Mertensia longissima, Kze.; *Lycopodium spectabile,* Bl.; *L. trichiatum,* Borg. We also meet still with *Phacellanthus multiflorus,* a *Carex, Polygonum corymbosum,* and *Imperata arundinacea.* A species of *Antennaria* and *Anaphalis,* among Composites; and certain Ericaceæ appear; also *Leontopodium*; *Elsholtzia elata*; *Wahlenbergia lavandulæfolia,* DC.; *Ophelia javanica*; *O. cærulescens,* Zoll.; *Melastoma setigerum,* Bl., the cells of which are said by M. Zollinger to contain crystals of pure sulphur; *Medinilla javensis,* Bl.; *Rubus lineatus,* Reinw.; besides other genera and species.

3. *Exterior region.*—This region gradually loses itself in the ordinary forest vegetation. Some rare Mosses, Ferns, and Orchids appear at the outer portion of the region. Among other plants may be noticed *Synœcia* (*Ficus*) *diversifolia,* Mig.; *Rhododendron javanicum,* Reinw.; *Agapetes elliptica,* Don, &c. Amongst the common arborescent plants may be mentioned *Agapetes varingiæfolia,* Don, and *Myrsine avenis,* Bl. The beautiful *Albizzia montana,* Bth., a social plant; *Casuarina montana,* Lesch., and *C. Junghuhniana,* Mig., are on the outer part of the region. We find also here an arborescent *Bœhmeria* and a dwarf *Epilobium.* Some twining plants form transition species, such as *Nepenthes gymnamphora,* Bl., and some varieties of *Polygonum corymbosum.* The order Ericaceæ is the predominant one. The genus *Rubus* is well represented. The Orchid that approaches nearest the craters is *Thelymitra javanica,* Bl.

III. *The Lotus or Sacred Bean of India.*—Dr. Buist gives some notes on the Lotus or Sacred Bean of India in the Transactions of the Bombay Geographical Society. Dr. Lindley is mistaken in saying that the wicks used on sacred occasions by the Hindoos are made of the spiral vessels of the leaves of the Lotus. They are formed, he says, of the dried flower or leaf-stalk. Dr. Buist does not believe that all the spirals of all the Lotuses in India, from the Himalayas to the Line, would make a lump of wick a yard long the thickness of the finger. Individually, the spirals are finer than gossamer; the leaf is 14 to 16 inches in diameter; the stalks about 6 to 8 feet long, and seldom rise higher than 2 or 2½ feet above the surface of the water. The leaf is buoyant enough to support a crow, and is frequently made use of by that bird as a fishing station, from which flies, snails, or water-lizards are preyed upon. The flower has something of the smell of the Tonquin bean, or the blossom of the bean. The upper surface of the leaf is a deep green.

MISCELLANEOUS.

PROF. OWEN'S LECTURES ON PALÆONTOLOGY.

The ninth Lecture, on Oolitic Crocodiles, delivered on the 29th April, concluded as follows:—

Since the publication of the remarks on the cranial structure of the Whitby Teleosaur in my 'Report on British Fossil Reptiles,' of 1841, I have had many opportunities of studying the osteology of the head in that and other species of *Teleosaurus* from British strata, especially of remarkably perfect skulls obtained by H. Moore, Esq., from the Lower Oolite of Somersetshire.

The following is the cranial structure in the *Teleosauri*, according to my present knowledge.

The occipital region, as in modern Gavials, is very broad in proportion to its depth. The foramen magnum is the sole vacuity in its bony wall, and is bounded by the ordinary occipital elements; the hind surface of the skull is completed by the parietal, the mastoids, and the tympanics.

The basioccipital developes the main part of the condyle, which forms somewhat more than the lower half of a hemisphere; the two upper angles being contributed by the exoccipitals. Near the upper part, which enters in a small degree into the formation of the great foramen, the condyle usually shows a small central pit. Below and in advance of the condyle, the basioccipital expands and bifurcates into two very short and thick diverging hypapophyses with rough truncate terminations; their bases converge forwards, forming the sides of a deep groove, at the fore part of which are two orifices leading to air-cells in the basioccipital.

