The Dinosaurs of Tendaguru

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THE DINOSAURS OF TENDAGURU

TENDAGURU in the southern part of Tanganyika Territory is now well known for its vast accumulation of bones belonging to the long extinct dinosaurs.

Few places in the world, if any, have supplied more relics of that bygone age when reptiles dominated the earth. For ten millions or perhaps nearer twenty millions of years these bones have lain buried in the deposits of clay or sand of Tendaguru. The Jurassic age was the great period of the dinosaurs. They survived on into the early Cretaceous age of that part of Africa, when they attained their maximum development, of which the Tendaguru deposits give evidence, and then they abruptly disappeared from off the earth. So long ago was this, that revolutions of the earth round the sun scarcely serve as a suitable measure of time. Man as yet was not, and all species of mammals were still in the future.

In the Jurassic age the distribution of land and sea was not as it is now. Africa, however, except for a fringe on the eastern side, chiefly north of the equator, was already dry land, but was of greater extent than at the present day, being then connected with South America by a wide land bridge; and at the end of this period Madagascar, where some dinosaur remains have also been found, seems to have been separated from the mainland.

Many species of reptiles then attained a gigantic size, larger than any elephant or mammoth. To these monsters has been given the name of Dinosaur, coined from two Greek words and meaning a Terrible Lizard. Their immense bones have been fossilised, and as hard as rock are the memorials of their former existence alive. They have also been found in such widely different localities as North America, Western Europe, including England, and Mongolia, thus indicating their distribution to have been world wide, though they probably only inhabited regions which were in the age that they lived in, either tropical or sub-tropical.

Tendaguru is by road about fifty-two miles inland north-westerly from Lindi, the principal southern port in Tanganyika Territory. A small wooded hill with cliff-like sides, it rises like an island above the surrounding country, standing on the edge of a deeply furrowed tract of country. On the west side the ground falls rapidly to the Mbemkuru river, some five miles distant, but to the north, east and south a few miles distant are still higher hills and plateaus. Of these Tendaguru represents a partially worn-down portion, and is a small surviving isolated fragment, on the top of which, at a height of about 850 feet above sea-level, there is a thin layer of smooth river gravel. All around the ground is much broken with water-courses, which are not seen till actually come upon owing to the vegetation, and except during the rains they are always dry.

There are no villages near, only scattered farms, and the vegetation is chiefly what is commonly called savannah forest. This consists of trees of not particularly large size which grow on grass-land, and which are able to resist the annual burning of the grass. It is, however, mixed with acacia trees, intruders from a yet drier vegetation zone, while in favoured localities, the nearest being within a couple of miles, are remnants of a once widespread "dense" forest. After the great burning of the grass and trees, which may be about the month of August, depending on the heaviness of the preceding rains, the whole country-side remains black for several weeks. Incidentally this is essentially the prospecting season. By October leaves and grass appear if there have been a few showers of rain, and there is a delightful appearance of spring over all the country-side, all the more appreciated after a month or so of blackness and soot. It is not until some time later though that birds come in ones and twos to see if the country is fit for them to return to.

All the drainage is towards the Mbemkuru, which flows northerly, then easterly, and is dry most of the year except for pools. There is a fall of about 500 feet to this stream from the average level of the Tendaguru bone-bearing strata, and it may be presumed that the ground has been scoured out, and the present-day river is only a small remnant of a

mightier one which flowed at a much higher level, and perhaps entered the sea to the south of Tendaguru instead of to the north as at present.

The Germans, when the country belonged to them, first discovered the dinosaur remains, and had worked them for about six years before the outbreak of war in 1914. The excavations were hurriedly abandoned, and many fine bones lie about at the present day in too advanced a state of decay through exposure to be worth removing.

Even before the War was over, the South Africans on active service were alive to the scientific value of the remains, and after the Armistice collected some of the more accessible bones and despatched them to the Cape museums. They were, however, stopped in this by the newly-formed local Administration, though nothing further was done until in 1924 the British Museum, having been able to get together enough funds, sent out a small expedition in charge of Mr. W. E. Cutler, a Canadian, to resume the excavation. Mr. Cutler died on the 30th August, 1925, and the present writer arrived out at Tendaguru in the middle of November of the same year to continue the work, returning to England in December 1926.

