The French Mission to Lake Chad
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which were all in connection with the sea. When the island was first elevated, it is reasonable to suppose that these were more numerous than they are now. The sea then, as now, therefore, could penetrate right through the island. It would at once begin dissolving the rock away, and then series of fissures could interconnect, owing to this solution. We could therefore get deep tunnels passing away into the island. The sea would naturally continue to wash the dissolved rock away until these tunnels were open to the surface. We should thus get tunnels passing into the centre of the land and increasing in size. The inner part of the island would be washed away first, owing to its low level, and would gradually become a lagoon, while the outer part, being higher, formed the land-rim.

THE FRENCH MISSION TO LAKE CHAD.*

By Captain J. TILHO.

Double Object of the French Mission.

We were assigned by our Government two distinct tasks; we had:

1. To define, in conjunction with the British Mission, the frontier between the French and British spheres, from the Niger to Lake Chad.

2. To carry out a programme of scientific researches on the country crossed by us, and especially to make a thorough study of Lake Chad and of the countries around it.

It is not our intention to speak to-night about the work of delimitation, but it is an agreeable duty for us to say how thoroughly pleasant and cordial have been our relations with all the members of the British Commission in the achievement of our common work, which went on without interruption from January, 1907, till February, 1908. The members of the British Commission were Major O'Shee, British Commissioner; Major Simonds, Lieut. Hearson, and Dr. B. M. Flood. We specially wish to pay a well-deserved tribute to the precision of the results obtained by our British colleagues, results which undoubtedly constitute a most valuable basis for African cartography. It was after having concluded the demarcation of the frontier line that the French mission commenced the study of Lake Chad, and of the neighbouring regions. We bring before you to-night the results of that work. Though the subject is rather a vast one, I will try to be as brief as possible.

When we arrived at Lake Chad an interesting and difficult geographical problem presented itself before us—

(1) Is Lake Chad gradually disappearing, or are its fluctuations subject to a fixed law?

* Read at the Royal Geographical Society, February 21, 1910. Map, p. 380.

(2) Is Lake Chad the lowest portion of the immense plain of which it marks approximately the centre?

Our work aimed at finding an answer to those two questions. Before showing you, by a few lantern slides, the various aspects of the lake as we saw it, let me recall in a very few words, what was our knowledge of Lake Chad in the beginning of 1904. We need not speak of the first explorers of that part of Africa, from Denham and Clapperton, who discovered the lake, to Gentil, who succeeded in navigating a steamer on its waters; the names of Barth, Overweg, Vogel, Nachtigal, Monteil, Foureau, and others are too well known to you. Nor shall I recall the crushing of Rabah, rightly called "the African Attila," and the subsequent study of the Niger-Chad frontier and of the lake by the Elliot-Moll Mission.

As a result of this mission a general map of the lake was drawn up, and a hydrographic monograph of the region was published by naval Lieut. Audoin. During the first journey of Captain Tilho to Lake Chad, in 1904, the drying-up of Chad was already very apparent, and vegetation covered enormous areas of the lake. A year later, Lieut. Boyd Alexander experienced great difficulty in navigating through the central part of the lake, and when he tried to sail into the southern part he was obliged to take his boat to pieces and to carry it over by land. Six months later, a French captain, Freydenberg, crossed, half navigating and half wading, the northern portion, and penetrated well into the interior of the lake, which had become by now a great marsh.

You understand our curiosity four years after having made our first map of Lake Chad, to see what was the aspect which this constantly changing lake was likely to present. When we arrived in the vicinity of the lake, we learned from the natives that caravans were crossing on dry land the northern portion, which in 1904 we had navigated on board the *Benoit Garnier;* that the central portion was merely a marsh where no boat could pass; whereas in the southern portion certain channels, which had formerly been closed to navigation, had become once more practicable. The drying-up of the northern portion, we were told, had been so rapid, that a great quantity of fish had not had time to flee southwards, and had taken refuge in the depressions, where they had been asphyxiated in the few inches of stagnant and muddy water that had been left behind. For the natives it was quite like a new Miracle of the Fishes; they gathered them in baskets. Even to-day large areas are covered with dead fish. The herds of cattle suffered greatly from this sudden transformation of the lake. The stagnant water, saturated with salt, and charged with decomposed matter, became poisonous, and animals perished by hundreds. The rhinoceros, the hippopotamus, the elephant, themselves, disappeared southward in the wake of the retreating water.

In 1908 Lake Chad appeared to us to be divided into four different zones: (*a*) the dried-up zone; (*b*) the marshy zone; (*c*) the navigable zone; (*d*) the lagoon zone.

1. *The Dried-up Zone.*—In 1908 nearly the whole portion of Lake Chad situated north of the parallel passing by the mouth of the Komadugu-Yobe was included in this zone, whose monotonous, desolate, and funereal aspect seemed strangely at variance with that described in such bewitching colours by Nachtigal. Seen from the dunes (30 to 40 feet high) which form its western boundary, the dried-up zone presents the appearance of a vast plain extending up to the limits of the horizon, and with no sign of water on its surface.

Immediately at the foot of the dune is a woody zone, and further on a sandy plain strewed with remains of fresh-water shells, and presenting the appearance of a field of *asclepias*, where grass is rarely met with, and where by a well-marked transition one reaches the land only recently abandoned by the retreating water. The ground then becomes clay, and is covered with large crevices and immense fields of bindweeds, which the wind often rolls up in a series of huge waves. Here and there are bunches of grey reeds dried or rapidly dying. In this slightly undulated plain one meets with small depressions 3 or 6 feet deep, in which the ground is strewn with huge crevices, and the earth more recently abandoned by the waters of the lake easily gives way under the footsteps and hinders the passage of men and animals. Now and then, far from one another, one meets with wells of from 3 to 6 feet deep, containing a small quantity of grey muddy and brackish water.

Little by little the denivellations become more definite. Their summit is a little higher, covered with sand, strewn with shells, and surrounded by a barrier of fragrant bush. These are the old islands environed by better-marked and deeper depressions. Sometimes, as was the case at Kindjiria, one meets with pools not yet completely dried up, and strewn all around with thousands and thousands of dead fish.* In these islands exist thinly populated villages composed of rough huts, where live the Buduma islanders, who have now become landsmen owing to the retreat of the lake.

Farther on towards the east the depressions, always dried up, become narrower and deeper. The islands that they surround become larger and higher, presenting the appearance of dunes joined together, and extending up to the Chittati and Kanem borderlands, where dried-up lagoons wind in and out along the country. They look at first

* Dr. Gaillard, the naturalist of our expedition, brought from Lake Chad thirty-seven different kinds of fishes; three of them were recognized by Dr. Pellegrin (of the Museum d'Histoire Naturelle) as being new species, viz. the *Marcusenius Gaillardi*, the *Gephyroglanis Tilhoi*, the *Auchenoglanis occidentalis*, var. *tchadiensis*.

