

So far as my information goes, the nest of this Eastern form has not been found ; but that of other species is described as being a domed structure, placed on the ground, and constructed of roots, leaves, and twigs, and lined with fine rootlets and grass. The eggs are white speckled with purplish grey.

A characteristic feature of these birds is their long tarsi which enable them to hop and run with great rapidity.

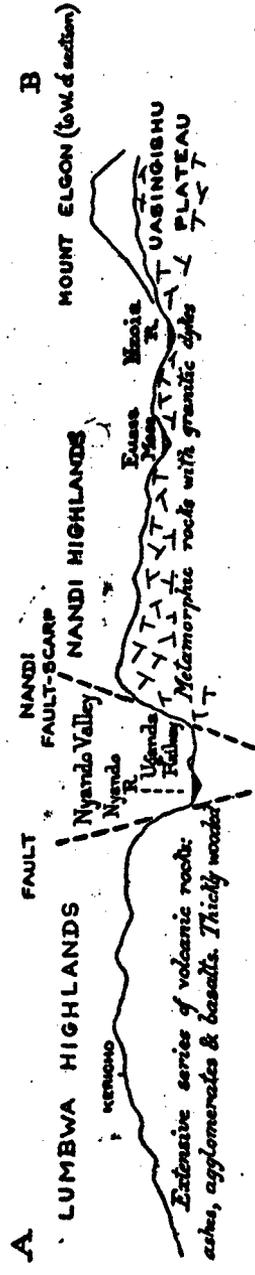
These birds, though conspicuously coloured, are difficult to see in the gloom of the great forests.

THE LUMBWA AND ELGON CAVES, WITH SOME
REMARKS ON THEIR ORIGIN AND THE
GEOLOGY OF THE REGION

By C. W. HOBLEY

In the Lumbwa highlands there are to be found an extensive series of caves, the occurrence of which has been the subject of considerable discussion, and it is only of late that systematic examination has been possible. It is now proposed to record the information available up to date. The existence of these caves was first brought to my notice by my friend the late H. B. Partington about eleven years ago. He was then the Commissioner of Lumbwa District. He informed me of the existence of certain caves called 'Kipchebos' on the Kiptiget River, and stated that at this place there was an extensive chain of caves which, according to the natives, ran due south for a long distance, and even extended under the bed of the Sondu River. He recorded the fact that the natives excavated a kind of salt earth from these places, but pronounced no opinion as to their actual origin.

During the last year these caves have formed the subject of investigation by Mr. Dobbs and Mr. Knight-Bruce, and some notes by the latter are given below, with a map of the area and a plan and section of one of the caves.



Rough Section from Kericho to the Uasingishu Plateau—Vertical heights exaggerated.

Both Mr. Dobbs and Mr. Knight-Bruce appear to be of the opinion that these caves are the work of the Lumbwa natives excavating in search of salt earth for the use of their stock. Until further evidence is available this view must stand, for the reason that the natives are digging in the caves and carrying away this earth at the present time. I only recently had an opportunity of examining a number of these caves, and I am able to support the view that they are of artificial origin.

The only other series of caves of such magnitude occurs on Mount Elgon, the inhabitants of which are the Lako, El Gonyi, and Savei, and are, by the way, of the same race as the Lumbwa or Kipsikis. I visited a number of these caves many years ago and tentatively formed the opinion that some of them were the work of wave-action operating upon soft layers of volcanic ash during a period when the waters of an inland sea attacked the flanks of the mountain, the mountain mass being later on raised through tectonic folding of the earth's crust. There is little doubt that the waters of the inland sea now known as Lake Victoria once covered a greater extent than at present; in fact, there is clear evidence that they extended up the Nyando valley certainly as far as Muhoroni, but that only premises a comparatively small rise in level. Now we know that in Miocene times the land comparatively near to the present shore of the lake was the habitat of beasts such as the *Dinotherium*, and the bones found in the beds near Karungu could only have been deposited in swampy flats of no great depth, and the greater extent of the lake at that period corresponds quite well with its extension up the Nyando valley and over the Kitosh plain. Dr. Oswald has recorded beds of Miocene age near Karungu about 140 feet thick.