The broad extended bases of the exoccipitals articulate with the sides of the condyle and of the hypapophyses of the basioccipital, and, after a slight contraction, each exoccipital rapidly expands and branches into three short and broad processes. The upper and inner one curves upwards and inwards to complete the periphery of the foramen magnum by uniting with its fellow above that aperture. The second extends outwards, and forms the compressed horizontal plate articulating with the lower and hinder part of the ridge of the mastoid: a vascular foramen and a deep and smooth notch divide this from the lower and third process, which represents the paroccipital: this part articulates by a broad overlapping sutural surface with the tympanic.

The groove dividing this surface from the paramastoid process is the back part or wall of the meatus auditorius.

The exoccipital thus articulates with its fellow and the superoccipital above, with the basioccipital below, and with the mastoid, alisphenoid and tympanic externally. Its internal surface is smoothly excavated, posteriorly, for the epencephalic cavity, and irregularly excavated anteriorly for the acoustic cavity. The epencephalic surface is perforated by small foramina for the roots of the ninth nerve.

The superoccipital is a depressed transversely extended bone, with an outer vertical subrhomboid surface: it articulates by broad sutures to the exoccipitals below and to the parietal above: the under surface, in advance of the exoccipital suture, is smoothly and deeply excavated, to form the roof of the epencephalic chamber; the sides of the bone are excavated by sinuses from the acoustic chamber.

In regard to the occipital elements, the Teleosaur differs from the Gavial in the division of the hypapophyses, and hereby more resembles the Lizards than the Crocodiles, in which the two processes are blended together in a thick descending mass: the paroccipital is equally developed with the paramastoid in the *Teleosaurus*, in which the latter process stands out clear of the tympanic: in the Gavial and modern Crocodiles, the paramastoid is much more developed than the paroccipital process, and it also articulates with the tympanic. In both the Teleosaur and Crocodile, the paroccipital process is divided from the paramastoid process of the exoccipital by the groove which forms the back wall of the meatus auditorius.

The basisphenoid presents a moderately extended, smooth and free or non-articular inferior surface, divided by a median ridge: each half of the surface contracts as it rises outwards, and is concave. The posterior angles of the basisphenoid are wedged into the fore part of each hypapophysis of the basioccipital, the rest of the posterior surface of the basisphenoid having a broad sutural union with the basioccipital. The upper and hinder part of the sides of the basisphenoid articulate with the alisphenoids; below and in front of this articulation is the sutural surface for the pterygoid: the upper surface of the basisphenoid forms the floor of the mesencephalon: its substance is largely excavated by productions of the auditory chamber.

The alisphenoid contracts a little after it rises from the basisphenoid, being notched behind for the meatus, and in front for the trigeminal nerve: it then rapidly expands in antero-posterior extent, but ends about half-way up the temporal fossa, uniting with the parietal above, the orbitosphenoid in front, the mastoid and exoccipital behind: below it articulates chiefly with the basisphenoid and a little with the pterygoid.

The parietal is a single, symmetrical, elongate-quadrate bone, contracted at the middle, with the angles produced. Posteriorly it forms the upper ridge of the occipital surface, overhanging the superoccipital, and overlapping the inner ends of the mastoids. The upper surface is extensively impressed by the crotaphyte surface: a very narrow longitudinal tract, becoming in old *Teleosauri* a ridge, divides these surfaces. The lower boundary offers two wide and shallow emarginations, the dividing angle projecting into the suture between the ali- and orbito-sphenoids. The anterior border is notched on each side to receive a process from each frontal. The under surface of the parietal contributes a narrow, elongated, slightly concave tract to the upper wall of the cranium. The parietal rests almost equally on the ali- and orbito-sphenoids.

The mastoid is a triradiate bone; its shortest ray descending obliquely outwards and backwards, to terminate the strong ridge for muscular attachments formed chiefly by the exoccipital: the broadest ray extends forwards, forming the hinder half of the upper zygoma: the sharpest and longest ray extends upwards and inwards to form the outer and greater part of the superoccipital ridge, which sharply divides the occipital from the temporal surface. The zygomatic part of the mastoid is sculptured on its outer surface. The mastoid unites with the parietal, alisphenoid, exoccipital, tympanic, squamosal and postfrontal: it forms the angles of the back part of the skull, and knits strongly together the contiguous bones.

