porridge alone. Sometimes they like to gorge themselves on meat, and no part of an animal comes amiss to them; but if you feed them on meat alone, especially beef, for two or three days, as we sometimes had to do, they get sick.

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At Yola we found the Fulani inhabitants not inclined to be friendly, but the Hausa and others who were not of the ruling class before our arrival had no prejudices. Away from Yola, especially in out-of-the-way places where they had not been much in touch with the ruling clique, there was less bad feeling among the Fulani. They are, however, not satisfactory people to deal with, being unpractical and unreliable. Of all the people with whom we came in contact—Hausa, Bornu, Pagan, etc.—I consider them the most untrustworthy. They are grasping, but lazy, and their intelligence is unproductive, and seems to have found its vent only in ruling without governing. My relations with them were chiefly on the food question, which was a constant anxiety and preoccupation. One reason for this was that there was an actual scarcity of corn, in fact, something approaching to a famine, while we were in Adamawa. Another, that, owing to the absence of markets of any size and the impossibility of dealing direct with the people, we had to get the supplies from the "kings" or headmen of towns, and no doubt very little of the cloth paid to them found its way to the actual growers. They were thus unwilling to bring it in, and the authority of the kings was not enough to make them.

The process of obtaining supplies under these conditions was always extremely irritating. You arrive at a village perhaps at three o'clock, after the day's march, send for the king, and tell him you want, say, eighty calabashes of corn. He promises earnestly to send this immediately, and retires to give orders. At six o'clock, as it is getting dark and you are losing patience, a procession of women comes out bearing twenty calabashes. You say that you must have more at once, and, after many promises and messages, perhaps at nine o'clock another small supply comes. Meanwhile you have been waiting to give out rations, and the carriers are going to sleep after another hungry day. It is a farce that is played with endless variations. A really good interpreter, a man of importance who carries weight with the people, is the best solution of the difficulty.

The relations of the Pagans with the Fulani in Adamawa were of considerable importance to us. I have mentioned that it was chiefly thanks to their horses that the latter defeated them and drove them to the hills. The greater part of Adamawa is hilly, the Kamerun range extending northward through it to the edge of the Bornu plain, about 100 miles south of Lake Chad. These hills are of granite, and may perhaps be called mountains, as they range from 1000 to 3000 feet above the river-level, which is here 1000 feet above the sea. They lie in very irregular isolated masses, ridges, and peaks, separated from each other by comparatively level valleys, where, when the bush is cleared, cavalry can act. The Bere hills just south of Yola (shown on the hand map) give an example of such an isolated mass.

The relations between the men of the hills, the plains, and valleys

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are practically the same as those of the highlands and lowlands of Scotland two hundred years ago. When the hill mass is large, as in the Pakha, Mandara, and Kilba regions north of the Benue, the tribes become powerful, and are not only safe in their hills, but can exercise influence in the neighbouring plains. In the smaller mass of Bere hills they are safe, but dare not venture into the plain, except for an occasional cattle-raid. In the isolated hills they live miserably, cut off from the rest of creation, and only existing by sufferance of the Fulani. It is needless to add that the hill tribes have their feuds among themselves. Some tracts of bush at the foot of the hills are a sort of no-man's-land, where neither Pagans nor Fulani dare venture for fear of the other party.

It was, of course, from the Pagans that the Fulani drew their slaves, and they used to make annual raids into the outlying hills for the purpose, as did also the Bornu people.

The state of armed isolation in which these people live makes them, of course, intensely suspicious of the outside world. Some tribes are quite impracticable; but with most of them we did not find it difficult to establish friendly relations. Our usual plan was to get a man from a village in the foothills who had some relations with the hill people, and had seen our ways, and could report well of us, and send him up with a message and a small present of cloth. Upon this the king would come down to our camp and have a talk, and next day would guide us up to his hill. Approached like this, we found them simple and friendly, curious as monkeys, delighted with small presents, and anxious to help in putting up survey-beacons or other ways. Physically they varied a good deal; some tribes had a good deal of the missing-link type, while others were quite fair specimens of manhood. They are good farmers, and their fields in the hills look very neat, and are far better kept than those of the Fulani.