One has only to walk about the country in the neighbourhood of Tendaguru in the dry season after the grass has been burnt to see at a glance how vast is this graveyard of dinosaurs. Recent denudation has removed the many strata of rock that the ages after their death piled up on their remains; and once again these bones lie close to the surface. Most of the damage done to them has taken place in quite recent years through the penetration of the roots of vegetation. At the present day they lie at an average level of 650 to 750 feet above the sea. Fragments of bone on the surface commonly, though by no means always, give an indication of where further bones may be dug for. The stratum, however, is not always an indication that bones may be found in it, for the dinosaurs which I collected lay in several different kinds of ground—in clays of more than one kind, some stratified and some much contorted, in loose sand, and in hard sand rock. The numerous ridges that run

down in the direction of the Mbemkuru from Tendaguru hill are bone-bearing on the very top only. If any bones are found in the intervening ravines, they have weathered out above and fallen down.

Digging during the twelve months under review was done on thirteen different sites all around Tendaguru hill, none being much more than a mile distant in a straight line, though of course commonly farther to reach by the bush paths. In addition prospecting was done farther afield, but, in view of the possibility of the work of the expedition in this locality continuing for more than one year, I decided to make an intensive study of the immediate neighbourhood first. All these diggings except one proved productive in more or less degree, and the single one with negative results was especially valuable in giving the limit of the bone-bearing area. All the other sites yielded results, either of scattered bones or of fairly complete skeletons. Altogether there was excavated material representing as many as thirty dinosaurs of several different species.

When I arrived at Tendaguru there was nothing to indicate which was the best place in which to continue my predecessor's work, nor any information on the subject to be gleaned. I therefore selected a near site to the south-eastward the first day, and work was begun there the next. There were both German diggings and Mr. Cutler's close together at this place. This site, which I called M 1, lay, I estimated, at a height of 715 feet above sea-level. I may here observe that I took a number of barometric readings at Lindi, and was thus able to fix the height of my house which stood on a small terrace just below the top of Tendaguru hill at 827 feet. From that I obtained the height of the various excavations as I required them.

M 1 first yielded a small dinosaur which was easily packed into nine head loads for transport to Lindi. This dinosaur, which has been opened up, is possibly a Kentrurosaurus, a reptile something like a Stegosaurus, having possibly a single row of plates set vertically, saw-like, down its back, with spikes, perhaps four only, on its tail. It has not yet been fully studied, however.

Near it lay another dinosaur of great size, which when excavated required eighty carriers to take to the coast. This second dinosaur, of which only a few of the packing-cases have been opened, the Museum having got no farther yet with the opening up of the collection, was a four-footed one, and possibly a Tornieria, and some indication of its size may be gained from the measurements of the scapulæ, which are 48 inches long and 28 inches wide at the widest part. It probably stood higher than the largest elephant, its bulk being increased by a long tail and a long neck as well. The larger part of the body had rested on a bank, but a small stream, not a present-day one, but one of the distant age when this dinosaur lived and died, flowed by and had disturbed the remains on one side, some of the bones showing plainly the action of this water. The pelvis, dorsal vertebræ and upper limb bones had apparently not been moved by this stream, though at no great height above it, but mixed with the lower bones were numerous river-worn pebbles, and in the case of one rib two smooth pebbles were tightly jammed under it, causing it to bend and of course break. This could only have taken place after the flesh was largely decomposed—some ten millions of years ago.

The dorsal vertebræ of this skeleton, which were all bunched together, were of great size, the central or drum-like part being well over a foot in diameter. As in other reptiles, the vertebræ, especially the cervical ones, were very elaborate and intricate in their structure; but only with one vertebra did I find the processes fairly complete and in position or intact. With all the others there was merely a mass of broken fragments, which had to be collected and packed with the vertebra to which they seemed most probably to belong. The solid central part of the vertebra was also often split open and the breaks filled with mud, due to the action of recent vegetation. When I mention that one vertebra was in over 160 pieces, some indication will be afforded of the work in store for the preparator. I some time since saw in the Press that a dinosaur's tail had been worked on in America for over two years, and it was estimated that another two years would be required before the reconstruction could be completed, and that of the

tail alone, which will give some idea of the time necessary to reconstruct a complete dinosaur. From a diameter of over a foot for the larger dorsal vertebræ, the processes excluded, the size gradually diminishes till the smallest caudal or tail vertebra is not more than an inch in diameter.