In addition to the facts just recorded, there is a theory that at a later date than Miocene times the lake extended far away to the north-east past Mount Elgon, and certainly an examination of the map produces the impression that originally the waters of the lake may have included Lake Kioga and also the chain of lakes called after Salisbury and Gedge in Kumama country; if this is so, a careful examination of the area would probably disclose traces of old lake-terraces,

but nothing of this nature has as yet come to light. The above theory also premises that the outlet of the lake seawards was to the north-east, possibly through the Rudolph trough, or if not, into the Pibor flats and so on into the Sobat valley.

The lowest line of caves on Mount Elgon must be at a height of nearly 6000 feet, and some, I think, occur up to the 7000 feet level, and the caves in Lumbwa are stated by Mr. Knight-Bruce to occur at the following heights: Bagau cave 7000 feet, Gitoi cave 6000 feet, Kibipiten cave 6000 feet, Kiptoit 6900 feet, Sausit 6100 feet, a total range in altitude of 1000 feet. Now if the caves on Elgon are attributable to excavation by water action we must adopt one of two hypotheses: either that there was a vast inland sea extending up to the Mau Escarpment on the east, and (if at an altitude of 6000 feet to 7000 feet) bounded by mountain ranges of still greater altitude on all other sides, which is somewhat inconceivable; or we must fall back on the theory that in comparatively recent times the mountain-mass of Elgon was vastly lower, and at that time in contact with the inland sea, and that it has since been raised by earth movements to its present level.

With regard to the second proposition, viz. the elevation of the mountain: this problem is not an easy one, for great mountain masses like Elgon would not, as a rule, be likely to be raised to any great extent, for after the occurrence of a vent in the earth's crust through which volcanic activity is manifested and a vast amount of material ejected, there comes a period of quiescence, and the tendency would be for the mass of ejecta to settle and arrive at a position of equilibrium as regards the surrounding area, for the piling up of an enormous mass of material cannot fail to produce a local stress, which has to be slowly adjusted. If this adjustment occurs very gradually nothing happens; if it occurs near a great line of weakness, such as a big fault plane, and abundant water is present, further eruptions probably take place.

With regard to Elgon our knowledge of the sequence of events is faulty, but, as before remarked, there appears to be little doubt that at one period early in the history of the moun-

tain the waters of Lake Victoria extended far to the north-east and covered what is now Busoga and Bukedi country and extended into the Karamojo plains north of the mountain. If this is correct we have the water necessary to excavate caves, but at first sight it seems unlikely that the waters of this extended sea were more than a few hundred feet above their present level, and we have caves on Elgon some 2000 feet above the ordinary level of the surrounding terrain, so that the question then becomes 'Can the mountain have risen?' It may have risen to some extent, for the following reason: At one period in its history there was evidently a great convulsion, for the eastern wall of the mountain is seen to be torn asunder, and a mighty stream of lava issued from the breach and flowed eastward for many miles over what is now the northern part of the Uasin Gishu Plateau, and formed a ridge which now separates the watershed of the Turkwell and Nzoia rivers.

Judging by the way the region in the vicinity of the Lake is faulted, there can be no doubt that the crust of this portion of the earth is in a condition of stress, and it is quite possible that the removal of several million tons of material by the eruption above referred to so lightened the mountain mass that it rose owing to reduction of local stress. The drying up of what may be termed the north-east arm of the lake would also further relieve the pressure on the crust in this area. These causes would, however, be unlikely to produce movement to the required extent.

On the north side of the alluvial plain between Muhoroni and Kibos there is a gigantic escarpment running east and west composed of ancient gneisses and schists, and rising nearly 2000 feet above the plain. High up on this escarpment there are a number of caves: one was the scene of a fight during the Nandi expedition about 1901, and it was said to be big enough to hold 200 head of cattle.