One result of the state of isolation and mutual fear in which these people all live is the extraordinary difficulty of getting correct information about the country. The fog of war is nothing to it. For instance, when we were in the foothills of Alantika, not 30 miles from Yola, at a time when food was very short, I was told that at a place called Uomini, at the foot of the hills, half a day's march away, there was a powerful and warlike Pagan king who had a town far bigger than Yola and plenty of food. I sent a message to him that I was coming in a day or two, and wanted food. The messenger came back saying that he had been driven out by the king, who told him that he would have no white men there, and if we came he would fight. I sent another and more reliable messenger to tell the king that I came as a friend, but that if he made trouble, I had soldiers enough with me to burn his town and twenty like it. In point of fact, we had at that time six soldiers in camp, but it was not necessary to say so. The second messenger came

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back, saying that the king had climbed down; he had plenty of food, and would send it or keep it for us as might be ordered. The ridiculous end to the affair was, that when we reached this rumoured stronghold we found a Pagan village of about five hundred people, and a decrepit and apologetic king who claimed a sovereignty, which no one else allowed, over some neighbouring villages—and there was no food.

Although we had some sympathy for the Pagans, as being, perhaps, on the whole more sinned against than sinning in their relations with their late Fulani rulers, it must be allowed that they are the chief source of trouble in the country. The plains people understand and recognize British authority, but the Pagans are Ishmaels, recognizing no one, and, like the little girl with the curl, "when they are bad they are horrid." They are especially mischievous in interfering with trade by blocking roads and murdering traders. This reminds me of a trader who wanted to join us for protection when we marched south from Dikoa. He could not get away in time, but he caught us up at Uba, about 100 miles farther south. He was dishevelled, but very pleased with himself. He told me that he had been stopped by the people at Dure, who had taken his merchandise and his wife; but when they wanted his horse, he said, "No, no;" he drew the line there, and he beat them off with his spear and got away. His point of view was quite simple: he had probably paid about the same amounts for the horse and the wife, but the horse was indispensable to enable him to get away, and the wife was not. This seems, in fact, to be the normal point of view of the native. It very often happened that a man would come and complain that his wife had run away with one of the carriers, and the burden of his complaint always was that he paid so much—perhaps £3—for her two or three years ago. When the lady was sought out and produced, and he was asked if he wanted to take her back, he always said he would rather have the money.

Turning now to geographical considerations, the most important question, of course, is Lake Chad. In order to give a general idea of the southern drainage system, the results of Commandant Lenfant's recent exploration have been added to the hand-map. They are taken from the map at the end of his book, 'La grande route du Tchad.'

Considering first the hills, we find that south of Yola they are spread in irregular masses, separated by well-marked valleys, covering a space of perhaps 100 miles from east to west. Of this country we have at present no accurate surveys. The Benue, from above Garua to Yola, flows through a great valley, of more or less oval shape, some 80 miles long by 40 wide. North of this valley we have still the same irregular masses, a broken sea of granite peaks, as in the south, whose summits are all at about the same level, of 1500 to 2000 feet above the river, which at Yola is nearly 1000 feet above the sea. Fifty miles north of the river, however, beyond Holma, we open up the Yedseram valley,

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which runs uninterruptedly, broadening as it goes, north-north-east along the boundary, into the Bornu plain. East of the valley, in German territory and separating it from the Musgu flats, runs a mountain chain of striking character, gradually narrowing till it terminates in an isolated peak at Zalladufa. In the southern portion of this range, where the granite predominates, are some of the most remarkable rock formations that I have ever seen, natural towers, battlements, and pinnacles crowning the hills, and giving individuality to each one. On one of them there is probably the finest natural obelisk in the world. This is Barth's Mount Kamalle, but it is so slightly mentioned by him that he must have seen it in a bad light. Standing symmetrically on the summit of a high conical hill is a gigantic pillar of rock. Seen from 20 miles away through the clear atmosphere of the rains, it looked like a huge factory chimney. Measured with the theodolite, it appeared to be 450 feet high, and 150 feet thick at the base.