As a bone puzzle, site M 1 was as nothing compared with site M 2, which lay to the north a mile off, and on a level about 70 feet lower. After this ground had been opened up, the first thing that would strike the eye of the visitor as he came on to the clearing through the bush would be two green tents and several waterproof sheets laid on the ground. It was the rainy season and the bones had to be protected as well as possible until the time came to move them into the central shed where they would be cleaned, examined and packed. Every morning after rain some part or other of the excavations would have water in it in spite of a drainage system which was not everywhere possible. So the water had to be baled out before work could be begun. Here an area of 88 feet by 64 feet was dug through, and the bones lay so thickly that it was difficult to find room among them in which to put one's feet. One had to tread very warily, and incidentally one's difficulties in this respect were added to by vast hordes of biting flies of many species and great size. Even the customary imperturbability of the native workers was ruffled by these venomous creatures, which had a marked partiality for the tents and were there all day.

In dealing with so great an accumulation of bones as was here, I found it better not to move any until the majority had been carefully marked on a plan and some impression gained as to the limits of each skeleton. This was occasionally difficult, as some bones lay on the top of others, although for the most part they were in a single layer.

There was here what might be described as a veritable Armageddon. We may figure to ourselves a region suffering a process of desiccation such as is going on in the lands bordering on the southern Sahara desert at the present day, and coming on again in this region too. All living things flocked to the remaining pools of water for vegetation to eat, and such water to drink as was left in the bed of a dried-up river; and they

perished miserably one on the top of the others. A subsequent good rainy season could not help them, as all was over. Sand swept over and covered their remains, and the brief annual flow of the river in subsequent years buried them in mud and sand. While at this site, M 2, the bones were largely though not entirely embedded in a matrix of sandstone, at site M 1, which I have already mentioned, they were buried in a grey clay with practically no sand at all.

In this great accumulation of bones there were the remains of more than one type of dinosaur. The skull would be a useful means of identification, but skulls of dinosaurs are generally missing and only a few fragments came to light. In a great many of these giant reptiles the skull was small, as may be seen in the case of the huge Diplodocus in the Natural History Museum. It was accordingly much more liable to destruction than the massive bones of the body, and curiously enough even the teeth are rare. I refer to this subject again later.

Site M 2 did not furnish any bones of outstanding size, the biggest of their kind being a femur of 55 inches and a humerus 40 inches. On the other hand, the finding of a pair of femora 14 inches long was of interest, indicating as it did either another species or a young one. I incline to the latter view, as I could detect no difference from the larger ones in the shape of the bones.

Judging by the confusion of the bones, the dinosaurs did not all lay themselves down at once to die in peace. There was much tramping by beasts weighing several tons on others already dying or dead, which would cause some breakage of the bones. I found a few bones which clearly showed breakage at or immediately after death and while the muscles were still operative, one being a femur.

Further I found one or two bones which seemed to have been broken during lifetime and to have joined themselves just as such a fracture—they were simple fractures—might be expected to mend itself. The differences between these fractures and the clean ones due to earth tremors or stresses or to the recent action of vegetation are readily apparent.

An interesting feature, especially noticeable on this site

owing to the great quantities of bones, was the varying state of preservation of the bones even in those of the same skeleton. Some were in excellent condition with the breaks sharp and clean. Some were rotten internally with a hard casing. In others the outer surface was flaking off. Commonly the ends were decomposed and missing, or at least broken up, the middle portion being intact. Some bones were highly crystallised. Others had deposits of lime on their upper surface. Yet others, which was rare, were spongy in texture; and a few were heavily impregnated with iron.

Site M 3 (745 feet), on the Lindi road near M 1, produced a femur in poor condition seven feet long, which was the longest I found. There was a small humerus close to it, and, besides other very damaged bones which were not removed, an enormous vertebra was found in good condition at a little distance. Here the deposit was sand.

Close to M 3 was M 4 (765 feet), where a small femur twelve inches long and a corresponding humerus were found, together with the bones of some larger animals which were so damaged and scattered that their removal seemed to fulfil no useful object.

