



DISCOVERY

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method. Pages of printed text fed into the facsimile machine at Calais were reproduced at a speed of one page per minute at Dover, thus representing a considerable advance on the speed of existing telegraph systems. The new development is described by an expert on another page, and a photograph of the apparatus is reproduced.

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The possibilities of the micro-ray are not confined to the field of wireless communication. Its use will materially extend the utility of lighthouses, especially when the visibility is poor; it is at such times that lighthouses are at present least effective. For maintaining secret communication between aircraft and the land and between the ships of a fleet at sea the ray also offers fruitful possibilities, while in the field of television its use should permit developments which were not possible when the transmission of pictures required so much space in the ether. Further refinements are being carried out to prepare the ray for every-day commercial application. Incidentally, it is interesting to recall that exactly forty years ago the first submarine telephone cable between England and France was laid on almost the same route as that traversed by the micro-ray at the recent demonstration.

* * * * *

The Society for the Protection of Ancient Relics, a semi-official body in China which is recognized by the Nanking Government, is renewing its disturbing activities against non-Chinese scientists. It may be recalled that, shortly after its formation, this body seriously hampered the work of the American expedition to Mongolia three years ago under Dr. Roy Chapman Andrews; indeed, in the following year, owing to the delay in negotiating a *modus vivendi*, the opportunity for the season's work was lost and on that occasion the expedition had to be abandoned. It appears that the object of the Society's present opposition is Sir Aurel Stein, whom it would expel from Chinese Turkestan, where he is now carrying on excavations. The reasons advanced for the demand are Sir Aurel's alleged political intrigue against the new China and his intention to smuggle antiquities

Notes of the Month.

THE successful demonstration last month of a new "ultra short wave" radio equipment marks an advance of the utmost importance in the field of wireless communication. Conversations were exchanged between Dover and Calais on a wavelength of only eighteen centimetres, using aerials of less than an inch in length, with a power of half a watt—which is just sufficient to light an ordinary flash lamp bulb. In the new apparatus, the sound of the speaker's voice at the transmitting station is carried to a "micro-radiation" tube where waves known as "micro-rays" are generated; the waves oscillate at a rate of sixteen hundred million times a second. After concentration by an ingenious combination of two reflectors into a fine pencil of rays, somewhat similar to the rays sent out by a searchlight, the waves are transmitted into space. An important feature of the micro-rays is that they are not subject to the "fading" effects encountered in ordinary wireless transmission, and they are not absorbed by rain or fog as is the case with light rays. The demonstration has shown that wavelengths of between ten and a hundred centimetres can be used for commercial transmission. This advance is regarded as highly important, for the experts point out that, even if the transmitters were made to differ in wavelength to the same degree as is now necessary with ordinary wireless transmitters, nearly a quarter of a million micro-ray instruments could be worked without any one of them interfering with another. After the telephone conversations, a facsimile telegraph system was demonstrated by the new

Digging for Dinosaurs.

By F. W. H. Migeod, F.R.G.S., F.R.A.I.

Leader of the British Museum East Africa Expedition.

Recent exploration of dinosaur beds in East Africa has resulted in many important discoveries, among which is the skeleton of a reptile whose appearance resembles that of a gigantic giraffe. Work has now ceased owing to lack of funds, but the author shows that continued exploration would be amply justified.

In the ages of the world known as the Jurassic and the Cretaceous the land was peopled by reptiles. It is hard for us human beings to recognize that all that had gone before in the fields of creation and evolution had no other destiny than to be the disregarded setting of almost brainless lizards. Yet so it was; and many millions of years had to elapse before the Creative Force recognized that what it had done so far might be improved upon. Then mammals with their larger brains entered in. Increasing in size to almost unwieldy proportions, the greater lizards came to an end.

East African Remains.

In many parts of the world these greater lizards, the dinosaurs, have left their bones. In East Africa their remains have so far only been found at Tendaguru, fifty miles north-west of the port of Lindi in Tanganyika, and in Nyasaland on the north-west shores of the lake. For some years, since 1924, the British Museum East Africa Expedition has worked the deposits at Tendaguru, but during the last year, for the first time, it has added to its exploratory work the deposits in Nyasaland. The exposed dinosaur beds in the neighbourhood of Tendaguru Hill cover some two hundred square miles. There are three layers separated by two marine beds, the upper known as the Trigonias Smeei zone and the lower as the Nerinea zone; and there is a remnant of a third, the Trigonias Schwarzi zone, eight hundred feet high on the top of Tendaguru Hill. Although there are these intervening evidences of the encroachment and recession of the sea, there seems to be no evidence that the dinosaurs are of radically different types. How far the marine beds, therefore, indicate complete submergence of the country, and how far merely intrusions by means of creeks, is not yet fully ascertained. The latter is probably the view that has most to support it.

