November 24, 1914.

Prof. E. A. MINCHIN, M.A., F.R.S., Vice-President, in the Chair.

Mr. E. T. NEWTON, F.R.S., F.Z.S., exhibited a series of bones of animals showing indications of natural repair, and a number of teeth of a female Sperm-Whale (*Physeter macrocephalus*).

Purpose and Intelligence in the Foraminifera.

Messrs. E. HERON-ALLEN, F.L.S., F.Z.S., and ARTHUR EARLAND, F.R.M.S., discussed the Phenomena of "Purpose" and "Intelligence" exhibited by the Arenaceous Foraminifera in the construction of their tests. They observed that W. B. Carpenter had stated in 1885 that the highest development of function and behaviour of protoplasm in the Protozoa was to be found in the study of the Foraminifera, and they exhibited slides of porcellanous and hyaline species, calling attention to the fact that of two groups of the same Zoological Order, constructed of the same simple protoplasmic element and living under similar conditions, one group secretes calcium carbonate and the other strontium sulphate from the same sample of sea-water, for the construction of their shells.

The behaviour of many species of Arenaceous Foraminifera in constructing their tests reveals a development of "purpose" amounting to what in the Metazoa would be termed "intelligence." This display of intelligence and purpose takes two forms: (i) The exclusive selection of certain materials out of a preponderating mass of other and more readily utilizable materials; and (ii) the manner in which those materials are used. This latter is subdivided under two heads—(*a*) to meet the requirements of the organism in adapting itself to environmental circumstances, and (*b*) to protect itself against the attacks of parasitic worms and other enemies.

Lantern-slides were shown, and the actual specimens exhibited under microscopes upon the table, to illustrate the following phenomena:—1. The selection of magnetite by *Haplophragmium agglutinans* and of topaz and garnet by *Verneuilina polystropha*, for the construction and decoration (?) of their tests. 2. The utilization of foraminiferal shells by certain abyssal worms, and the method employed by *Pectinaria auricoma* in "laying" fragments of sponge-spicules of even length in the construction of its tube. 3. *Psammosphæra parva* Flint, which builds a monothalamous shell of sand-grains round a long sponge-spicule, which is used as a "catamaran" spar to buoy it up upon the bottom ooze. 4. *Psammosphæra bowmani* Heron-Allen & Earland, which constructs its shell of flakes of mica cemented together at their edges to form a transparent polyhedral test. 5. *Psammosphæra rustica* H.-A. & E., which constructs a polyhedral test between long "catamaran" spicules, filling the interspaces with fragments of spicules of graduated length and occasionally using a triaxial spicule to fill an awkward space or angle. 6. *Nouria harrisii* H.-A. & E., which supports itself, aperture uppermost, upon the mud by means of spicules projecting at the aboral end of the test. 7. *Haliphysema tumanowiczii* Bowerbank, which protects its aperture from parasitic worms with an investment of projecting spicules. 8. *Crithionina pisum* Goës, var. *hispida* Brady, 9. *Pilulina jeffreysii* Carpenter, and 10. *Hyperammina ramosa* Brady, which protect themselves with a close investment of spicules all over their shells. 11. *Marsipella cylindrica* Brady, which protects its aperture with a crown of loosely aggregated spicules. 12. *Marsipella spiralis* H.-A. & E., which arranges the spicules of which it is constructed in a left-handed spiral to give tensional strength. 13. *Technitella legumen* Norman, which constructs its shell of fragments of spicules in two layers, the inner layer being laid at right angles to the outer. 14. *Technitella thompsoni* H.-A. & E., which selects from the environmental material for the construction of its test nothing but the perforated plates of an ophiurid or echinoderm.

In the opinion of the authors, "purpose" and "intelligence" are revealed by these phenomena. If they depended on surface-tension, all the individuals in a dredging would exhibit the same phenomena, and the theory of natural selection resulting in the survival of the fittest is met by the reply that these selective and purposive individuals constitute a marked minority in the dredgings in which they are found.