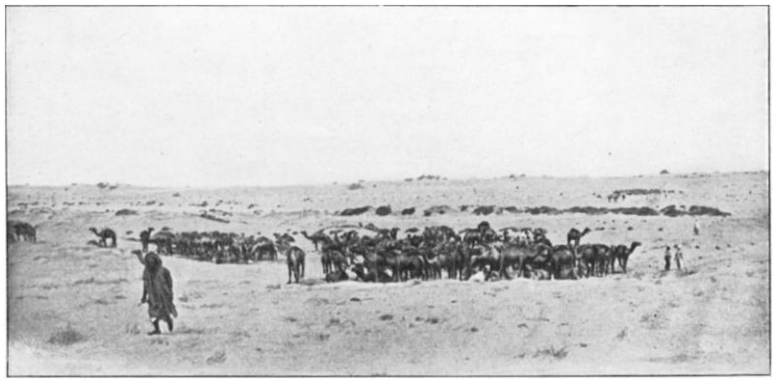
like dried-up rivers, then only like discontinued thalwegs, and then again like a series of well-separated and independent pools. The transition between Lake Chad and the Kanem country is hardly noticeable, and it is impossible to tell exactly where the one ends and the other begins. In all this zone, where our camels and oxen were able, from November, 1907, to July, 1908, to pass without hindrance, Captain Tilho and Naval Lieut. Audoin had in 1904 navigated without difficulty from the mouth of the Komadugu Yobe to Ngigmi, from Ngigmi to Ngollom and Kuloa, and from Kuloa to Fargimi and Debuaram. The depth of water at the time was from 2 to 4 feet, and the boat *Benoit Garnier* had a draught of 2 feet. In the islands cattle were abundant, and thrived well; in the peninsula buck was found in hundreds, while hippopotamus, rhinoceros, elephants were frequently met with.

2. The actual marshy zone of Lake Chad was in 1904 a vast expanse of open water, of from 3 to 6 feet deep on an average, with now and then at the surface tufts of grass. Navigation was easy with the *Benoit Garnier*, which had a draught of 24 inches, and on the Bornu side it was possible to anchor easily at distances of from 500 to 1600 yards from the shore. There were then but two navigable channels, "Bidellam" in the north, and "Debuaram" in the south; a third one, near Sayorum Baga, gave access for a boat to the basin of the Shari.

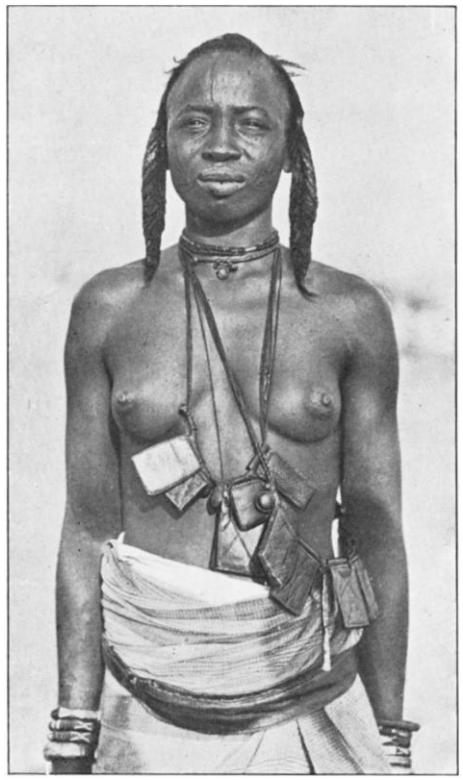
In 1908 things had greatly changed. We noticed it all the more that we had to wade for five days through the marsh that had taken the place of the open water in order to establish a beacon at the point 22 miles east of Bosso. Starting from Bosso, one travels for two hours, across a cultivated plain raised some 10 or 19 feet above the winding bed of the Komadugu Yobe, which was almost dry and had become, in fact, a succession of ponds, on the banks of which crocodiles were found in great numbers, and great quantities of ducks and other water-birds were fishing. Suddenly the river-bed disappears in the grass. One has then arrived at the junction of the river with Lake Chad! But no more a lake! There is not a sign of water. Everywhere are grass and reeds. In the distance a sombre mass bars the horizon like a line of hilltops. It is the forest of "*Ambach.*" You have heard of this curious tree of the tropical regions, which grows in the water and attains in two years a height of from 8 to 9 yards, with a diameter of from 12 to 15 inches. It dies when the water fails altogether, or rises above a certain level, or when it contains a too large proportion of salt. Its scientific name is *Hermininiera elaphroxylon*, its Arab name *Ambach;* the Bornuans and Kanembus call it *Fogu*, and the Buduma islanders *Marea.* When it is dry it is the lightest wood known. Its density is ten times less than that of water and two and a half less than that of cork. As you see, the impression, therefore, that one has on reaching the shores of the lake is that of entering a forest. Let us penetrate in this forest.

MARSHY REGION OF LAKE CHAD.

THE DRY REGION OF LAKE CHAD.



CAMELS AT THE WELLS OF ALI-AGRENGHA.



BORNU WOMAN.

The muddy and opaque water in which it lives conceals gullies that are deep enough and broad enough to provoke the most comical falls. Progress is slow; not more than a mile an hour, for it is often necessary to cut one's way through, as the aquatic bush is very thick. After a few miles, the traveller leaves the marsh and arrives on a low waterless plateau of black clay, which is full of gullies. On these plateaus one might think that fresh water is easily obtainable on digging the soil. It is not so generally. We have dug wells 3½ yards deep without reaching water. When the plateau is crossed the marsh begins again. Then one finds another plateau, and so on. Apart from the ambach, the vegetation of this part of Chad consists principally of high reeds and papyrus. As to its inhabitants, I think the mosquito is the most important, the liveliest, and the cruellest! The marshy zone covers about a third of Chad.

3. Let us now study briefly the *navigable zone*. It has undergone important modifications. The average depth has changed but little, but the vegetation has developed almost incredibly, reducing the navigable portions to a small number of channels. The only means of communication by water, when we were at Lake Chad, between the coast of Bornu and that of Kanem or the mouth of the Shari, started from Sayorum Baga, 27 miles to the north-east of Kukawa, the old capital of Bornu. One has to punt at first across an expanse of open water covering an area of from 16,000 to 20,000 acres, bounded on the north, south, and east by impenetrable forests of ambach. Then one enters a narrow channel about 2 miles long, which has been cut through the forest, and which leads into open water resembling more a large river than a lake, with thickly wooded banks. Following this river, one meets with waterways, most often leading towards the centre of the forest. As a matter of fact, only two or three of these waterways lead towards Kanem, or the mouth of the Shari. The landscape is unchanging in its interminable monotony, and it is impossible to see anything else in any direction but the impenetrable barrier of thick and high vegetation. There are no birds, no animals of any sort, apart from mosquitoes and fishes. Now and then a band of Budumas pass slowly in their heavy straw canoes transporting dry fish, *natron*, or cattle which they barter at Bornu for millet, cloth-stuffs, salt, pottery, etc.; and when the canoe has passed, the oppressive silence of this dead or sleeping Nature returns, troubled solely by the noise of the big fish leaping in the water. The edges of the ambach forests gradually widen out, and after long hours of slow navigation, one enters at last into a large expanse of open water encircling the mouth of the Shari, and covering an area about the size of, I should say, London and its suburbs. This forms only about the fiftieth part of Lake Chad, and it is all that remains of the original aspect of the lake. The rest is merely marsh, lagoon, or dry land. Depths of 12 feet are rare. The

average depth is from 6 to 8 feet. East of the mouth of the Shari the depth diminishes rapidly, and the limit of the navigable zone at that point is marked by the meridian of Hajer-el-Hamis.