All the granite country of Adamawa is picturesque, even in the dry season. In the rains the soft pinks and greys of the rock, half veiled by creepers and long grass, are wonderfully pleasing after weeks of riding through the dreary African bush. The Mayini valley, south of Yola, would be thought beautiful even in Europe. There are green glades studded with great shade trees, a silver river winding through them, softly undulating wooded hills around, and in the distance the granite peaks, with a bright thread of waterfall—everything that delights the educated eye.

On the western side of the Yedseram valley the hills are scattered in less-defined masses, and present no special features.

The watershed between the Benue and the basin of Chad is near Mubi, where the Kilunga and Yedseram rivers, issuing from the hills to the west within 5 miles of each other, flow south and north respectively. Beyond the eastern hills, the water-parting is at the Tuburi marsh. This great swampy lake lies on a plateau considerably above the Benue valley, and feeds both the Benue and Chad. It is drained northward through the Musgu and Kotoko flats by the Logone, and westward over the cataract of Lata, 370 feet high, by the Mayo Kebi to the Benue. The success of Commandant Lenfant's mission lay in discovering the connection, and proving that there is a practicable waterway in the rains for boats drawing 2 feet. It is now possible to go by water the whole way from the Niger to the Shari with only one portage, at the cataract of Lata.

The Yedseram river and the Tuburi supply, of course, a good deal of water to the lake, but by far the most important feeder is the Shari, of which, indeed, the Logone is only a tributary. After the Shari in importance is the Yo river, coming from the highlands of Kano.

Considering the lake generally, and the changes which are taking

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place in its shape, we find that these are occurring in the east and south. On the east it is being filled up by the sand blown from the desert, aided by luxuriant growth of vegetation. On the south, the loss of area is principally due to the dropping of the surface level. The presumption is that the rainfall is decreasing; partly, no doubt, in consequence of the deforestation of the country, which is aided by the annual burning of grass and bush by the natives. This point is well brought out by Lenfant. The bed of the lake in the south is so extremely flat that a shrinkage of a few inches in the surface level makes a sensible difference in the area of the lake.

The lake, as we know it, is the residuum of a far larger inland sea, which must have extended southward to the base of the Marghi and Mandara hills, and far towards the Tuburi marsh. Lenfant is of opinion that this sea discharged itself through the Benue into the Atlantic, that the connection was lost by subsidence, and that the desiccation has been going on ever since. Whether there was such a connection or not, I certainly formed the opinion, when in the mountains south of Yola, that the Benue was once of immense volume, and that not only the Benue valley, but the valleys among the hills, several hundred feet above the present level of the river, were formerly under water.

Following the valley of the Yedseram, we find stony ground and outcrops of rock as long as we are quite close to the base of the hills. When we leave them, for a few miles there is gravel, gradually growing finer, then sand. From this on the country is almost dead level, and we soon come to the deposits of sediment (known as the Bornu black earth) that mark the comparatively recent presence of the lake. Westward, that is south-west of the lake, the ground undulates slightly, and there on the higher levels the surface is all sand, with a slight admixture of humus.

To the east the ground is all of the nature of a delta, covered with swamps in the rains, and partially drained by an infinite number of shallow channels. The great difficulty of surveying these has led to inaccuracy in previous descriptions of the course of the rivers. Thus Barth describes the Maiduguri river as flowing by Dikoa and Ngala to the lake. So much respect is due to Barth's statements, that it would be unsafe to say that it did not do so in his time; but at present it flows past Maiduguri in the opposite direction, and, as far as we could conjecture, must lose itself in the sand somewhere to the north-west, as there was no recognizable outlet for it to the lake between Dikoa and Kukawa. The Yedseram river flows by Dikoa, but a few miles further on loses itself in an extensive marsh, and only a portion of its water gets down to the lake by a well-marked channel that drains the north side of the marsh past Urge; and it is apparently the Bahr Afade, a branch of the Logone, that flows past Ngala. This river continues to flow

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till late in the dry season, long after the Yedseram swamp has dried up.