These caves have recently been explored by Mr. P. L. Deacon, District Commissioner, Nandi, and his description leaves little doubt that they are what is called fault-caves. We have on the Nandi Escarpment a mass of metamorphic rocks which are traversed by granitic dykes; a fracture in the earth's crust which runs from the Maragoli Hills north

of Kisumu due east to opposite Muhoroni, and this produced a gigantic fault which was the cause of the Nandi Plateau. At a later date a north and south fracture occurred which was the origin of the fault scarp which runs from Kabras to Kibos.

The reason for the occurrence of this fault on an east to west line is obscure: the folds of the continent are from east to west, and therefore most of the fault scarps run north and south as in Taita, the Ukamba country, the Rift Valley, &c., and one cannot but suspect that it is in some way connected with the intense volcanic activity which is centred in Tinderet. This problem will, however, not be clearly solved until a detailed geological survey of the region is made. There, however, appears to be little doubt that the caves on the Nandi Escarpment are due to the falling together of masses of the granitic dykes, fractured and dislocated, during the formation of the fault scarp. A certain amount of water erosion has doubtless increased the cavities, for we hear of the occurrence of small streams in some of them.

On the south side of the Nyando valley we have what is probably a similar fault scarp, but it is not so sharply defined, and the upthrow on the face is not so great; in fact, it appears to have been masked to some extent by volcanic deposits, but the foci of eruption have not been identified. It is, however, probable that the Lumbwa highlands have been elevated by faulting in Tertiary times, but the information regarding the area south of the Nyando valley is at present too scanty to warrant any dogmatic conclusions.

To refer again to the east and west fault scarp parallel with the railway between Muhoroni and Kibos (as a matter of fact, the bearing or strike of this fault is about W.N.W. and E.S.E.). The highest portion of the Nandi Plateau is close to the fault plane, and the terrain of the Nandi country falls steadily to the north until the valley of the Nzoia is reached; north of the Nzoia valley the country gradually rises again towards Mount Elgon. It would therefore not appear that any causes which produced the elevation of the Nandi and Lumbwa plateaux would have appreciably affected Mount Elgon and raised that mountain to a similar extent.

As previously mentioned, there is a theory of considerable

probability to the effect that the lake once had a great extension to the north-east, and it is quite likely that this Nandi fault line, extending in a W.N.W. direction along the southern face of the Maragoli Hills and on past the Samia Hills, slightly raised the northern shore of the lake between Samia and the Nile, and cut off the ancient north-east arm, thus forming the present lake shore. The upthrow of the fault would naturally decrease to the westward. A section and map showing the faulting of this region is given.

To come back to the Elgon caves and the possible modes of formation. Caves can be classified under various heads. There are the caves of limestone countries due to the excavation of the rock by a process of solution by water charged with carbonic acid gas, which finds its way down the joint planes and along the bedding. There are the caves formed by the action of waves beating against a rocky shore and detaching a bed of softer rock. Examples of both these classes are common in Europe, and examples of the latter class are to be found along the shores of East Africa. Now what do we find in the way of caves in volcanic countries? We find caves due to the occurrence of huge bubbles in lava, which are caused by accumulations of water met with during the course of the lava stream and which generate steam; the lava cools rapidly on the surface and forms a crust over such pockets of water-vapour. Ages afterwards the lava weathers away and exposes such cavities. Other caves in lava occur owing to the rapid cooling of the crust and the molten mass underneath breaking out in a weak place and leaving behind it a cavity covered by a thin crust. These caves are more common than those caused by steam, and many examples are to be found in Hawaii, Iceland, &c.

Caves are also sometimes formed upon lines of faults; the space between the two rock walls is often filled with broken *débris*, and this may be removed by the agency of water, leaving curious caverns.

Since examination of the Lumbwa caves, I must confess to being prejudiced against my former view—that the Elgon caves were caused by the action of water, especially as it necessitate the foundations of a satisfactory theory explain-



Map showing North-east Portion of the Lake Victoria Basin.
Scale approximately 1 inch = 35.5 miles.

ing the elevation of the mountain mass by some 2000 to 3000 feet. We should, however, consider all the facts available.