4. There is also a *Zone of Lagoons in Chad.* It is situated all along the coast opposite to that where the tributaries run. The shore is cut by a multitude of lagoon-channels of varying depth and breadth, intersecting one another in all directions, and penetrating into the interior by narrow closed lagoons which wind, like dead rivers, and end in chains of ponds or in independent basins. When Lake Chad was full of water this system of lagoons began at N'guigmi and continued uninterruptedly along the Kanem coast up to the mouth of the Bahr-el-Ghazal. At that period, 1908, the entire portion between N'guigmi and Kindin followed the movement of the northern portion and dried up. The southern portion alone still preserved the character which had been observed in 1904.

The intersection of these numerous channels has, naturally, created a quantity of islands, which form the archipelago of Lake Chad, and which may be divided up into four classes: (1) *the cultivated islands* near the Kanem coast, which are from 35 to 50 feet above the lake, and are virtually dunes covered with the familiar Sudano-Saharan steppe and savanna vegetation, while the Egyptian palm is now and then to be seen at the base of the dune, behind a girdle of reeds; (2) *the inhabited islands*, somewhat less elevated (15 to 25 feet), further from the coast, with little flora save the pale-leaved *asclepias*. These islands afford shelter to the Budumas against the attacks of the Tedas, Oulad Sliman and the Wadaian bands; (3) *the pasture-land islands*, still less elevated than the preceding, and still further from the coast, and utilized by the magnificent herds of the islanders; (4) *the islands in formation*, or banks: it is ground that has temporarily emerged, and is generally to be found at the edge of the lake forest lying between the zone of the lagoons and the navigable zone. Submerged from November to April, they serve for the rest of the year as anchoring points for the native fishermen. There are but three channels permitting a boat to quit the zone of the lagoons: (1) Samia-Sayorum-Baga; (2) Samia-Shari; (3) Bol-Shari.

The Budumas.—We must now deal with the inhabitants of Lake Chad, those dreaded islanders whose daring flotillas spread terror along the Bornu and Kanem coasts. The word Buduma means "reed-dweller," but they call themselves Yedinas, a name which recalls that of *Yedi*, by which the Kanembus indicate the region of Bahr-el-Ghazal. The Budumas of the south-east of the lake are particularly known as Kuris, and are somewhat different from those of the north. The Kuris are for the most part an agricultural people, who cultivate successfully the fertile low-lying soil temporarily abandoned by the lake. They willingly mingle with the inhabitants of the lake-shore, and in this

particular resemble the Kanembus. The Budumas of the north-east, on the contrary, are more warlike. They are herdsmen who do little farming, and live on milk and fish. Intermarriage within a single tribe is common among them, a fact both weakening and refining the race. Their customs are virtually those of the negro tribes of the centre of Africa, who are partly converted to Islamism.

They have a legend to the effect that a Kanembu, by the name of Bulu, had an elder brother who shortly after his marriage went on a pilgrimage to Mecca. Three years later, since he had not returned, Bulu, believing him dead, married his sister-in-law. She was about to become a mother when the return of her husband was announced. Rather ashamed and afraid, Bulu fled to the lake. He lived in hiding, on fish, at Taguel, near Samia, when one day the strong wind blowing from the west brought to him a large calabash containing millet. Surprised and delighted, he concluded that the western shore of Lake Chad must be inhabited by cultivators, and he decided to visit them. He utilized the *calabash* as a boat, and made his way thus as far as Kawa. There he went ashore, was captured by the reigning tribe, the *Sos*, and taken to the chief, to whom he related his adventure. This chief treated him well. But Bulu, incorrigible, having made love to his daughter, called Sado Saorom, the chief was, according to the laws of his tribe, obliged to give him his daughter in marriage. He did so, and ordered him to return to Lake Chad with his wife in order to conceal their fault. Upon his return to Taguel, Bulu set out for Kanem, with the intention of asking his brother for his share of the cattle of the paternal heritage. But at the last moment, not daring to appear in person before his brother, one fine night he carried off the entire herd, and hastily rejoined his wife at Taguel. The brother pursued him, and came upon him in his island, thinking he had overtaken some ordinary robber. All his resentment disappeared at the joy of seeing again his younger brother, and at the surprise of finding him married to a woman of an unknown race; he asked him to go back to Kanem with him. Bulu, however, refused, and the herd having been divided up, he remained alone in his island with his wife, where they became the ancestors of the Budumas. The children learned their mother's language, and that is why the Budumas' language is so much like that of the Kotokos, who are the descendants of the Sos. All that happened at some vague period between the ninth and the fifteenth centuries.

Since then the Budumas, defended by their lagoons, have lived independently in their islands. Rabah himself could not injure them. Their audacious robberies gave them the reputation of being terrible warriors, and alone the white men, "with their boat which travels swiftly and their far-shooting rifles," as they say, could worst them and suppress their pirate expeditions. They actually number about

45,000. To-day peace reigns all about those shores and throughout the archipelago.

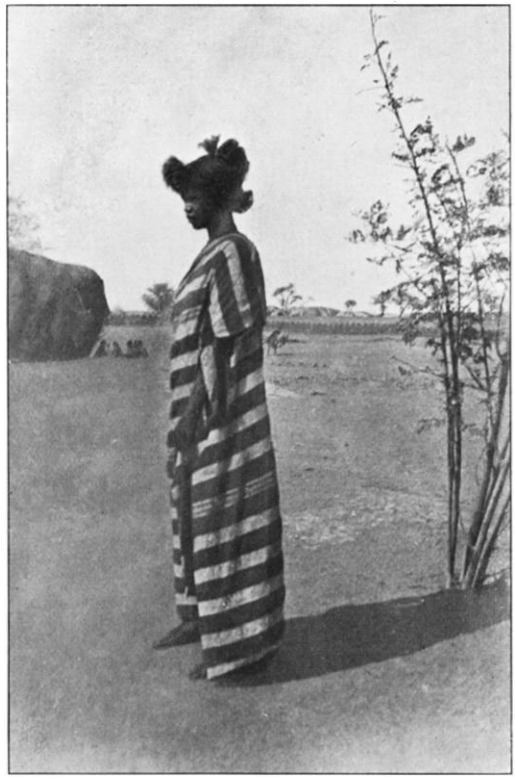
From a general point, Lake Chad is a vast closed depression of slight depth, entirely independent of the great tributaries of either the Atlantic or the Mediterranean. It occupies an area of about 10,000 square miles, that is to say four-fifths of Belgium. Its average depth is 5 feet, and no lake in the world is so shallow. Its shores are very undefined, for the slope is so gentle that very slight variations in the level of the liquid expanse are sufficient to cause the submersion and emersion of vast tracts of soil. Even the wind is sufficient to do it on the southern and western banks. It can provoke within a single day a movement so important that certain travellers have maintained that the lake was subject to tidal phenomena.