An interesting discussion followed, in which, amongst others, Sir H. H. Howorth, F.R.S., Sir E. Ray Lankester, F.R.S., and the Secretary took part.

Egg of the New Guinea Rifle-bird.

Mr. D. Seth-Smith, F.Z.S., Curator of Birds, exhibited an egg of the New Guinea Rifle-bird (*Ptilorhis intercedens*) which had been laid in the Society's Gardens in July last. The bird that laid it belonged to Mr. E. J. Brook, F.Z.S., who had kindly lent it in the hope that it might pair with a male belonging to the Society. While in Mr. Brook's aviaries in Scotland, this bird paired with a male of its species, and in 1911 and 1912 constructed a nest and laid eggs, but in both cases they were infertile.

The birds were placed last spring in the Summer Aviary, where they appeared to do well, and in July the female built a nest, composed of dead leaves and dry grass, in a bush, about five feet from the ground, and laid two eggs. She sat well and was not disturbed in any way, but about three weeks after the eggs were laid they were apparently thrown out of the nest by the sitting bird, for they were found broken upon the ground. Neither appeared to have been fertilized. The one least damaged was saved.

This is the first instance of any species of Paradise-bird laying in these Gardens, and the eggs laid in Mr. Brook's aviaries were the first ever laid in captivity. The bird that laid these eggs was captured on the nest in New Guinea by Mr. Goodfellow, and the nest and two eggs upon which she was sitting are now in the British Museum.

The egg is very similar to that of the Greater Bird of Paradise (*Paradisea apoda*), and, so far as we know, characteristic of the whole group. The ground-colour is cream, bold streaks of reddish brown radiating from the larger end and overlaying fainter splashes of pale grey.

Dental Variations in Mammalian Skulls.

Dr. Robert Broom, C.M.Z.S., exhibited :—

(1) A number of skulls of *Trichosurus vulpecula* illustrating dental variations. Normally upper p^1 is situated 2·5 mm. behind the canine. Two skulls exhibited show it from ·5 mm. to 1 mm. behind the canine. One skull shows on the left side p^1 closely pressed against the canine, and on the right side the two teeth fused together. Another skull shows the p^1 entirely absent. In the lower jaw normally the small tooth behind the large incisor is close to it. One jaw shown has the second tooth 2 mm. behind the large incisor. A second jaw has 2 mm. behind the normally placed second tooth a third small tooth, which may be either a third incisor, a canine, or a first premolar.

(2) A skull of *Phascolarctus cinereus* showing in the right lower jaw a small tooth behind the large incisor, resembling in position the second tooth in the mandible of *Trichosurus vulpecula*.

(3) A series of skulls of *Chrysochloris hottentota* and *C. asiatica* illustrating the peculiar loss of teeth found in nearly all sexually mature Moles in the Stellenbosch district, S. Africa. As Dr. Broom pointed out in 1907, *C. hottentota*, when probably two years old and when in full sexual activity, suffers from a disease of the gums, probably pyorrhœa, and the teeth become loose and fall out. The disease appears also to damage the developing second set, which never fully replaces the lost milk set, and hence specimens are found where the disease has been arrested in a practically toothless condition.

It is very interesting to note that these toothless specimens appear to be in fairly good health. In their stomachs are the remains of worms broken into segments, as in the fully toothed individuals.

Though specimens in a similar condition have been obtained from other parts of S. Africa, they are rare.

Chrysochloris asiatica rarely suffers with its jaws, but a specimen was exhibited in which the disease had led to extensive injury to the bone.

(4) A skull of *Chrysochloris hottentota* with only eight teeth in each upper jaw, though there are the normal nine on each side of the lower.

A new Thecodont Reptile.

(Text-figures 1, 2.)