Site M 5 (635 feet), on the north side of Tendaguru, was a hillside working just above a small watercourse. It promised well at first with the discovery of a short line of small vertebræ; but all subsequent bones were mere fragments, and, as the deposit was one of much-contorted clays of a great variety of colours, it was abandoned.

Site M 6 (700 feet), on the west side of Tendaguru hill, only produced many scattered and unassociated bones in sand and clay. Many were in good condition, and so were taken. It was here that numerous belemnites were found, indicating that a salt-water estuary had reached as far as this side of the hill.

M 7 (740 feet), on the western slope of Tendaguru hill, was the most interesting site of all on account of the large bones it yielded as well as other objects. I had from the first been desirous of digging into Tendaguru hill itself, standing as it does on the top of the deposits, and for the additional reason that if cut into deeply the bones found might have escaped the destructive action of root penetration.

Though at the time of my departure the work of cutting

into the hillside had not reached a point beyond the reach of tree roots, which in this dry climate go down very far, the results were satisfactory. Two bone levels were exposed at a vertical difference of about three feet. The upper level yielded the bones of one or more very large dinosaurs. A femur measured 5 feet 7 inches (67 inches) and weighed nearly four cwt. when plastered, and a humerus about 5 feet long, with the ends incomplete, were among the finds on this level, besides some ribs and vertebræ. The stratum was a greenish-grey clay. This clay rested on a sand bed, and here at the meeting of the two strata other bones of an apparently different type of dinosaur were found. On this lower level too, and near the bones, lay a tree-trunk 26 feet long with peat adhering, numerous bivalve shells of small size, traces of lignite, and impressions of plants. Horizontal progress here was necessarily slow owing to the great amount of earth that had to be pulled down and removed; and when I left the excavation was still in the foothills with some 30 or 40 yards to go before the actual base of the hill itself could be reached with its almost vertical sides. Here digging would practically have to cease, as the removal of a whole hill to look for bones would be too expensive an undertaking.

Besides the bones found at M 2 which showed traces of violence, I found later a complete skeleton which also bore traces of violence which had occurred at or immediately after death. This skeleton, of which the site was M 8 (S.S.E. 755 feet), was lying fairly complete with most of the bones in their proper relative positions. The tail lay straight out to the length of 11 feet from the end, unbroken and on one level. At the 11-feet point a break occurred. Its total length was about 15 feet, and this interval represents where near its junction with the body the tail had been pressed down some two feet into the ground. It had not been completely severed, but two vertebræ nearest the pelvis were hanging vertically; there were two or three at the bottom, and one or two nearly vertical against the upper one joining the unbroken part of the tail. It was just as if at death or shortly after some other huge dinosaur had set its foot on the tail in passing and pressed that part of it down into the mud.

This skeleton was a fairly large specimen, perhaps 40 feet long including neck and tail, but of slender build. The femur, which was rather slender, measured 51 inches, the scapula 44½ inches and the humerus 33 inches. The fore-part of the body was on a slightly lower level than the hind-part, and the head and neck, which were displaced, were in such a position as if it had died in drinking or trying to drink water. The displacement of these bones would be readily accounted for had they lain in running water while the main body of the skeleton lay on dry land or at least dry mud. In the circumstances several solid masses of mixed bone had to be plastered, my hope being all the time that the skull would be found therein, as a small portion seemed to indicate. Another and perhaps the most interesting feature in this skeleton, which lay as a whole on a reddish-brown clay somewhat darker than laterite, was that enclosing the bones was a green matrix which did not exist apart from the bones. It almost looked as if the flesh in this case was never completely decomposed, but was subjected to some chemical action which partly preserved it, though I failed to detect the skin of the animal. The upper surfaces of the bones, including the tail, were mostly without this matrix, which adhered more to the sides and under-part. In the case of two limb bones one above the other brown clay was interposed between them, the matrix being on both bones, which seems to confirm that this matrix was formed independently of the stratum. I never found another similar instance among all the bones I excavated. Usually they lay in a soft greenish-grey clay or in sand, both of which might be easily scraped or brushed off. Only a few were in a hard sandstone which could not be readily removed.

Of the remaining five sites, four of them near one another and north of Tendaguru hill, M 9 (710 feet) and M 10 (690 feet) yielded a few bones, but none were of particular interest. M 11 (710 feet) yielded a compact mass of fragments of some organism in a pavement-like form, the thickness being only from about one to two inches. It extended in patches of several square feet over a distance of some twelve feet each way, and lay on a bed of sand. With it were found a few decomposed bones and a large claw.