In previous years I worked the top deposits. During the last season I confined myself to the second in the area known as Kindope, from a stream of that name.

The lowest is yet unworked by the British Museum. The Germans, who maintained a big expedition in the field before the war, made great discoveries in both the uppermost and second layers, and studied the lowest to some extent. It was near where the Germans found their celebrated Kentruosaurus, a horned dinosaur related to the stegosaurus, that the British Museum expedition last season discovered a large dinosaur, which is perhaps allied to the brachiosaurus. I marked out a small area the previous year (when the grass was burnt) for intensive examination, and the result was the discovery this season after about a fortnight's work of the skeleton, the site of which is recorded as M 23.

The two marine beds between which M 23 lay, the Trigonias Smeei and the Nerinea, are about a hundred feet apart vertically, and the skeleton lay somewhat nearer the upper bed than the lower, its altitude being 472 feet above sea level. The rock on which it lay was a grey clay like the Kimmeridge and containing boulders of the same material. Above were alternating red and grey clays in thin layers. When viewed in a vertical wall the layers were seen to be in a waving line. A fault was visible crossing the ground a little below the ventral side of the skeleton. From its position it might be assumed that the carcass came to rest in the backwater of a river. It partly sank in the mud and the upper and exposed side must have been somewhat rapidly buried by intermittently running water.

The Site of "M 23."

It is probable that the "Kimmeridge" clay had been partly exposed when this dinosaur of presumably Jurassic Age settled down in it, and the surface was swept by currents of water bearing alternately scoured-out Kimmeridge and brown clay from near by. The brown clay subsequently formed a thick deposit over all, and it is on this brown clay that the upper marine bed directly lies.

The carcass lay on its right side and the extremities are missing. All parts of the skeleton, too, are not

equally well preserved; the roots of present-day trees have done some damage, principally at the sacral region. In one place there was a damp layer, so that while the highest and lowest bones were hard, the intermediate section was powdery. A strong and corroding impregnation of iron here and there had in addition done some considerable damage. As to the general appearance of the dinosaur, it might be said that it was giraffe-like in shape but on a far larger scale. Being a reptile, it would have had a hide like a lizard's. Presumably it was cold blooded; although whether the dinosaurs were actually so is a point that has been debated. At the shoulder it must have stood eighteen feet high, with its neck towering over twenty feet higher. At its hind quarters it was not more than twelve feet high, and a moderately long tail tapering away behind would give a total length of perhaps seventy feet. The tail was presumably not so long as that of the diplodocus or brontosaurus, which carried their necks horizontally and were lower at the shoulder than at the hind quarters.

Some remarks must now be made about the bones. Of the skull no fragments have so far been identified, and thus the most interesting part of the body, as is so commonly the case with the dinosaurs, is lost. But a large tooth was found measuring $6\frac{1}{2}$ inches in length with a maximum circumference of $5\frac{3}{4}$ inches; this would indicate that the head was large. The tooth is pointed and has a slightly serrated inner edge. Two small teeth were also found in other places. Their dissimilarity in size would not be unusual if the dinosaur were a theropod, the flesh-eating kind, which had teeth of very varying sizes; but it is rather disconcerting in this case, the presumption being that the reptile was a sauropod, the vegetation-eating kind.

Comparing the vertebral column with that of the diplodocus in the Natural History Museum at South Kensington, the most striking feature is the far greater size of the lower neck

vertebrae. On the other hand, the posterior dorsal vertebrae are somewhat smaller. Owing to some damage at the sacral region, it was not possible in the early stages of excavation to decide which was the last sacral vertebra so as to number the dorsal vertebrae therefrom. In default the shoulder vertebra had to be taken, and contrary to expectations it showed distinctive difference. This vertebra, which measures 24 inches in length, became the zero, and nine neck vertebrae were found leaving perhaps five more to complete the neck.