On comparing the parietal segment of the skull in the Teleosaur and existing Crocodiles, the first difference to be noted is the greater proportion of the external surface of that region of the skull which is contributed in the Teleosaur by the basi- and ali-sphenoids: they maintain more of their normal shape and proportions in the ancient Crocodiles. In the modern ones the lower surface of the basisphenoid is little more than the edge of the wedge, just expanding enough at its middle to contribute part of the eustachian outlet, with a scanty portion of a free smooth surface, on each side, in the Gavial. The alisphenoid in modern Crocodiles has the whole of its outer surface broken up into irregular parts of the auditory cavity: it offers no surface of attachment for the crotaphyte muscles. The sides of the parietal descend much lower, to compensate for the restricted outer expansion of the alisphenoid. The parietal is much shorter, has a broad and flat sculptured quadrate surface between the temporal fossæ; and the posterior margin does not overhang, but is a little in advance of the superoccipital.

The Gavial differs from the Crocodile in the greater outward production of the posterior angles of the parietal, and in that respect more resembles the Teleosaur. The parietal of the Teleosaur retains more of the normal type: it is not, however, perforated as in Enaliosaurs and Lacertians.

The presphenoid is represented by a pointed styliform compressed production of the basisphenoid.

The orbitosphenoid is of great fore-and-aft extent, deeply excavated internally where it forms the side of the widest part of the cerebral cavity, protecting, as in the Crocodile, the cerebral hemispheres: externally the bone is convex vertically, concave lengthwise; expanding anteriorly to form the back part of the orbit, uniting with the parietal and frontal above, with the alisphenoid behind, and with the basi-pre-sphenoid below.

Traces of the frontal suture remain longer in the Teleosaur than in the Crocodile, especially on the inner surface; but the frontal is a single bone long ere the Teleosaur is adult. It is of an elongate subhexagonal form, the long lateral borders emarginate for the orbits: the posterior border is notched at the middle, and is impressed on each side of the upper surface by the fore part of the temporal fossæ: the broad interorbital tract is flat: the inferior cerebral surface is long and narrow, bounded laterally by moderately curved sharp vertical ridges, convex towards each other, concave towards the orbits.

In modern Crocodilia the vertical diameter of the orbitosphenoids exceeds the longitudinal one: the frontal is not impressed by the temporal fossæ, and the interorbital space is concave through the elevation of the upper borders of the orbits.

The postfrontals have their sculptured outer surface almost vertical in the *Teleosaurus*: it is horizontal in modern Crocodilia: in the Teleosaur it is produced much further back, and forms a larger proportion of the upper zygoma: it is also continued upon the descending process which joins the malar, whilst in modern Crocodilia this process is smooth, and is more or less overhung by the sculptured horizontal surface of the postfrontal. In this respect the Teleosaur manifests its more general or lacertian character.

The prefrontals have a short, broad, facial plate, and appear to have had a much shorter descending neurapophysial plate than in modern Crocodiles; their orbital border is not produced or raised, as in the Gavial.

The nasals are relatively broader behind than are those of true Crocodiles and Gavials, and resemble the latter in their non-extension to the anterior nostril; their proportion, as to length, much resembling, in *Teleosaurus latifrons,* that of the nasals in the *Gavialis gangeticus.* They overlap a considerable extent of the bifurcated anterior end of the frontal.

The premaxillaries are shorter in proportion than in the Gavial; but, as in that animal, they wholly surround the external nostril, which is terminal, and its plane nearly vertical, instead of being horizontal. The end of the muzzle, so formed, is less expanded than in the Gavial; so that the Teleosaur must have been able to breathe by protruding from the surface of the water a much less proportion of the muzzle than the Gavial does; but it must have raised the head more obliquely in the act.

The maxillary bones are of great length. They unite with each other above, along a tract varying in length in different species, between the premaxillaries and nasals; they unite behind with a great proportion of the nasals, with the lacrymal, and with the malar.

The lacrymal extends much more forward than the prefrontal, being continued, in a pointed form, in advance of the small vacuity, or quasi-nostril, which is left between the nasal, the lacrymal and maxillary.

The malar, which begins below this vacuity, without entering into its formation, has its narrow anterior part wedged between the lacrymal and the palatal process of the maxillary: it bounds the lower part of the orbit, joins the broad descending process of the postfrontal, and is continued, as a straight slender bar, to join, underlapping, the lower end of the squamosal, completing with this bone the lower zygoma. Neither the lacrymal nor the malar develope any outstanding plate where they form the orbit.