At M 12 part of the skeleton of a small dinosaur was forthcoming, the bones being in good condition; and M 13, the last excavation I made before I left, on one of the ridges running down to the west, yielded only a solitary small femur, but in perfect condition.

In excavating these dinosaurs and working among their bones a curious sensation comes over one. One begins to feel oneself actually to be in that remote age when mammals as yet were not and man was not, perhaps I might say, even thought of. To students of anthropology the Pleistocene age extends far back in the history of the world; but even the earlier Pliocene age, so very remote to the anthropologist, has no existence to the palæontologist working in the world of the dinosaurs. In those Jurassic days the sun rose and set as it does now. There were cloudy days and days on which it rained. The moon shone at times; and the vault of the heavens with its twinkling stars must have looked much as it does now. Trees and other plant life grew luxuriantly. There were insects, land and sea shells, crustaceans, fish—as well as huge reptiles in the waters. Yet all of these would have made no mental impression on the small-brained and thick-skinned yet mighty dinosaurs that were the highest development of animal life then existing. Might it not be that the creating cause then felt something was wanting? In any case there succeeded a radical change in the life on the earth. Reptiles were no longer to dominate it. These huge monsters, together with their smaller kindred, had their day, and, having been weighed in the scales and found wanting, passed away.

Nevertheless there are not a few reptiles left in the world at the present day. Perhaps these survivors had some merit which enabled them to pull through when others failed; and what is perhaps curious is that some of the existing reptiles, so far as present knowledge goes, have increased in bulk since the day their ancestors were contemporary with the extinct dinosaur. I refer to the crocodiles, the pythons and other great serpents, and perhaps some of the great tortoises may be included. It is to be noted though that whilst most of the great dinosaurs of old are reputed to be vegetation eaters,

the surviving great serpents and crocodiles are flesh eaters. Absence of brain power may have had something to do with the vanishing of the dinosaurs, even though some reptiles still survive in spite of the fact that they are not to be compared in this respect with mammals. The brain of all the dinosaurs was extraordinarily small. A reptile weighing several tons would have a brain the size of a man's thumb or less. Such a diminutive brain was probably capable of doing little more than affording a motive power to the eyes and for operating the other senses. The main brain, if one may so call it, lay at the base of the spine near the pelvis. Here was seated all the acquired knowledge of the race, so that it may be inferred that these creatures performed most of the functions of life instinctively. Any knowledge acquired became in course of time an instinct. Of course their mode of life was simple. In fact it would consist of little more than feeding and procreating, and as regards the vegetarians, probably owing to their bulk, steady feeding during all hours of daylight was a virtual necessity.

In all I found parts of three or four small skeletons which seemed to be those of youngsters, the bones being apparently the same as those of the larger specimens, and they were mixed up with the larger bones as if they had perished with their elders. I have hopes that the position of at least some of these smaller bones may serve to indicate that the associated larger bones are those of a female dinosaur, and that perhaps a slight distinction from those of the males may be observable. The problem will be simplified by the fact that the small bones include the femora, which are generally the best preserved.

Most people are now fairly familiar with the general aspect of the dinosaurs as reconstructed, though increased skeletal material to hand has caused the earlier reconstructions in the last century to need revision. Imagine, however, a two-legged reptile kangaroo-like in form, sitting up on its tail and waving its small fore-limbs twenty feet above your head, with its own face and long neck looking around another twenty feet higher and trying to find the small object—yourself—which he has missed. Other four-footed ones pounded along waving their long necks from side to side. Yet others with

fore-limbs longer than their hind ones carried poised on a long vertical neck a small head that gazed round on all sides with an inquisitive look. Some were cased in extraordinarily heavy armour, as if the thick skin common to most of them were insufficient. One may ask, against what was it insufficient? Were there then mosquitoes and other biting flies of extraordinary size and ferocity?