The first cervical, C 1, is 33 inches long, compared with about two feet in diplodocus. Running its full length and connecting with preceding and succeeding vertebrae is a great superstructure. This is built up of "girders," plates and "buttresses," giving great strength for very little weight, and stands 44 inches high. The longest cervical actually is C 3 which is 41 inches in length; and thereafter the size diminishes. A considerable number of short neck ribs were lying near the lower cervicals. In addition was the discovery of a number of neck tendons of great length. One of them, extending backwards from C 5, measures $97\frac{1}{2}$ inches and is completely ossified and fossilized. It is about an eighth of an inch in diameter throughout its entire length and has an elongated triangular head ten inches long with a terminal width of six inches.

Coming back to the shoulder vertebra, the first dorsal was no more than fourteen inches in length, and the centra of the remainder measured from eleven to nine inches till the sacrum was reached. Most of the centra were firmly fixed into each other, and although to outward appearance solid, they are of very light internal construction, the cellular spaces being filled with the different coloured clays in which the skeleton lay. The neural spines were of great length especially on the anterior dorsals, on which they leaned forward to allow for the elevation of the fore part of the body. On the more anterior vertebrae



THE SITE OF THE GIRAFFE-LIKE REPTILE.

The digging party at Tendaguru where the skeleton of the giraffe-like creature was unearthed. The exposed dinosaur beds in this neighbourhood cover about two hundred square miles.

the spines spread themselves into "wings." Of the tail only a part was excavated intact, but three small stray vertebrae were found later.

In most cases it has been found at Tendaguru that the limb bones are in evidence, while the rest of the body is scattered or broken up. M 23 was quite an exception, and while the spinal column was intact the limbs had suffered. The best find among them, in very good condition, was the left scapula. It had shifted to the end of the line of the neck vertebrae and lay on a natural curve. The coracoid was completely fused and the total length measured on the curve was 87 inches. It measured 26 inches across the arm and shaft, and the end, which was splayed, was 27 inches across. Of the right scapula there was no trace. The humeri were $57\frac{1}{2}$ inches long and 20 inches maximum width. The femur was about four feet long, but owing to damage its exact length could not be ascertained. An ischium and parts of a pubis were found, and the right ilium was intact.

It was unfortunate that the sacral region and the last dorsal vertebrae were somewhat damaged, as it is here that was located the large expansion of the spinal cord which may be three or four times the size of the head brain, and formed a sort of second brain. Its functions and relation to the anterior brain afford an interesting subject of speculation.

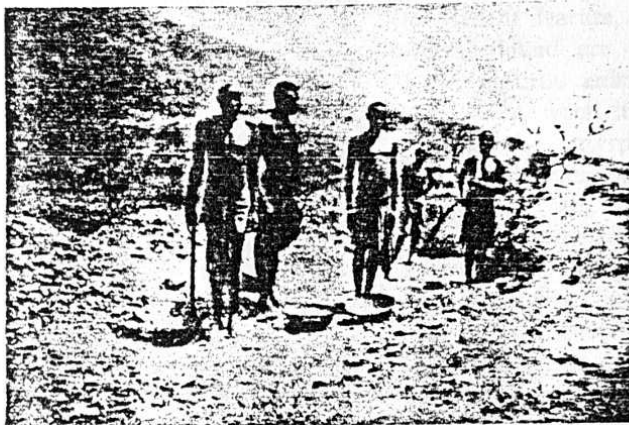
A last note to be made on this skeleton relates to the ribs. Lying on its right side it is only to be expected that the left ribs, which would be uppermost, should be broken and carried away by intermittently flowing water. The right side ribs, however, were pressed down into the mud, and there they lay until with decomposition the whole flank became separated and the muscles joining the ribs to the vertebrae came apart. Their distance down is about four feet at the breast, and this figure doubled gives some idea of the thickness of the body of the living dinosaur. One of the heaviest ribs measured eighty-two inches, but a thinner one was over ninety-two inches long. The

former had a somewhat triangular section, and another big rib lying under the breast was flat and had a width of about six inches.

The time came to carry out the other part of the season's programme, which was to examine the dinosaur beds of Nyasaland. I therefore covered up the bones I had not had time to remove and left them until I returned in November. Mr. F. R. Parrington, of the Cambridge Museum of Zoology, who had been lent to the expedition, had gone on in advance from Lindi early in August, by lorry to Songea, and thence on foot to Manda on Lake Nyasa, taking most of the stores. I followed at the end of

the month, and joined him at Manda with a day to spare before the steamer arrived. Between Songea and Manda a botanical collection was made at Likuyu about three thousand feet above sea level, and some surface bones, part of a dicynodon, were collected at Munya Maji.

The north-west shore of Lake Nyasa is remarkable for the fact that within a few miles of each other collections of bones



DIGGING IN MWAKA SYUNGUTI VALLEY.