Sir Frederick Jackson recently informed me that when he made the first ascent of the mountain in 1889 he saw at one spot a cave half-way up a cliff about 200 ft. in height, and in a position quite inaccessible by man, but of course the floor of the valley in which it occurred may have been very rapidly eroded. I remember visiting one about 1899, which had a great vaulted hall nearly 30 ft. in height, with a spring dripping from the roof and with a colony of natives living inside; this cave tapered away in its recesses to a height of about 2 ft. I asked the natives if it was excavated by man, but they ridiculed the idea. In some of the caves, however, marks were seen where fragments of the soft ash had been chipped off with the butt end of spears.

A hurried examination of the floor of a cave to a depth of 4 feet demonstrated that it had been inhabited at intervals for a considerable period, for charred wood, ashes, and fragments of bones were found at varying depths. I should like to add that none of the caves visited by me were in lava, so they could hardly have been caused by cavities in eruptive masses or by steam bubbles; they were invariably in porous volcanic ash or agglomerate. In one or two cases there was a waterfall over the mouth, but no evidence that the stream once flowed through the cave instead of over the top. The majority of the caves were very dry and dusty inside, and some swarmed with fleas.

The present population on the mountain is scanty, and it is hard to believe that they could account for the numerous caves on the mountain. Some of them are high up in the bamboo zone, and far above the limit of human habitation; others again are on the east flanks, which are now uninhabited. The present inhabitants, moreover, do not appear to be excavating anything from the caves.

Of course if it could be shown that the mountain is, or has been, rising with comparative rapidity, it might just be possible that what is now the high forest zone was in Palæolithic times a zone habitable by man—that is to say, if one entirely adopts the view that they are excavated by man. Primitive man,

as far as we know, rarely, however, excavated caves; his implements were of too rude a character for extensive work of this kind, and he generally occupied such caverns as nature provided. We have no evidence of the period which has elapsed since Elgon and the Nandi and Lumbwa plateaux were first occupied by man; the present tribes have not been in occupation more than a few hundred years at the outside: they came in from the country north-west of Elgon, viz. from the hilly country east of the Nile. They were also probably the first people to bring domestic animals, such as cattle, sheep, and goats. If this premise is correct, it tends to confine the period during which natives would have dug into the earth for salt. When they arrived in this area from the north we do not know if they found the country already occupied by agriculturists, but some think that this may be the case on account of the existence of what appear to be ancient dams for conserving water for irrigation. The real ancient inhabitants were, however, the Dorobo or Oggiek or Okiek, and these were the people who fashioned the stone implements, arrow-heads, and bowls which are now being brought to light as the country is opened up. They are generally classed as Neolithic in type, but this diagnosis fails to give us a date, for there is no reason to believe that stone implements in Africa are contemporaneous with implements of a similar type found in Europe, and which were gradually superseded by those of the bronze age, and later on of the iron age, and so on until we can obtain a grip upon a basis of historical dates.

In order to render some of the previous references to earth movements, &c., clearer to readers, the tabulated statement on p. 290, given by Professor Gregory (*vide* his book, 'Great Rift Valley,' p. 235), is republished. It is an attempt at the correlation of the volcanic rocks and earth movements in British East Africa, and is a marvellous example of geological insight, especially when one considers the limited time that scientist had in the country and the scanty information at his disposal.

So far as I am aware, the sequence he sets forth generally stands, but I am venturing to suggest the following amendments:

EAST AFRICAN SEQUENCE OF VOLCANIC SERIES ACCORDING TO PROFESSOR GREGORY.