Dr. Broom also exhibited the skull of a new type of Thecodont reptile (*Youngina capensis*) from the Upper Permian beds of South Africa, and remarked:—

"Hitherto, though there has been some evidence of the occurrence of primitive Thecodonts in the Karroo beds of Upper Permian age, no satisfactory skull has been known. Some years ago I described the two types, *Heleosaurus scholtzi* and *Heleophilus acutus*, both of Middle Permian age, and Watson is describing another form of the same age which may be allied. Unfortunately, little is known of the skull in any of these types.

The new form which I am exhibiting was found by me at New Bethesda, Cape Colony, in beds which are in the *Cistecephalus* zone, at least 600–1000 ft. below the *Lystrosaurus* zone, and most probably belong to the Upper Permian age.

The specimen consists of the almost perfect skull of a small crocodile-like reptile, with a considerable series of vertebræ, but unfortunately with no satisfactory remains of limbs or girdles.

The skull measures about 60 mm. in greatest length, and is 42 mm. in width. The tip of the snout is missing, but as the anterior ends of the lower jaws are preserved, very little can have been lost.

The orbits, which are situated near the middle of the skull, are large and are directed upwards and outwards. The antero-posterior diameter of the orbit is 17 mm. The interorbital width is about 8 mm.

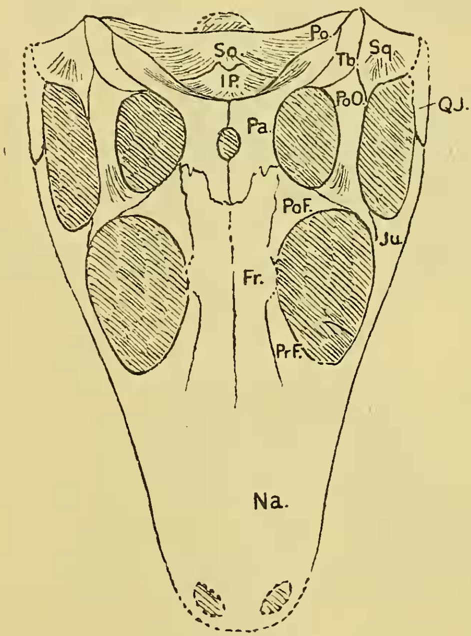
Behind the orbit is an infratemporal fossa slightly smaller than the orbit, and a supratemporal fossa about a third of the size of the infratemporal.

The premaxillaries are lost but must have been small.

The nasals are imperfect and crushed; they are manifestly fairly large. The nostrils must be situated well forward.

The maxilla is long and narrow, and on the right side shows 16 rounded pointed teeth. The complete series is probably about 21, a number evidently having been shed and were being replaced. The posterior end of the maxilla passes under the orbit, and has a long articulation with the jugal.

Text-figure 1.



Upper side of skull of *Youngina capensis.* About $1\frac{1}{2}$ times nat. size.

Fr., frontal; IP., interparietal; Ju., jugal; Na., nasal; Pa, parietal; Po., Paroccipital: Po.F., postfrontal; Po.O., postorbital; Pr.F., prefrontal; Q.J., quadratojugal; So., supraoccipital; Sq., squamosal; Tb., tabular.

The lacrymal is not well preserved on either side, but is manifestly small.