The waters of the lake are renewed (1) by atmospheric precipitation for about a tenth part; (2) by the contributions due to its affluents for about nine-tenths. Those affluents are: *the Shari*, which in 1908 brought to it about 40 milliards of cubic metres of water (about one-ninth of the Danube), but which has of late years fallen off; *the Komadugu Yubé* (130 millions cubic metres); *the watercourses of German Bornu*, too dry during our visit to permit of any calculations. It is a special characteristic of these affluents which run from the equatorial or tropical regions towards the desert that they diminish in volume as they get further from their source, and that they contain any considerable amount of water only at certain months in the year.

The losses of Lake Chad are due to *evaporation* and *infiltration*, evaporation being particularly intense just at the epoch of the year when the tributaries have the least volume of water. In 1908 it measured 6 feet. The loss by infiltration we were unable to calculate. The variations in the extent and level of the lake surface are consequently entirely due to meteorological causes, and it is impossible in the present state of the science of meteorology, as applied to the climatological conditions in Central Africa, to formulate a law governing the rise and fall of this sheet of water. There is, however, no reason to suppose that the lake is likely to disappear. It will remain for a long time still in the centre of Africa, now dilated, now contracted, and in general offering unfavourable conditions for navigation, so it will always constitute rather a barrier than a bond of union for the inhabitants of its shores.

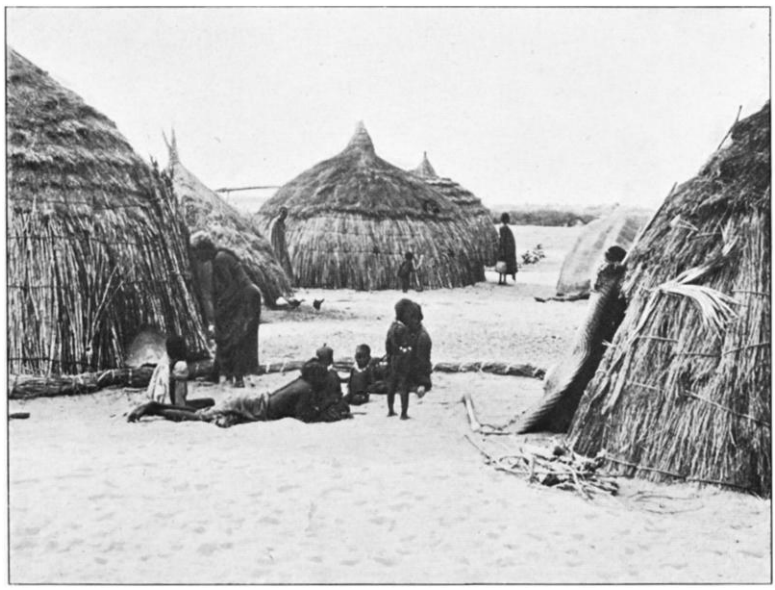
The Chad Low Region.

Let us now deal with the second portion of our geographical problem. Is Lake Chad the lowest point of the immense plain of which it is approximately the centre?



BORNU GIRL.

BUDUMA CANOE ON LAKE CHAD, NEAR BOL.



BUDUMA VILLAGE.

BUDUMAS FISHING.

In the south and west the course of the affluents to which I have referred (the Shari, the Komadugu, etc.) is sufficiently indicative of the direction of the slopes. But in the northern and eastern regions the absence of visible tributaries of the lake left much doubt, and gave rise to various hypotheses. We confided the investigation of this interesting question to two reconnoitring forces. The first was ordered to proceed up to the boundary of the Borku country. The second was directed to study particularly the region of the Bahr-el-Ghazal and of Lake Fittri. Both these regions are desert, and are often traversed by Senoussi incursions from Borku and the country north of Wadai. These bandits, who are brave and well armed, are notoriously cruel. They fight the sedentary and the nomad tribes placed under our protection in order to take their cattle, and above all to obtain slaves for export to the Mediterranean coast and the vilayet of Tripoli. Their chief headquarters is Ain Galaka in Borku. They are well commanded, not very numerous, but very enterprising, and give a good deal of trouble to our Kanem Meharists, who, to the small number of fifty, keep in order as well as they can this immense region, which is half the size of France.

To give an idea of the daring and ferocity of this enemy, and of the rapidity with which news travels in the desert, we shall relate an incident which occurred during the reconnaissance under the command of naval Lieut. Audoin. When he was in camp at the Guradi (Gossom) well on May 22, 1908, a friendly Teda, who had followed the detachments by our trail, brought the news that five days before a razzia from Galaka had carried off at Bir Daudi a part of the smala of the friendly Arabs and Tubus, and that all the auxiliaries of the post of Ziguei had been immediately sent in pursuit. Two of the Arab guides who accompanied the Audoin detachment heard that their wives and children had been captured. They requested to be allowed to leave the column in order to pursue the robbers.

On May 29, at the well of So-Yamussa (Toro) on the return journey from Koru, three Tadas brought us the news that the razzia, comprising eighty Khoans, had been within one day's march of the Audoin column, and had been attacked by the Ziguei auxiliaries at Ekinde, where an indecisive engagement had taken place.

On June 10, at the well of Ali Agrengha, an Arab from Ziguei brought fresh details as to the fighting at Ekinde. The auxiliaries had been surrounded by the Khoans, but some of them succeeded in escaping, among them our informant. Four others, however, were captured, including the two Arab guides who had left the column at Gouradi, and whose wives and children were prisoners. The man added that, fearing to be accused of being a coward, he had returned two days later to the well of Ekinde. The Khoans had there abandoned their prisoners, after having cut off their feet, broken their fingers, and placed them

alive on a fire made of camel offal. The poor devils were still alive, and had had the strength to drag themselves a few feet away from the fire towards the well. That is the kind of bandit with whom our Meharists have to deal.

Let me now give a brief idea of the aspect of the regions traversed by these two detachments.