Geological Period	East African Representative	Rift Valley Area			Nyansa Basin
		Volcanic Action	Lakes	Earth Movements	
Pleistocene	Upper series	Longonot, Donyo Ngai, and Telaki volcano in eruption	Modern lakes, Neolithic extension	Last series of faults	...
	Lower series	Longonot, Kyabus, and existing crater of Kilimanjaro	...	...	Elgon series in eruption. Formation of Nile gorge
Pliocene	Naivasha	Donyo Nyuki (often called Surua)	Lake Soco	Extension of Kenya glaciers, second series of Rift Valley faults	Depressions of area and formation of Senahiki Rift Valley
Miocene ?	Plateau eruptions	...	...	...	Basalt eruptions
	Nyasan	...	Lake Kamasia	First series of Rift Valley faults, see in southern end	...
Eocene	Dormyan	Kenya Sitima and Mawenzi in eruption	...	Edge over Rift Valley	Plateau conditions
	Kapdia	First plateau eruptions	...	...	...

1. *Pleistocene Period*.—Elgon series in eruption: this is doubtless correct, but what may be called the birth of Elgon will probably be found to date back to late Miocene times.

2. *Cretaceous Period*.—Kaptian. Referring to Professor Gregory's 'Great Rift Valley,' p. 230, it will be noted that he places the formation of the lava sheets of the Kapiti Plains as far back as the Cretaceous era, and considers these plateau eruptions to be chronologically coincident with certain denuded volcanic cores which protrude through the Jurassic rocks near the coast north of Vanga at Jombo and Kiruku. He unfortunately does not give the data which led him to the conclusion that the Kapiti lava sheets are as old as he states; personally I am inclined to essay the opinion that they are not older than the Pliocene era. The insignificant hills of Jombo and Kiruku are, however, I consider, the oldest traces of volcanic activity in British East Africa (excluding, of course, granitic dykes in the old metamorphic series), and quite distinct from that of the high plateaux of the interior. Between these two hills, for instance, lies another hill called Mrima, and this is composed of Triassic sandstones, and an unaltered exposure of these beds was observed close to Kiruku peak, which shows that at that period Kiruku at all events had ceased its active life, and had been eroded down to a mere core. The rocks from both Jombo and Kiruku are of an older type than anything I have seen up country, but I am unable to accurately describe them until a section can be made for microscopic examination. At any rate these old volcanoes should, pending a more detailed survey, be tentatively considered to date back to Jurassic times.

The full consideration of these problems has, I fear, brought under review a number of questions which at first sight may have appeared somewhat irrelevant, but if any of the caves are of natural origin the causes which produced them are inextricably bound up with the geological history of the Lake Victoria basin. It is to be regretted that fuller information is not available, and I would have then ventured to take up a more dogmatic view. After considering the evidence, and seeing that in Lumbwa the natives of the same race to those living on Elgon are actively excavating material

from caves in very similar rock, and which they consider to be of great fattening value for their live-stock, the presumption at present is undoubtedly to the effect that the Elgon caves were excavated by man for a similar object.

Anyone who realises the size of East Africa and the difficulty and cost of exploration work will readily understand that the full solution of this and many other kindred questions may have to wait until the country is in a position to bear the cost of a properly equipped geological survey.

A great deal can, however, be done by the accumulation of data by officers resident in the districts, and by planters and farmers who reside for years in one area, and attain a more detailed knowledge of a particular locality than it is generally possible for a district officer to obtain. I desire to express a grateful acknowledgment of the data supplied by Messrs. Dobbs, Deacon, and Knight-Bruce.

DESCRIPTION OF CAVES ON NANDI ESCARPMENT

BY P. L. DEACON

The largest of the caves called Kiptile is situated a short distance from the top of the escarpment beneath the hill on which is a beacon. This hill is the next one to the west of the Gordi Juok, which is the name of a large and prominent rock, easily visible from Kisumu or the Uganda Railway. This cave is situated on a ledge some two or three hundred feet from the summit of the escarpment, and there are huts near by. It must be some 2000 feet or more above the level of the lake. The cave is about 20 yards long and 10 broad, and has a curved roof over 7 feet high in the middle. It is hollowed out from beneath a gigantic boulder or possibly in the middle of the boulder. The boulder gives the impression of having been eaten away to form the curve. The floor is solid stone, and is probably part of the same boulder. It is covered with earth to a depth of a foot. Flakes¹ of rock

¹ These turn out to be of a pink granite.