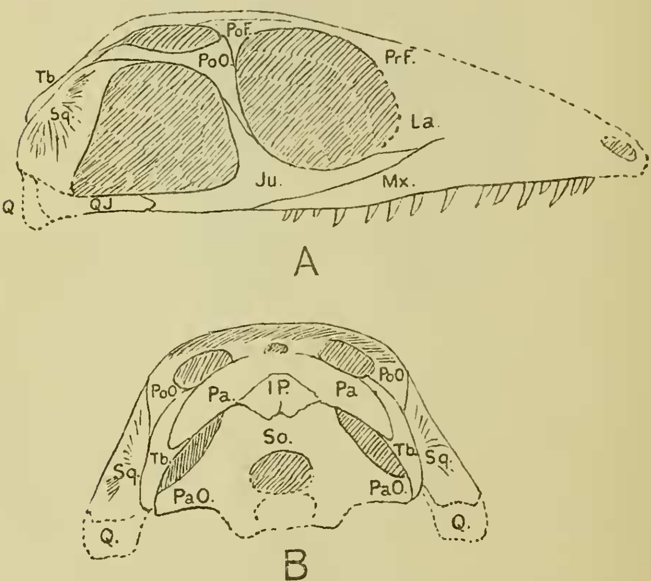
The prefrontal is a fair sized element. It forms the upper and anterior border of the orbit, and, with the postfrontal, nearly shuts out the frontal from the orbit.

The frontal is moderately large. It extends in front a little beyond the plane of the front of the orbit, and behind as far as the plane passing through the front of the pineal foramen.

The jugal is a long triradiating bone. Its anterior process forms the lower border of the orbit, and passes forward between the lacrymal and the maxilla. The ascending process passes up behind the orbit to articulate with the postorbital; while the posterior process forms the lower border of the infratemporal fossa, and lies above and internal to the quadratojugal.

The postfrontal is a small triangular bone which forms the upper and anterior border of the orbit, and the anterior border of the supratemporal fossa. It articulates with the frontal and parietal internally, and the postorbital externally.

Text-figure 2.



A. Side view of skull of *Youngina capensis*. About $1\frac{1}{2}$ nat. size.
B. Occiput of *Youngina capensis*. About $1\frac{1}{2}$ nat. size.

IP., interparietal; Ju., jugal; La., lacrymal; Mx., maxilla: Pa., parietal; Pa.O., paroccipital; Po.F., postfrontal: Po.O., postorbital; Pr.F., prefrontal; Q., quadrate; Q.J., quadratojugal; So., supraoccipital; Sq., squamosal; Tb., tabular.

The postorbital is moderately large. It forms part of the postorbital margin and most of the bar between the two temporal fossæ. The posterior process is well developed and passes back between the squamosal and the tabular.

The parietals are smaller than the frontals. Between them is a fairly large pineal foramen. The posterior process of the parietal is directed outwards and backwards, as in lizards and *Sphenodon*, and rests on the bone which I believe to be the tabular.

The structure of the post-temporal region is a little difficult to make out, but as it is well preserved on both sides the difficulty consists largely in distinguishing cracks from sutures, and I think there is practically no doubt but that the elements are as I have figured them. Whether my interpretation of them is correct is, of course, another matter.

Forming the posterior border of the infratemporal fossa is a fair sized triangular bone, which I believe to be the squamosal. It articulates above with the postorbital, and below it probably articulates with the quadratojugal. The quadrate is very largely hidden by it.

With the posterior end of the jugal articulates an element which I believe to be the quadratojugal. Unfortunately its posterior portion is not seen on either side. It cannot be a part of the element which I identify as squamosal. The relations of the quadratojugal, squamosal, and jugal are somewhat similar to those in *Sphenodon*.

Along the upper and posterior side of the squamosal lies another element of considerable size, which I believe to be the tabular. In front it meets the postorbital, and its inner side is partly covered by the posterior process of the parietal. Posteriorly it articulates with the paroccipital (opisthotic).

Behind the parietals and above the supraoccipital is a fair sized and certainly distinct interparietal. Possibly it is paired.

The occiput, though fairly well preserved, does not show the limits of the various elements. The supraoccipital is low and broad; the exoccipitals are probably small, and there are short paroccipitals directed backwards and outwards. Between the sides of the supraoccipital and the tabulars are a pair of narrow fossæ. On the whole the resemblance of the occiput to that of the lizard is considerable, the presence of a distinct interparietal being the only important difference.

The mandibles, though present and complete, have not been cleared of matrix, as it would be difficult to do so without injuring the teeth, and the presence of the mandibles renders it impossible to display the palate.