These dinosaurs, and certainly the flesh eaters, fought among themselves. Their existence often depended on it. Assuredly too at least the males of the peaceful vegetation eaters also fought among themselves. The fact that they did so has considerable bearing on the state of the remains at the present day. Whilst some of the flesh eaters had large heads and formidable jaws, the vegetation eaters had mostly small heads, and coupled with the fact that these monsters possessed a thick and hard hide, the only vulnerable part of them would be their head. On this the carnivorous dinosaur would direct his attack, the only defence the other had being to keep it clear by means of his long flexible neck. When feeble with old age the end would come swiftly. Further, the head of such a species as the brontosaurus, being very small, would soon be bitten off any individual that died a natural death. To this reason may perhaps partly be ascribed the great number of dinosaurs in all parts of the world which have been found headless.

Up to the present in the Tendaguru deposits no dinosaur eggs have come to light. In fact there are two disappointments in connection with the work here. This is one. The other is the exceedingly few fragments of skulls that have been found, the reason for which I have already given.

I must now make a few remarks on the field work and other circumstances attending the expedition. Fragments on the surface often, but by no means always, give an indication of bones below. At the least they may indicate that there are bones at no great distance either horizontally or vertically.

When a site has been decided on and opened up there are many things to be done before a single bone can be removed.

The site must receive a number and a notice-board be put up. Failure to do this makes it difficult for others coming after if there has been a discontinuance of work. An early duty, depending largely on the weather, and also the state of the bones themselves, is their protection until the time of their moving. This is best done by giving their exposed surface a coat of shellac as they lie. When a sufficient number of bones are exposed a plan has to be begun, made to scale, showing the position and appearance of every bone found. Each bone then receives a label on which is written its position on the plan. No bone should be removed until it has been labelled. At this stage bones may be brought into the shed —planks, trays, iron dirt-carrying bowls or any useful receptacle available being used for the purpose. Here they are cleaned and prepared for packing. Delicate or much-broken bones are best set in plaster of Paris, thus making a solid block of them before removal. The process is as follows: The bone is pillared by the surrounding earth being dug away, and is left poised on its own original site. Having been well brushed it is sprinkled with water and tissue-paper laid on, which prevents the plaster from adhering to the bone. Next short strips of canvas, say, 8″ × 4″, are dipped in wet plaster of Paris and laid upon the paper, one strip overlapping the other. The reason the canvas is put on in small pieces is to facilitate pulling off afterwards. The upper surface is then left for a day or two to dry. Some strength is already given to the bone, which may be increased by using splints. After this the bone is carefully turned over and the underneath part similarly plastered. Finally, when quite dry the bone can be handled readily with safety, and can be put on a plank and carried to the shed. In digging great care is naturally required. Heavy pickaxes may be used until bones are found, when light pickaxes must be substituted for them, and when getting out the bone itself nothing but awls and brushes should be used. The safety of the bone is more important than speed.

Whilst digging on level ground is an easy matter, cutting into a hillside presents difficulties. Great quantities of earth have to be removed, and with care; and it is never possible

to leave the bones in position until one can view the whole skeleton. A bone has to be extricated and taken away as soon as found to make way for the diggers to get at the cliff face again. Hence precise charting of the finds is not easily done; and the relative vertical position of the bones is as important as the horizon.

After the bones have been brought into the shed the principal work on them begins. They have first to be scraped and brushed quite clean. The one original label put on in the field to cover a mass of fragments is now not enough, and all the larger pieces have to receive a separate label, which is gummed on. Besides, the original label has probably faded if it was left lying out for some time. Then all the pieces of fragments have as far as possible to be laid out in position and joined only with gum, so that they can be easily separated when they arrive at the Museum and a permanent adhesive used when the time comes to set them up. Gum is not usually strong enough for big pieces of bone, so for these a thin glue may be used. The bone is now possibly in condition to be identified and may be packed, all unjoined fragments being put with it, as a further study later may enable their correct position to be ascertained.

It has not usually been the practice in excavation work to carry on all the year through. Coming out as I did, however, shortly before the rainy season, I decided to venture on it,—with quite satisfactory results. The rainfall was not excessive, and even an occasional flooding of a working did not delay progress for more than half a day, as the parts that could not be drained were soon baled out. For this reason I established continuous work, which of course doubles the possible output for the year.