The squamosal is a very small bifurcate bone: its back part unites with the outer side of the tympanic condyle, whence the larger branch extends obliquely upwards and forwards to the junction of the mastoid and prefrontal; the lower and shorter branch extends directly forwards, overlapping the hind end of the malar.

The bony palate is imperforate where it is formed by the premaxillaries, maxillaries, and fore part of the palatines: these latter bones are broader and flatter than in the Gavial: the vacuities between them and the ectopterygoids are narrower in the Teleosaur: but the most important modification of this part of the skull in comparison with modern Crocodilia, is shown in the much larger relative size, more advanced position, and more horizontal plane of the true internal or posterior nostril; which is surrounded, not in every species exclusively by the pterygoid, but having its pointed anterior end produced between the diverging hind ends of the palatines.

The eustachian outlet, regarded by Professors Bronn and De Blainville as the true posterior nostril, is shorter and wider than in the Gavial: the posterior primary division of the eustachian canal penetrates the basioccipital and expands there into a subcircular sinus: the anterior primary division perforates the substance of the basisphenoid and ascends obliquely forwards a little way before bifurcating to form the anterior canals leading to the right and left tympanic cavities, which are extended by the production of its air-cells across the basioccipital and basisphenoid, and upwards into the tympanic, mastoid, alisphenoid, exoccipital, superoccipital, and parietal bones.

The temporal fossæ vary in shape in different species of *Teleosaurus*, being subquadrate in *Tel. latifrons* and *Tel. Cadomensis*, oblong in *Tel. Chapmanni* and *Tel. brevior*; but they are always relatively larger and with the upper outlets closer together than in the Gavial. In most old and large *Teleosauri* the parietal is reduced to an intermuscular crest between them; as is the mastoid, between their back part and the occipital fossa. In general the upper zygoma is on a lower level than the parietal, not as in modern Crocodilia on the same level. The orbits, of a full oval form, look more outwards than upwards; their rim is sharp, and not raised above the level of the rest of the skull.

The true external nostril is single, as in other Crocodilia; but is terminal, as above mentioned.

Rudiments of the divided nostrils, situated as in *Ichthyo-* and *Plesio-sauri*, a little in advance of the orbits, are present in most *Teleosauri*. I conjecture that they were not used as nostrils, but are a typical retention of a structure, indicative of the closer affinities of the *Teleosauri* to the *Nothosauri* and *Enaliosauri*.

The modifications of the cranium of the Teleosaur, compared with the modern Gavial, all bespeak its better adaptation for swiftly cleaving the liquid element. The upper jaw, not suddenly, but gradually, expands into the orbital region, and is not marked off by any outstanding plates of prefrontal, lacrymal, or malar. The cranium behind the orbits, moreover, goes on expanding to the occipital plane, instead of contracting, or retaining its sides parallel, as in the Gavial. The sloping of the sides of the temporal region, where it is formed by the broad upper zygoma, is another modification which would favour the progress of the head in a movement tending to roll it from side to side, as it was pushed through the water. The diminished expanse of the premaxillary end of the muzzle in the same degree decreases the resistance of this part during aquatic progress. All these cranial modifications harmonize with the amphicœlian vertebral column, the very small fore limbs, and comparatively large hind limbs in a crocodile organized for marine existence.

The lower jaw presents the same complex structure as in modern Crocodiles; a large vacuity also intervenes between the subangular, angular, and dentary elements. The ramus is of relatively greater depth at this part in some *Teleosauri*, e. g. *T. brevior*, than in the

Gavial. In *Tel. brevior* and in *Tel. latifrons*, the rami unite to form a symphysis as extended as in the Gavial; but in some other species, *Tel. temporalis*, e. g., the free portion of the ramus is longer.

The teeth of the *Teleosauri* are more numerous, more slender, less compressed and more sharply pointed, than in the Gavial; they are slightly recurved, and the enamelled crown is traversed by more numerous and better defined longitudinal ridges, two of which, on opposite sides of the crown, are more produced than the rest. The fang is smooth, cylindrical, and always excavated at the base.

The teeth of the *Steneosauri* are thicker in proportion to their length, and larger and fewer in proportion to the jaws; but their transverse section is also, as in *Teleosauri*, more circular, or less elliptic, than in the Gavial. In both genera of Liassic and Oolitic Crocodiles, the teeth have a closer resemblance to those of the *Notho-*, *Pisto-*, and *Plesio-saurus* than the teeth of modern Gavials have. In these the modification consists in the compression of the crown, rendering the opposite ridges trenchant edges.

