and other physical observations which were made will be published in well-arranged form. At the furthest point reached, a bread bag filled with the scrapings of the pannikins and a little pemmican was lowered to the bottom of the sea, and, having been kept there for some hours, was hauled up, and was found to be almost alive with numerous small crustaceans and foraminifera. With the thermometer a series of temperatures was taken at every ten fathoms, while the specific gravity of the surface-water was also obtained. Tidal action was apparent, though it was impossible to collect any exact data.

Capt. Markham, like his relative, Mr. C. R. Markham, is evidently of opinion that the Eskimo entered America from Asia, spreading eastward, and finding their way to Greenland by crossing at almost 81° 54′. This is, we confess, the theory which most readily presents itself, but those who have studied the subject most deeply, and in all its aspects, have come to the conclusion that the Eskimo are virtually indigenous, and came northwards from the American continent itself, the migration being from America to Asia, and not the other way. Indeed, some ethnologists go so far as to maintain the essential unity of origin of all the American families, and that all the differences in physique, language, &c., may be explained by differences of environment. In the case of America, probably, more than anywhere else, language is a really important factor in the ethnological problem. (See Prof. Sayce's article last week on "The Ethnology of North-West America.")

Capt. Markham gives an extremely pleasant account of the winter amusements on board the *Alert*—the Royal Arctic Theatre, the Thursday Pops., the school for the men, &c. The last-mentioned institution appears to have been a great success, and we are sure the men will feel the benefit of it all their lives. One feature of the Thursday Pops. we must mention with special approval; except on the evenings exclusively devoted to the legitimate drama, these entertainments were always preceded by a lecture delivered by one of the officers on some interesting and at the same time instructive subject, adapted to the knowledge and intelligence of the audience. In this way thirteen lectures were given altogether, and with the exception of one on a historical subject by Mr. White and one on Sledging Experiments by Capt. Nares, they were all on scientific subjects. Capt. Nares began the series by a lecture on Astronomy, which was followed by lectures by the other officers on Magnetism, Geology, Meteorology, Steam, Mock Moons under the Microscope, Light, Astronomy again, Food in the Arctic Regions, Arctic Plants, Hydrostatics. Indeed it is difficult to conceive that more could have been done to enable the expedition to pass as cheerful a winter as possible under the circumstances.

Altogether Capt. Markham's work is a thoroughly interesting and instructive narrative of a memorable expedition. The numerous illustrations and the maps add considerably to its value.

ON THE STRUCTURE AND DEVELOPMENT OF THE SNAKE

IN my paper on the skull of this type (see abstract *Proc.* Roy Soc., January 10, 1878, pp. 13-16) I spoke of the snake as "lying at the very base of the *gill-less* vertebrata, and possessing a skull at once the simplest and yet the most curiously specialised," of any of the many kinds I have worked out.

As far as existing forms of reptiles are concerned, the snake does lie at the *very base*, yet, on the whole, I am inclined to add it to the other limbless lizards, such as the blind-worm and the amphisbæna, and to consider it, therefore, as a lizard which has had its limbs starved out for special purposes.

Much of the cranio-facial axis of the snake remains in a very primordial condition, but the outworks of the skull are modified to such a degree that "the power of nature could no further go."

I have not yet worked out the skull in the amphisbænidæ, but I expect to find it to have many things in common with that of the serpentiform amphibia, the "Cœcilians."

But the "Anguidæ," taking the common blind-worm (*Anguis fragilis*) as an example, are merely "Scincoids" that have dropped their limbs but retained their limb-girdles: they are *lizards* to all intents and purposes, and the native kind only differs from its quadrupedal relatives, in possessing an additional segment ("mesopterygoid") in the "pterygo-palatine" arcade, a segment common in osseous fishes and birds, but suppressed, as a rule, in the scaly reptiles.

As to that which is *archaic*, the chameleons so common in Africa, and the unique New Zealand Hatteria (*Sphenodon*), these outliers of the lizard tribe are evidently more generalised than the serpents.

But all these forms—snake, tropical lizard, legless lizard, and old aberrant lizards—all these come as close to the bird as the *pupa* of a dragon-fly does to the *imago* of the same insect.