(1) *Kanem.*—Kanem and the regions which depend upon it geographically (Chitati, Lilloa, Manga) constitute a plain, the level of which, according to our observations, is sensibly the same as that of the lake. But this plain is covered by a layer of sand, which thickens as one leaves the lake and attains its maximum (70 to 75 yards) in the vicinity of Mao and Ziguei. The sands have the form of a succession of waves moving from north-north-west to south-south-east in the hollows of which are wadis, a kind of dune valley, which resemble the depressions of the borders of Chad. So that the whole of the Kanem region was obviously an old archipelago of a larger Chad.

(2) *Bahr-el-Ghazal.*—To the south-east of Chad extends a plain of black and broken clay covered with a fairly dense vegetation, in which Egyptian palms dominate. It is the plain of the Bahr-el-Ghazal, where, amidst the low and often ill-defined islands, is distinguishable an unbroken ridge, sown with *débris* of shells and covered with Asclepias, and about 100 to 500 yards broad. According to our observations the Bahr-el-Ghazal presents none of the characters of a valley, but recalls rather the dried-up lagoon zone of Chad, but a lagoon in which the invasion of the sand began a very long time ago. The subterranean liquid expanse is now very near the surface, now at a depth of from 15 to 16 yards. According to our measures its level is that of Lake Chad. We were unable, owing to lack of time, to explore the Bahr-el-Ghazal beyond Fantrassu. North of that point up to Kuri-Torao and Jérab methodical investigations remain still to be accomplished.

(3) *Lake Fittri.*—Fittri is a closed lake, fed solely by the local rains, of a slight depth (5 to 6 feet) with the area of Paris when the water is low, and with an expanse four times as great when the water is high. Although there are no outlets the lake is not saline, in which respect it is, with the Chad, an exception to the general rule. According to our observations it is 50 feet above Lake Chad. The inhabitants of the Fittri region are sedentary Bulalas, chiefly occupied in the cultivation of millet and cotton.

(4) *Eguei.*—It is impossible to call Eguei a valley or even a depression. At no moment has the traveller the impression of "descending" into Eguei. Seen from the plain which borders it on the south, the Shilim Fahalanga, or from that which borders it on the north, the Moji, the Eguei region has a chaotic aspect, in which the fixed or moving dunes, of from 60 to 100 feet in altitude, are mixed in inextricable

confusion. Another peculiarity of the plain of Eguei is the proximity of the subterranean water. In certain points the antelopes have only to scratch the soil with their feet to obtain drinking-water. The average level of this water is 6 feet lower than that of the liquid expanse of Chad. It is not impossible that the two expanses were formerly in superficial communication, and even that they communicate still below the surface. The remains of the lake fauna, the vertebræ of the fish, and the shells gathered in the Eguei region are identical with those found in Lake Chad. The well water in the Eguei region has certain curative properties which are appreciated by the camels in the neighbourhood. They are brought thither annually for a three or four weeks' cure.

(5) *Toro and Koru.*—After three days' march in the denuded, often rocky, and absolutely waterless region that extends to the north-east of Eguei which the Tedas call Moji, one arrives in the Toro region, where the water is at the surface of the soil. This region communicates by the Jerab with the Bahr-el-Ghazal. The Toro is even less than the Eguei a valley or depression. It is an inextricable mixture of mobile dunes running from east to west. To cross this sand-waste one requires a foot as expert as that of the camel. The water of Toro, which is still more curative than that of the Eguei, is, according to our calculation, 195 feet below the level of that of Chad.

A stage to the north-east, at the limit of the Borku territory, is Koru, a chaotic plain resembling Toro, where water can be found at a depth of from 3 to 6 feet. Its altitude is 480 feet, according to our calculation—that is to say, 203 feet below that of the level of Chad.

The general result of our observations goes to show that to the north-east of Chad there is a series of low plains, whose altitude is considerably inferior to that of the lake. The country drops off at about 205 feet in less than 250 miles. Lake Chad is not, therefore, the lowest point of the immense plain of which it occupies approximately the centre. This plain falls from the west to the east at a uniform rate of about 1 in 5000. Must we conclude that the Lake Chad low regions have received the overflow of the lake at the epoch when the Sahara was more moist than at present? That is not impossible, but it cannot be proved by mere considerations of difference of altitude.

It would have been highly interesting to continue our researches in order to determine the lowest point of this immense plain, which holds in the pockets of its gentle declivities the waters of the Chad, the Eguei, and the Toro, and to verify the affirmations of the old geographers as to the presence there formerly of a branch of the Nile. But the instructions we had received from our Government did not allow us to cross the boundaries of the Borku region. We were obliged to return,

and to leave, we hope, to the future the joy of surprising the secret of these hundreds of miles of unknown country, the mysterious attraction of which is so powerful.

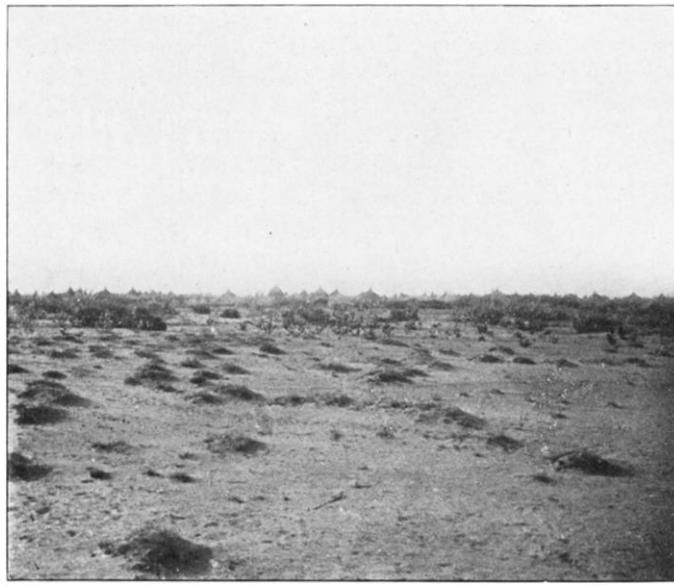
The Return by Northern and Southern Nigeria.

When we had finished our studies of the Chad region, there arose the question of our return. The journey was accomplished in two groups. The more important, under the orders of Lieut. Audoin, took the desert route along the southern edge of the Sahara. It was to continue to take along that route the same scientific observations which had been made along the frontier-line. The other group, of which Captain Tilho took the command, went through Kamerun (*viâ* Dikoa) and Nigeria, which the British authorities had graciously allowed us to cross, and which was the shortest route. We went *viâ* Kano, Zunguru, Ilorin and Lagos. Everything we saw from Lake Chad to Zungeru shows the methodical and practical way, the intelligence, the energy, the strong will of the men who have undertaken the task of civilizing and improving all that part of the British Empire.