In *Teleosaurus Chapmanni* I have counted $\frac{46-46}{48-48}=188$ teeth: in *Tel. latifrons* $\frac{36-32}{38-38}=144$ teeth: in *Tel. Egertoni* $\frac{39-39}{38-38}=154$: Cuvier has assigned to the *Tel. Cadomensis* $\frac{45-45}{45-45}=180$ teeth. The above formulæ will not be found constant in different individuals of the same species, by reason of the uninterrupted and irregular shedding and replacement of the teeth; but the numbers indicated in the British fossils are those of the sockets, some of which always appear empty. When these, however, have been scrutinized, they have given evidence that the same law regulated the succession of the teeth at the ancient period when Crocodilians prevailed in greatest numbers and under the most varied generic and specific modifications, as at the present day, when they are reduced to a single procœlian family, forming, as Linnæus believed, a small section of his genus *Lacerta*.

Comparing, agreeably with the principle which has governed my illustrations in the present Course of Lectures, the present and past forms of Crocodilians, I would say that, in the modern Gavial, the two lower processes of the basioccipital have become blended into one descending mass of bone: the paramastoid has been developed at the expense, as it would seem, of the paroccipital process. The basi- and ali-sphenoids become contracted, and cease to present those proportions of the external surface which they do in the more typical Teleosaurian skull: the parietal, by way of compensation, descends lower down the temporal fossæ; but it is much restricted in length, and more flattened above. Every trace of those vacuities which hold the position of the pair of nostrils in the Plesiosaur has disappeared in modern Crocodilia. Their sole external nasal aperture is somewhat raised upon the upper surface of the end of the snout, so that, with the head parallel with the surface of the stream, the nostril alone can be raised to inhale air, or can be lifted out of the water at the same time that the high-placed prominent eye is opened above the surface of the water. The border of the orbit is raised for that purpose, so as to bring the eye to the summit of the head in modern Gavials and Crocodiles,—conditions for speedy progress through water being sacrificed for other advantages, necessitated perhaps by the more formidable enemies that modern Crocodilia have to encounter, as compared with ancient ones, and by the frequent position of those enemies on dry land. With the *Teleosauri*, the danger would come most probably exclusively from *Cetiosauri* or huge *Ichthyosauri* cleaving the same element. Accordingly the eyes looked outwards rather than upwards, and the outer surface of the head was evenly shaped and expanded to concur with other modifications of their frame for swift natation.

As we discern, therefore, in the upraised orbits of modern Crocodilia, their advantage in being able to peer abroad and scan the banks of their stream with the least possible exposure of their head, and connect that advantage with the position of the formidable enemy to which they are now exposed ; so, likewise, we discern in the shortening and expansion of their jaws, the enlargement and strengthening of their teeth, and the development of certain of these into canine-shaped tusks, a relation to a source of food in the coexisting Mammals, which would seem not to have existed for the *Teleosauri* ; if, indeed, large quadrupeds of the Mammalian class coexisted at all on the land washed by the ancient seas in which the *Teleosauri* seem habitually to have dwelt.

The pterygoids in modern Crocodiles are so developed in breadth and length as to carry back the inner nostril much beyond its position in *Teleosauri* ; and the pterygoids are united together to such an extent as much to reduce the size of that aperture. This contracted posterior nostril is associated in modern Crocodiles with a peculiar development of the base of the tongue and soft palate, which shuts off all communication between the cavity of the mouth and the air-passage from the nose to the windpipe. Hence, while the crocodile is holding under water a struggling and drowning quadruped, the water in the mouth of the crocodile cannot flow into the glottis ; and, if the raised nostril on the upper surface of the skull be protruded, air can be inhaled into the lungs without any need for relaxing the grip of the prey and closing the mouth. Supposing the *Teleosauri* to have subsisted exclusively on fishes or aquatic animals, as the gavial-like length and slenderness of their jaws and their numerous sharp serial teeth would indicate, such departure from type as the pterygoid developments in modern Crocodilia would not be needed ; and we again discern in the latter their relation to the higher forms of animal life with which those Crocodilia are now associated.

And these indications collaterally bear very significant evidence against the inference, based on the insecurity of negative evidence, that Mammalian life may have been as rife in Oolitic and Liassic times as at present, only not yet discovered.