For this new reptilian type I propose the name *Youngina capensis*, in honour of the late Mr. John Young, LL.D., F.G.S., Under-Curator of the Hunterian Museum, Glasgow University, to whose early assistance and kindly encouragement I am mainly indebted for my interest in palæontology.

Though *Youngina* cannot be placed close to any previously well-known type, we can nevertheless give it a fairly definite place in the reptilian series.

If we exclude the Cotylosauria, the Therapsida, the Chelonia, the Ichthyosauria, and the Plesiosauria, all the remaining orders may be grouped together as reptiles with two temporal arches or modifications of the same type. In *Sphenodon* we have a simple modification of the type; in the Crocodile another, and in the Lizards a third where the lower arch is lost. Among extinct forms we have many other modifications. The Phytosaurs and Pseudosuchians afford the best known Triassic types, and other varieties of the type are seen in the Gnathodonts and the Dinosaurs. *Youngina* represents a type more primitive than any previously known, and one which is especially important in that it is very near to the ancestral form.

The Pseudosuchian, *Euparkeria*, which I recently described from the South African Upper Triassic beds, bears considerable resemblance to *Youngina* but is very manifestly a much later type. It has lost the large pineal foramen seen in *Youngina*, and the post-temporal region differs considerably through the loss of the tabular, the reduction in size of the squamosal, and the increased development of the quadratojugal and quadrate. Yet such a type as *Euparkeria* might readily be descended from a form like *Youngina*.

Euparkeria further represents a type from which the Theropodous Dinosaurs might be derived, but is too far advanced to have been ancestral either to the Sauropoda or Predentata. *Youngina*, on the other hand, retains the characters that we require in the ancestor at least of the Sauropoda, and possibly also of the Predentata.

But the most interesting point in the structure of *Youngina* is the light it throws on the origin of lizards.

No point in reptilian structure has given rise to so many different opinions as the nature of the post-temporal region in lizards. In *Sphenodon* there is no difficulty. There is low down an undoubted quadratojugal, and between this and the parietal a single large bone which is unquestionably the squamosal. In the typical lizards, on the other hand, between the top of the quadrate and the parietal are two small bones, and the difficulty is to determine which is the squamosal. The upper and inner bone has been regarded as the squamosal by Gegenbaur, Baur, Gaupp, Case, and Watson; the lower and outer by Parker, Huxley, Cope, Boulenger, and Williston. Until a year ago I favoured the view of Baur, but the study of the Mosasaur skulls in the American Museum led me to adopt the view of Williston, that the outer bone is the squamosal and the inner the tabular.

About a dozen years ago I made a study of the development of the pterygo-quadrate bar in a number of lizard types, and found that the lower end of the quadrate is fixed to the lower end of the epipterygoid by a small bar of cartilage almost exactly as in *Sphenodon*. So strikingly similar is the condition that it seems extremely probable that there was in the ancestral lizard a lower bar as in *Sphenodon*.

While *Youngina* is certainly not a lizard, it throws very definite light on the nature of the lacertilian post-temporal bones. The upper arch is formed mainly by the postorbital but partly by a lower bone which I regard as squamosal. Whatever this lower bone is, it is quite certainly the homologue of the outer post-temporal bone of the lizard, and as there is a quadratojugal still lower down, it cannot be the quadratojugal. From its relations to the quadrate, there seems little doubt but that it is correctly identified as the squamosal.

The bone internal to it may be the so-called "supra-temporal," but from its articulating with the paroccipital it seems much more likely to be the tabular.

Youngina may be regarded as the type genus of a new family, which may be called Younginidæ, and it must also be placed in a new suborder of the Thecodontia, which may be called the

Eosuchia.

The Eosuchia may be defined as Thecodont reptiles which have no antorbital vacuity, and retain the interparietal and tabular bones, and have a large pineal foramen."