There can be no doubt, from the French observations, that the shrinkage of the lake, due to the deposit of desert sand on the eastern shore and in the Shari delta, is going on fast; but I do not think that the level of the lake is falling as rapidly as is generally supposed. This is a point on which it is impossible at present to have definite knowledge, as the level varies so much from year to year according to the rainfall. Native evidence, of which I took a great deal, is vague, and not always consistent. Some will tell you of a cycle of eleven years governing the highest floods. One old man told me that forty years ago the floods used to come every year close round the walls of the town of Seram, opposite Ullgo (perhaps 8 feet above the present low-water level of the lake), but that they have been gradually receding ever since. Colonel Destenave gives 4 feet as the difference between high and low water, from his observations in 1902. I am inclined to think that the old native exaggerated his maximum level largely.

As regards the alleged continuous fall in the floods, we have, on the other hand, the fact that the great flood in 1854, recorded by Barth, and Rabeh's flood, as it is called, in 1893, both reached approximately to the same point on the west, namely, the town of Ngornu.

Perhaps the most interesting feature about the lake is the second flood. The first rise of the lake comes with the rains; the second, which is expected to be the greatest, comes in the middle of the dry season, about Christmas.

The rainy season is over in Bornu towards the end of September, at which time most of the country for miles round the south end of the lake is under water. By the middle of November the flood of the Shari is practically over, and the smaller rivers are bringing down nothing. The lake recedes, and at Christmas rises again, as a rule higher than before. The rise is, therefore, not due to the rivers, or to rain; it comes after a spell of the strong north-east wind. The natives say, "Chad likes cold." It was most unfortunate that in the winter of 1903–4, when we were there, the second flood failed altogether.

It is on the southern bay of the lake, which is almost entirely filled up with long grass, bulrushes, and marya, growing 8 or 10 feet above the water, that one gets the clearest descriptions of this rise, which is a real definite rise. One gets no clear account of a similar rise on the open western share. There the water, when driven before the strong north-east wind, may spread itself from time to time over half a mile or so of the flat ground, and retire as soon as the wind goes down. It is possible that the second flood, as it was described to me, may occur only in the southern bay; that the northern edge of the area of vegetation blocking this bay may resist the pressure of the water driven by this

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wind for a certain time, and then when it yields the water rushes in; but I do not venture to offer an opinion.

A few notes on the survey operations of the commissioners, which were carried out by Captain Whitlock and Lieuts. Jackson and Doucet, R.E, may be of interest.

For the longitude of Yola, the British commission relied on occultations, using a $2\frac{1}{2}$-inch astronomical telescope made by the late Dr. Common. It was an excellent instrument, but a larger one would have been better. The German commission took out a fine altazimuth, with a special observatory tent and materials for making a concrete pillar, and they worked by moon culminating stars. For the special conditions under which we worked, this method was probably the best, for several reasons, one of which was that we could not reach Yola before the clouds began to gather for the wet season, and consequently most of the occultations were hidden; but, as a general rule, I should certainly recommend the occultations.

The base for the triangulation was $1\frac{1}{4}$ mile, that being the longest that could be got on fairly level ground. It was measured four times with a 100-feet steel tape, the greatest difference between the measurements being 8 inches. A 400-feet steel tape was tried, but was found difficult to handle. From this base, triangles were built up until we got a line about 32 miles long from Mount Bagele to Beruere. The length of this line was worked out from two separate sets of triangles, which gave results agreeing within 6 inches. It was the base for the triangulation carried up to the lake, as well as for the Yola arc of about 30 miles' radius. The theodolites used were a 6-inch and a 5-inch micrometer microscope (by Troughton & Simms), which answered extremely well, though they had unavoidably some very rough usage.

A good deal of trouble was experienced in laying out the small triangles from the original base, on account of the difficulty of getting points of view in the undulating and thickly-wooded valley of the Benue. Once in the hills, this difficulty disappeared, not much clearance as a rule being required.

The triangulation beacons were tripods of poles, mostly 12 to 15 feet high, about 4 feet of the top being covered with straw mats, which were worked to a point at the top; the tips were bound with black and white cotton cloth. For the longer lines, heliographs were used in conjunction with the beacons.