There was no made road suitable for loaded motor lorries from Tendaguru to its port Lindi, though two light cars did on one occasion succeed in getting through. Hence the bones had to be carried down by the labourers of the expedition, who took it in turns to go, which was a safer method than motor transport on a bad road. As far as possible the bones were packed in single head loads of about half a cwt. each, and empty kerosene or petrol cases were bought up in Lindi

for this purpose. They were taken to pieces and carried up in bundles by the returning men. These boxes are not strong enough to stand a voyage by sea, so big packing-cases were made at Lindi, the planks being bought as far off as Nairobi, and into each of these, made exactly to fit, three kerosene boxes were dropped. No repacking of the smaller bones was therefore necessary at Lindi. The large bones, which were all plastered, travelled down made up into bundles with grass and bamboo and tied on to long poles, and on arrival packing-cases were made to fit them. About every three months, depending on the very irregular steamship service to Lindi, a consignment went home to the Museum.

I was able to obtain all the labour I needed, and found an average of forty men sufficient for all purposes, including transport, these being distributed in parties of ten or less in one place. Their output was about the maximum I was able personally to deal with. Having been accustomed to the more intelligent natives of West Africa, I found the East African natives somewhat trying. The enormous difference in brain power is, of course, not apparent to Europeans who only know East Africa; and I think from a superficial study of their crania that it is scarcely possible for the East African natives to rise to the mental level of those in West Africa unless a very general fusion of tribes takes place.

My labourers were drawn from several different tribes, principally from the Wa Muera, Wa Yao and Wa Ngoni. A few of the original men with whom I started settled down to the work well and were still working at the end of twelve months. These had, of course, become useful and earned more pay, and I always gave an increase of 2*s*. after six months' continuous work, making their wages, ration money included, 20*s*. a month. I insisted on full time, and an absence from work entailed an invitation to go and seek employment elsewhere where full time was not demanded. The natives in this part of the country like to work a short time and then go away, either resting or working elsewhere. I always refused to take back a man who left merely because he thought he would like a change. The workmen therefore in time recognised that if they had a good thing it was as well to keep it.

I further endeavoured to give them good houses and to encourage them to bring their wives and children.

Food was a difficulty, and in the dry season the water, never plentiful, had to be used carefully. Hence incidentally my attempt at a vegetable garden was not a success. The country would produce plenty of food if it were only grown; but the local population is inert. Everything, therefore, had to be bought at Lindi and carried up to Tendaguru. Were the local Administration to put it to the chiefs that adequate supplies of cereals and other food must be grown, it would be done. Even fowls, eggs, etc., could only be obtained rarely and from considerable distances. None of the chiefs in the neighbourhood of Tendaguru were ever helpful in the least degree, either in the matter of food supply or labour supply, even if they were not the reverse.

As to game, the immediate neighbourhood of Tendaguru is not well supplied, and I was rarely able to supplement my larder with even a pigeon, though a few miles off guinea-fowl and bush-fowl were not unobtainable. The smaller antelopes were rare, but eland used to pass by in small herds at the period of the new grass. Elephants, chiefly females with young, used occasionally to come near, and an occasional lion might be heard roaring at night.

The net result of the first twelve months' work of the expedition since its resumption, is that 431 boxes or packages of bones were sent down to the coast, requiring 530 carriers to take them. In addition a small botanic collection of about 400 different plants was made. In other branches of Natural History, however, it was not possible to make collections, one reason at least being that the immediate neighbourhood of Tendaguru did not provide any appreciable quantity of material to work on.

Of the European staff, Major T. Deacon, who followed me out, was mostly at Lindi and went home a short time before I did.

On my departure, in anticipation of the exploration of Tendaguru being continued, I left the work in the hands of Mr. G. W. Parlett and Mr. W. Kershaw, who joined the expedition locally.

This dinosaur field is by no means worked out. One might say it has only been scratched. That future work will yield many duplicates of the species already found is only to be expected; but it would be a serious loss to the scientific world if the area were exploited on lines of only taking certain bones and abandoning all the rest to perish from exposure, simply because no immediate use can be made of the output. To cover up bones again is not the same as leaving them untouched. There is probably enough material at Tendaguru to supply all the principal museums of the world with specimens, and the Administration should see that any persons or institutions excavating bones there in future do not do so wastefully.

F. W. H. MIGEOD.

P.S.—Plants identified up to date by the staff of the Geological Department of the British Museum are *Sphenopteris fittoni* Seward, and *Sphenopteris aff. fontanei* Seward. Mollusca are *Trigonia* sp. and *Mytilus* sp.