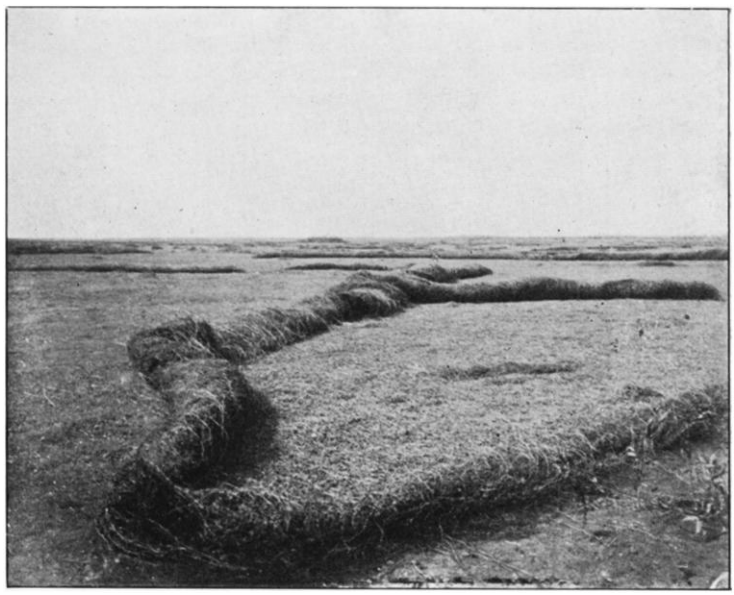
We met the Governor of German Togo, Count Zech, on the Niger. He was coming to study the administrative methods which have given such good results to the British in both Nigerias. He dined with us on the evening of his arrival, and so did our sympathetic British comrade Captain Kempthorn. We cannot help recalling the vision of that gathering around a French table under the African sky, and by the British Niger, of the representatives of those three nations who are responsible for that part of the world through which we had travelled. Those nations are no doubt perfectly united in the spirit of the constant necessity of co-operating in colonial matters; they have made themselves the guardians of these African populations. The noise of the discussions they might indulge in in Europe ought never to reach Africa; their administrative methods ought to be as far as possible on the same lines on both sides of the colonial frontiers; it would certainly be the best means, under different flags and with different languages, of achieving the triumph of order and peace against anarchy and insecurity which, till recently, have impoverished Africa and made its population so miserable. All the Africans support that "colonial entente," because they know how useful it would be. We may be allowed to say that all those friendly delimitations of colonial frontiers which have been made in recent years, prepare the way to a more complete understanding between the interested nations in Central and Equatorial Africa. The co-operation of the administrations of the different colonies would be the most powerful means, and most probably the only one, to utterly destroy the scourge of slavery in Central Africa.

CHIEFS ON ISLAND OF LAKE CHAD.

IN THE MARSHES AT ROSEAUX.



VILLAGE IN THE DRY REGION OF LAKE CHAD.



DRY VEGETATION ROLLED BY THE WIND.

During our journey across Nigeria, we heard several times some people expressing the idea that if the slave trade was still flourishing around Lake Chad the fault was chiefly due to the Germans and to the French, because they did not repress the evil with sufficient energy. I think it is our duty to be very clear on that point: we can repudiate such supposition as far as France is concerned, and no doubt Germany may do the same. Everywhere, where civil or military administration has been established by France, the slave trade has completely disappeared. At present it exists only in the countries which have till now escaped the action of the French as well as of the English, in the proximity of the frontier-line, which divides the regions of the Chad from the regions of the Nile, on 1500 miles of country. Last year the French occupation of Wadai was a great step towards the suppression of the slave trade, and since then the caravans carrying slaves have abandoned the route of Abeshr, probably to take another route more to the east. It is specially upon England and France that devolves the duty of achieving the suppression of slavery in those regions which lie in their zone of protection. But to obtain that result two paramount conditions are absolutely necessary :—

1. A thorough co-operation in the means of working towards that aim, between England and France, and also Germany.

2. To proceed, as soon as it will be possible, to the effective occupation of the respective British and French territory lying between Lake Chad and the Nile.

It is a great task which civilization imposes upon England and France in that part of the world. I do not think it is too much to say that our honour, as civilized countries, is at stake in it.

Three days after leaving the Niger we arrived at Ilorin, where we took the English railway for Ibadan. We met there with the most courteous reception from the Governor of Southern Nigeria, Sir Walter Egerton, and from Lady Egerton. We arrived at Lagos on August 12, after ten hours of railway across a country showing marks of the most evident prosperity.

We had an identical general impression during our goings and comings in Northern Nigeria and Southern Nigeria, that they are regions rich in resources, inhabited by a relatively numerous, active and intelligent people, and generally law-abiding; they are governed by officials who know their business perfectly, and who are sincerely interested in their work. I think Great Britain may justly be proud of the work she has done and is doing in this portion of Africa, work which we have most sincerely and greatly admired.

I cannot close this lecture without addressing to the Government of H.M. the King, the expression of our deep gratitude for the kind way in which we were accredited to the British representatives in Nigeria. I wish also to express our gratitude to the Royal Geographical Society

of London for the honour they have done Captain Tilho and his Mission in allowing us to bring before this distinguished audience the results of our studies on Lake Chad and the country east and north of the lake.

NOTES.

1. *Vegetation.*—One might ask why it is that vegetation is so scarce and miserable all around that part of Lake Chad where the heat is great and water abundant. The cause will be found in the very slight hygrometrical condition of the atmosphere save during the four annual months of the rainy season. The annual rainfall likewise is very small, 5 inches (mean); 7½ inches in 1908, which year was considered as very wet. One must not forget, also, that the northern shore of Lake Chad is that of the desert, while the other shores belong to the Sudan region.

2. *Alluvia—Organic Deposits.*—The different tributaries of Lake Chad deposit alluvia on all the surface of the lake; these deposits, together with those due to decomposition of aquatic plants and to the supplies brought by the winds, contribute to the heightening of the bottom of the lake, and add to the other causes determining the instability of the level of its waters. Part of these alluvia are deposited near the mouth of the various tributaries, thus forming *cônes de déjection* standing out for a few hundred yards only. These *cônes de déjection* once crossed, nothing reveals the presence of a river-bed in the near proximity, and coming from the lake one can easily pass before the mouth of one of the Chad tributaries without noticing its presence.

3. *Depth—Annual Flood.*—As is well known, one calls—

(i.) Mean depth of a lake the relation between its volume and its surface;

(ii.) The hollow of a lake, the relation between its volume and the square root of its surface.

The mean depth of Chad is insignificant; 5 feet or thereabouts in the navigable zone; 7 to 9 feet in the lagoon zone. The maximum depths observed by Naval Lieut. Audoin in 1903 are: 20 feet between Madiorou and Karinda, and 13 feet between Wanda, Kann, and Iba. These depths are exceptional.