When we left the mountains, going north into Bornu, a great difficulty appeared in the flatness of the country, which was also densely wooded. This was made worse by the fact that most of the country north of the hills was at that time under water, and marching was extremely difficult. After a good deal of trouble, a couple of points were found near Malmatari, from which the peak of Zalladufa could be seen.

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The longitude of these was got by latitude and azimuth, and thus a fresh base was obtained.

At Malmatari we were 30 miles from Dikoa, and the whole distance was covered with thick bush, with a great many hard-wood trees, through which avenues had to be cut for the triangulation. This work was very tedious, the rate of advance being only half a mile a day. As I had been told that Bornu was practically treeless, we were very short of tools, and had to fall back on native axes. Luckily, after our experience in the Benue valley, I had got up several 5-feet crosscut saws from Lokoja, which were invaluable. We ought to have had five dozen felling axes, six crosscut saws, and some guncotton. The work was done by the carriers. They did not like it, and, if the Pagans had not been between them and their homes, would have deserted *en masse*; but they worked well after they got used to our tools.

After Dikoa, though we sometimes met with bad stretches of bush, the work was not so heavy, some of the ground being absolutely clear, with nothing growing but coarse grass.

A further difficulty, caused by the heat in Bornu, was that, owing to the vibration of the atmosphere, it was impossible to observe accurately except for an hour after sunrise and an hour before sunset.

The results of the triangulations carried up from Yola by the British and German commissioners differed at Kukawa by 11 seconds of latitude and longitude.

Before the paper, the PRESIDENT: I have great pleasure in introducing Colonel Jackson to the meeting, who has been employed on the Anglo-German Boundary Commission, and has done a great deal of very valuable geographical work. I am quite sure the paper he is going to read to you this evening will be extremely interesting. I now ask Colonel Jackson to read his paper.

After the paper, Colonel ELLIOT: I did not expect to be called upon, but I have listened with great interest to what Colonel Jackson has said, and I notice he had very much the same difficulties as I had. He spoke a good deal about food. Food is one's first thought, and it is a very great difficulty to get food in these districts. Another question was transport—that was also a great difficulty. Colonel Jackson appears to have suffered a great deal from swamps. I suffered from the opposite—lack of water and dust. I also had the same difficulty as he had about the question of the ladies with our own caravan, and eventually I had to give in. I found them fearful thieves; that was what I objected to them for chiefly. They would go into the village and lay their hands on whatever they could, and get the men into trouble. But I found they were such good cooks, and looked after the men so well—and our men had very hard work indeed—that eventually, without saying so, I had to give in on that point. Colonel Jackson has thrown a lot of extra light on the subject of Lake Chad. I was not there as long as he was there, and I was very much puzzled to account for the rise and fall of the lake. I noticed bones of large fish at some considerable distance away from the shores of the lake, which shows there is a great rise and fall of the lake. I understand that there was a sort of periodical rise and fall of the lake; the lake had a period of some years, but, from what Colonel Jackson says, it is an annual or a biennial period. What Colonel Jackson saw I saw in a less degree. My first

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Kukawa

N'Gornu

Approximate water level Feb 1904

Marte

Wobbia

Urge

Missine

Ala

Logomani

Gagibu

Dikoa

Gorege

Gauaa

Maiduguri

Malari

M. Yedseram

Yale

Kuntaga

Malmatari

Kabuiri

Bama

Urga

Issa

NORTHERN

N. Molgoi

Muduve

Dure

S. Molgoi

M. Hobsiu

Zalladufa H.

MANDARA

MANGOSHI HILLS

Isge

Kobshi

Tizel

Zuu

MOGGA HILLS

Madagal

Muengje

Mikwa

Musa

Dille

Kofa

NIGERIA

Milaka

Melko

Note. The region between Yola and L. Chad including the Nigeria-Kamerun Boundary, is taken from Col. Jackson's Survey. The Shari R., Lake Tuburu &c. is from Capt. E. Lenfant's survey as shown on the map in his book "La Grande Route du Chad". Between these two surveys the map has been filled in from Sheet No 4 of the "Grosser Deutscher Kolonialatlas".