Four sites were explored in the Mwaka Syunguti Valley, the object being to ascertain how nearly related the dinosaurs of this region were to those discovered at Tendaguru.

can be made from such diverse beds as Karroo, Dinosaurian (Jurassic and Cretaceous), Pliocene and Pleistocene. Hitherto only small surface collections had been made by geologists studying the country from the point of view of minerals. The two months' work there, however, shows that the possibilities of the ground are great. It was the dinosaur beds with which the expedition was principally concerned, as it was desired to ascertain how nearly related the dinosaurs of Nyasaland were to those of Tendaguru. Although these beds extend as much as seventy-eight miles north and south, they are only a very thin line, and the point selected to work at was up the Mwaka Syunguti valley in the foothills of the Nyika Plateau.

After a few days spent in a preliminary examination of this very broken valley, digging began and four sites were explored. Site A was about a mile straight up the valley from the small village where the camp was situated. It was on a hill top, and excavation was easy as it was only necessary to throw the earth

down the hillside. Here a number of bones were laid bare. They belonged to at least two individuals and most were in good condition. Among them was a scapula measuring forty-five inches by seventeen inches, a radius, a pair of sternal plates, parts of ribs and a pubis and ischium, besides some vertebrae, mostly the centra only.

Site B was about a mile farther up the valley. Only a few bones were found here and they were scattered as much as ten yards apart. They were on the surface or immediately below it, and digging did not reveal other bones in proximity to them. The finds were a humerus of thirty-two inches; a femur, forty-six inches long, the centra of two caudal vertebrae, and another of extremely small size. In addition were some small fragments of bones about a millimetre in diameter, two shells (*Unio sp.*), and part of a big bone completely calcified. Site C lay towards the east side of the valley and about the same distance from the camp as A. The finds included a femur, a tibia, a meta tarsal, a sacral vertebra and several centra; and, what was most interesting in this association, a vertebra with a neural spine which was cup-like. Site D was another hill peak only about a hundred yards from A. It produced a group of bones all belonging to a single small sauropod. On the surface of the ground close by, amongst the coarse quartz gravel which covers the surface of nearly all the valley, were found several pieces of fossil wood which were probably of derived origin. Most of the limb bones were found, and there were a few vertebrae with their spines complete. To give some idea of the size of the reptile it may be mentioned that the femur measured 34 inches and the humeri 27 inches.

It is early yet to state definitely the connexion of the Nyasaland dinosaurs with those of Tendaguru. There are species of *gigantosaurus* common to both



SCAPULA OF A DINOSAUR.

This unusual photograph is not a mountain scene but the scapula of a dinosaur. It was left lying on a mound after excavation until it could be set in plaster.

localities and others will undoubtedly be recognized. One salient feature, however, is that all the bones hitherto found are very much smaller than those of the gigantic animals so common to Tendaguru. Incidentally, when it was seen that fossil bones had a value, one enterprising native down the valley made a collection of all he could find on his farm and putting them in his house offered to sell them to me. He received sixpence for his report; but a sale was not effected. Outside the foot-hills and rising out of the alluvial plain is Uraha Hill, 250 feet high. It constitutes one of the best exposures of the Pliocene beds, on the top being a thin Pleistocene deposit. Some collecting was done here on the slopes of the hill and it is well worth a detailed examination. The last part of the work of the expedition in Nyasaland was on the Karroo deposit south of the conspicuous Mount Waller. Close by are hot sulphur springs and coal. The Chiweta beds, so-called from the village below them, are about half a mile from the lake shore, rising to some two hundred feet, and cover not more than a square mile. The ground is mostly a very hard shale and difficult to break up, and the dip being northerly to north-east, the oldest reptilian remains are on the south-west side. Surface finds of varying value were made over the whole ground, dicynodon bones—chiefly parts of skulls—being most in evidence, and the skull of a labyrinthodont has also been identified. At the beginning of November work had to cease, and I took the monthly steamer back across the Lake to return the same way as I had come, to Tendaguru, where the last remaining bones of M 23, which have been left covered up, were taken out, and the site further dug over. The visit to Nyasaland was little more than a preliminary reconnaissance, but it proved that further digging there would be amply justified. This is not likely to be done in the immediate future for the same reason that work at Tendaguru has been stopped. Funds are lacking.



VERTEBRA OF "M 23."

In the foreground is a cervical vertebra of the reptile "M23," which is thirty-three inches long. It was divided up and the parts were set in plaster.