The immerged outline of Lake Chad differs totally from the theoretical outline of our European lakes. However, if one tries to estimate the hollow of the great Central African lake in order to compare it with the hollow of certain well-known lakes, it will be noticed that it is incomparably smaller than that of any of them.

The hollow of Lake Chad equals approximately 1 : 24,000; that of Lake Peypus (Russia), which is considered as extraordinarily small, equals 1 : 4420.

The highest level of the water is reached in Lake Chad in December, and the lowest level in August. The difference between those two levels in 1908 was 31½ inches.

4. *Proportion of Salt.**—Nachtigal has written that the waters of Lake Chad are fresh. From this statement it has been concluded that the lake must have an issue somewhere, and the hypothesis of the Bahr-el-Gazal being an "effluent" of Chad

* The analysis of the different samples of water taken by us in the different zones of Lake Chad is not yet completed. It is being done at Copenhague, by Dr. John Schmidt (Commissioner for Havundergelser Afdeling Fiskeri).

seemed to give to that conclusion a tempting appearance of probability. Our reckonings have shown that the Bahr-el-Gazal, situated on the same level as the lake, could not be considered as its "effluent."

On the other hand, the water of Lake Chad is really fresh only at the mouth of its tributaries; its proportion of salt becomes more and more noticeable as one goes farther from the mouth of those rivers. In the lagoons the water is sometimes so full of salt and impurities that it is absolutely useless.

5. *Signal-marks—Anomalies.*—Owing to lack of proper means, we were unable, in 1904, to place in different parts of the lake the sign-posts which would have been necessary to assure the precision of the comparisons that were to be effected afterwards. Hence we were only able, in 1908, to estimate approximately the difference in the level of the lake in 1904 and 1908 through comparing the results of the soundings effected during those two years at the same points. The fall was evident in northern Chad, and we estimate it to be $3\frac{1}{2}$ to 4 feet. In southern Chad the fall was much less obvious, and cannot in any case be above 12 to 16 inches.

In order to be able to appreciate exactly the future fluctuations of the level of the Chad, we placed in the lake (and in the best positions of stability possible) two hydrometrical sign-posts, one at *Bol*, the other at *Kouloa*. Two other iron sign-posts, of the same model as the first, were placed so as to mark the position of the frontier, one in Binger island (northern Chad), the other in Sayorum Fallières island (southern Chad).

In certain "bahrs" or lagoons of southern Chad which were dried up in 1904, we found in 1908 that the water was again rising; for instance, north of Bol, west of Kanassarom, and regions of Koukia, Materam, N'Guirom. In other places we found an increase of depth of water; for instance, between Bol and Berim, north of Tindal, between Bol and Kanassarom, between Kanassarom and Goudji, and between Mishilela, Tatavirom, and Kelbou.

These facts, which at first sight appear anomalous, because of the general drying up of the lake, may be explained either by the increase of depth in certain "bahrs" (caused by currents), or by the increased height of the central part of Chad under the influence of alluvia and organic supplies; this increased height rendering all means of communication between southern and northern Chad most irregular.

6. *Climatology.*—The natives divide the year into three different seasons succeeding each other very quickly—

(i.) The cold season (November to February).

(ii.) The hot season (March to June).

(iii.) The rainy season (July to October).

Cold season. Our observations give 34·5° to 37° Fahr. as absolute minima for January and February, 1908. The wet thermometer of the psychrometer fell to 29·5° Fahr. on February 16, 1908. The maxima during these two months were 99·5° Fahr. January 5, and 100·2° Fahr. February 21. During this season the atmospheric moisture was very slight, and the dominant winds blew from the north-east and east-north-east.

Hot season. Our observations give: absolute minimum 57 Fahr., March 5; absolute maximum 113·2° Fahr., March 20. The temperature marks a considerable rise, its variation in one day reaching sometimes 45° Fahr. The hygrometrical state of the atmosphere increases; the winds are less regular and have a tendency to blow from the south; several tornadoes, generally dry, appear in May and June. Decomposition of organic matters becomes very active in the waters of Chad under the high temperature, and the quality of these waters may be very much influenced.

Rainy season. Our observations give: absolute minimum 70·2° Fahr., September; absolute maximum 104·4° Fahr., September. The temperature is slightly less high than in the previous season, but as the hygrometrical state of the atmosphere rises steadily, reaching its maximum in August, it is much more painful to bear. The winds blow very irregularly from the south-west. They are very strong only during the tornadoes, and they then blow from different quarters. Well-characterized tornadoes run generally from east to west, and very rarely from west to east. The following are the results of rainfall observations at our meteorological station of Chad (Bol):

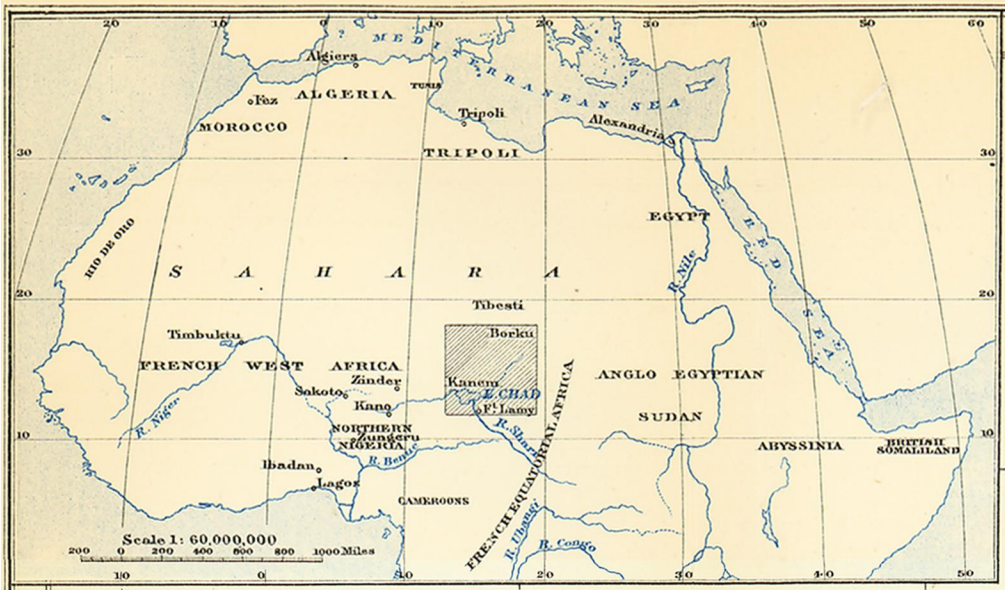
July	6 days' rain;	rainfall	32^{mm}·1 or 1·3
August	11 „ ;	„	134^{mm}·3 „ 5·4
September	4 „ ;	„	21^{mm}·7 „ 0·9
October	2 „ ;	„	4^{mm}·3 „ 0·2
November	no rain		
December	„		
Total for 1908 ...		...	192^{mm} 4 or 7·8

The year 1908 was considered as very rainy; we estimate that two-thirds of the rainfall of that year (5·2 inches) would be approximately the mean of the annual rainfall on Lake Chad.