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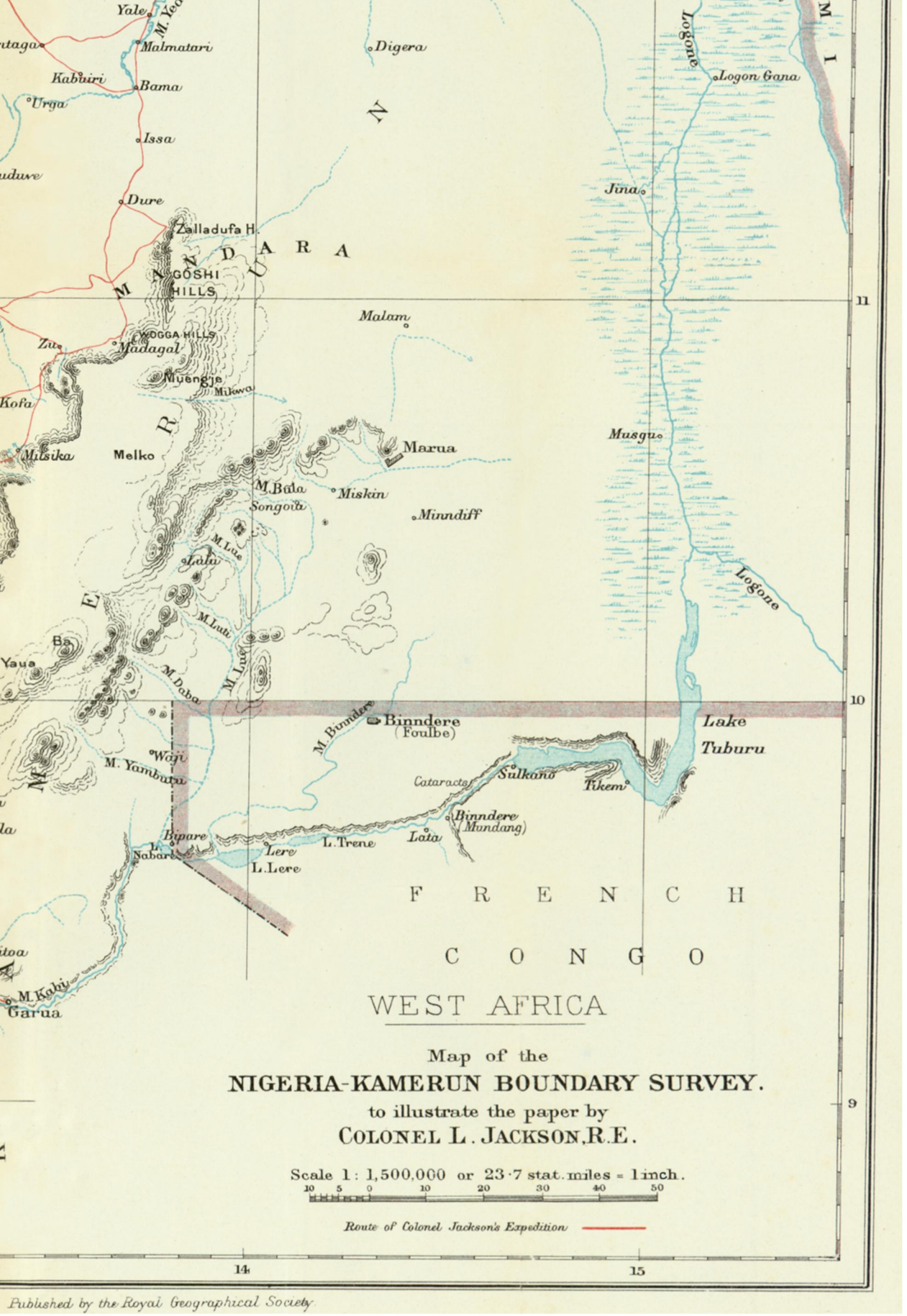

WEST AFRICA

Map of the

NIGERIA-KAMERUN BOUNDARY SURVEY.

to illustrate the paper by

COLONEL L. JACKSON, R.E.

Scale 1: 1,500,000 or 23·7 stat. miles = 1 inch.

10 5 0 10 20 30 40 50

Route of Colonel Jackson's Expedition

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