7. *Note on the Determination of Altitudes.*—Our altitude reckonings in the country east of Lake Chad were based on the simultaneity of observation of the atmospherical pressure between the meteorological station of Chad and other points whose altitude was to be determined. Every precaution was taken to suppress errors due to the instruments. But it is well known that the formula of Laplace becomes of less certain application when the distance between the stations increases. The Eguei country being approximately 190 miles from Bol, we estimate that 33 feet (corresponding to a total error of 1 mm. of pressure) will represent the possible uncertainty in one sense or the other, in the results we have obtained.

8. In the *Bulletin du Muséum d'Historie Naturelle*, 1909, No. 6, p. 375, Mr. L. Germain says that the Tilho mission brought back a great deal of material for scientific study, amongst which that coming from Eguei offers special interest, as it fills up a gap in our knowledge, and gives us a fresh proof of the uniformity of the fauna throughout the regions included between the Nile and the Senegal.

The PRESIDENT (before the paper): We have come here to-night to enjoy what I think may be fairly described as a peaceful invasion of the French army, the French forces being under the command of our distinguished guest, Captain Tilho. In 1907, a party of French officers and men under the same commander met in Africa a party of English soldiers, their object being (our ancestors would hardly believe it) not to fight, but to settle in a peaceful way certain questions concerning a boundary, and I am delighted to say that those labours have been brought to a perfectly harmonious conclusion, the final act concerning this mission having been signed this very day. Nothing could be more satisfactory. Captain Tilho on that mission was accompanied by several colleagues, by Lieut. Mercadier, by Dr. Gaillard, and by Captain Lauzanne. After the conclusion of his labours as regards the boundary, the French Government very wisely, if I may venture to say so, deputed him to undertake a careful scientific examination of Lake Chad and all the region lying to the north-east of it. I am not going to anticipate what he will tell us about that mission. One remark, however, I must make, because I am sure he would not make



SULTU

Hangara 781

16°

Bedwaram

Alo

Ngurede

Mull

Deborom

15°

Kifei

Urei

SHITATI

Hexi

Foiyo

Leshur

Walad Sliman and

Yodom

Metime

N'Gum

LILLOA

Bir-Alali

Kornakab

Rig Rig

N'Gigmi

Garon

Yuno

Mao 1066

18° 17°

KORU

Koro Kidinga 525

Wani 620

TORU

Toro Dums 620

GOSSOM

Guradi 590

SULTU

MODELLI

Hangara 781

Sekhab 755

BODI

EGEI

Hacha 745

Fanenyha 797

SHILIM

FAHALANGA

Aurak 840

HITATI

Zigei 1036

Walad Sliman and Tubus

Leshur

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LILLOA

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Rig Rig

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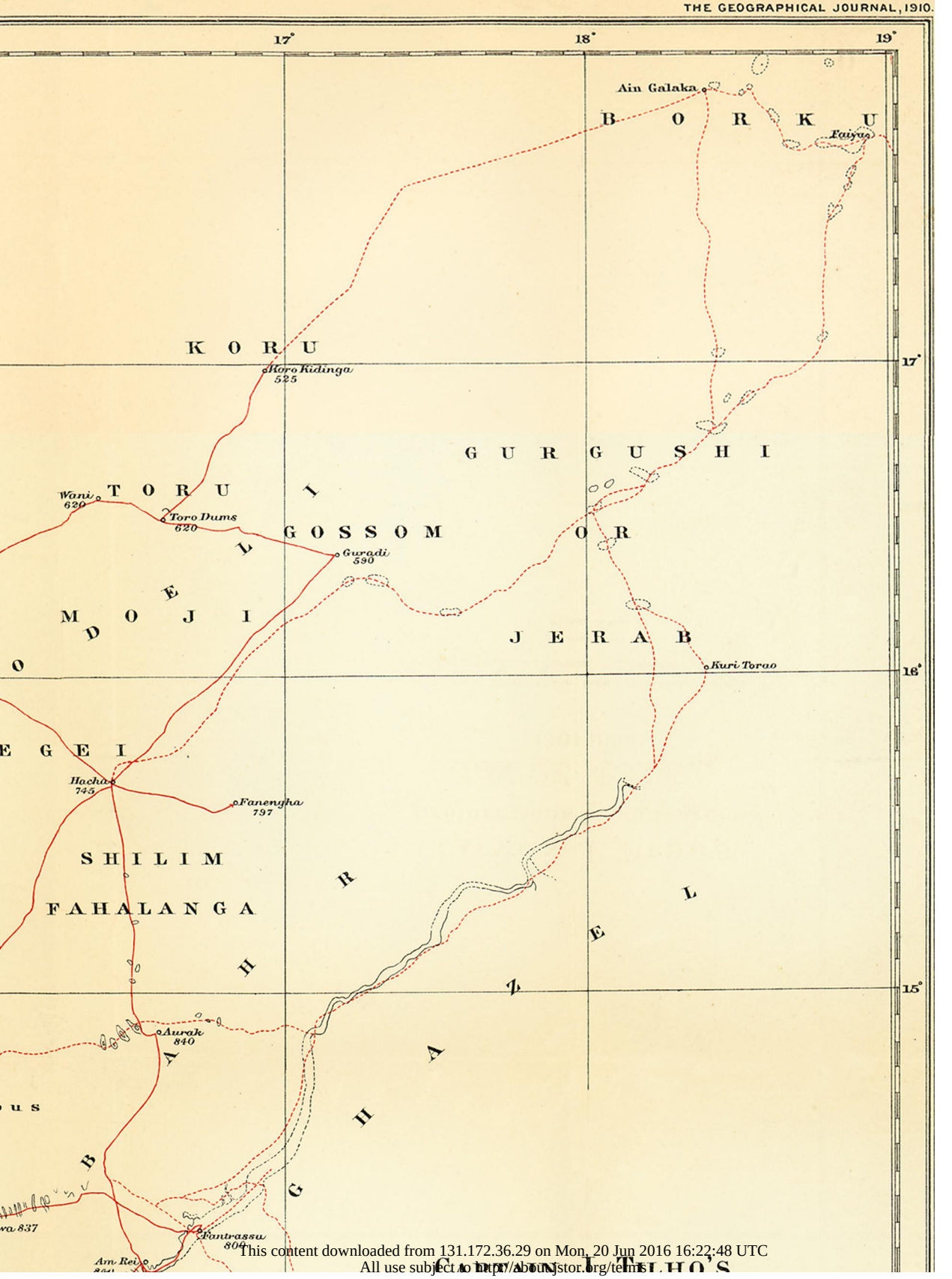
Kantrassu 800

Am Rei

Mao 1040



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