With regard to the earlier stages and to the mode of development of the embryo, generally, I have stated in my paper (pp. 9 and 10), that "As to the general embryological study of the snake's embryo, it may be remarked that it is almost exactly that of the birds. Comparing my own observations on this low type with the results given in the study of the chick in Foster and Balfour's excellent work, I find that few paragraphs in it would need any material alteration, and that the figures would mostly serve very accurately if in that work the word *chick-* were to be exchanged for that of *snake*-embryo. The development of the vesicles of the brain, the organs of special sense, the rudiments of the cranium and face—those things that come across my path, to say nothing of the rest of the growing germ, all are developed similarly in the snake, below, and in the bird, above."

If this be so, the modifications undergone afterwards, in the specialisation of the skull and skeleton generally, and in the appearing and packing of the enclothing muscular masses, those "cunning machines" that do the gymnastics of the body—the development and endless modifications of these parts must be of the greatest interest.

I must refer to Professor Huxley's paper "On the Classification of Birds" (Zool. *Proc.*, 1867, pp. 415-418) for a comparison of the bird with the reptile, and for the reasons existing that have led modern anatomical zoologists to put the reptiles and birds into one group, viz., the "Sauropsida."[1]

With regard to the loss of limbs it is not a little remarkable that, on the theory of the "Ratitæ" being parental to the "Carinatæ," in the bird class, that pair of limbs which was to be most metamorphosed was not quickened into new life until it had died. Morphogically, the wingless *Dinornis* stands directly beneath the whole of the "winged fowl" known to us, and the steps and stages from that monster up to the sun-bird and the humming-bird are very gentle and gradual.

But there were *reptiles* in the olden times "that spread their limber fans for wings," and there were true birds also which had evidently only just escaped from the reptilian territory, as the *Archæopteryx*, for instance, and these are seen to be actually modifying the paw into a *wing*.

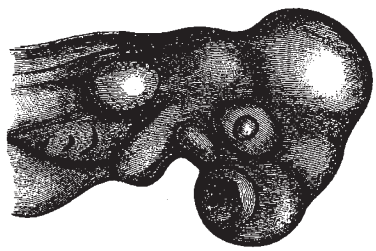
Perchance the birds grew out from many a kind of old generalised reptile; yet, be this as it may, the eagle himself is not a more powerful or beautiful creature than a python or a boa, nor is there much more to wonder at in

[1] That account of the "Sauropsida" needs a little modification in the light of newer discoveries. I have given such an *improved* account in my article on the Anatomy of Birds in the ninth edition of the "Encyclopædia Britannica," vol. iii., p. 278.

the manner in which the morphological force has enclothed a vertebrated animal in the case of the bird than in that of the huge "creeping thing."

Certainly the skull is in some respects much more simple in the serpent than in the bird, for the bird having built up its skull with all the old reptilian architectural elements, afterwards blots out their distinctness for the most part, and only leaves marks here and there of the early subdivision of the parts.

But this is due to "the hot condition of their blood" and, especially in the higher kinds, the "altrices," the life-vessel of a bird almost literally boils over; in a few short weeks the shapeless embryo of a swallow or a swift is able to join the "airy caravan" of its migrating parents



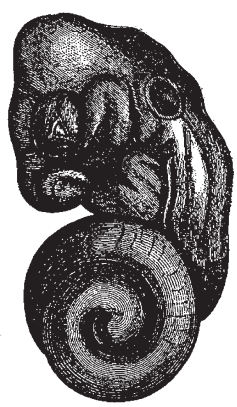
Head of Embryo Snake, 1 inch long, magnified 8 diameters.

and relations "high over seas," and in far distant countries seek for perpetual summer.

The great serpent, I ween, took a century or two to finish in its fulness his huge bulk; time, so important to the "turtle, and the crane, and the swallow," could be of no importance whatever to pre-Adamite boa-constrictors and pythons. Was not the whole jungle theirs, and theirs also every kid and fawn, to say nothing of the luckless unwary bird?

That the spinal column is as complete and beautiful a piece of machinery in a boa-constrictor or ordinary snake as in the bird there can be no doubt.

Talk of specialisation! Why, Prof. Owen's terms for the parts and processes of a snake's vertebra would take



Embryo of Snake, ¾ inch, magnified 8 diameters.

up half a column in a scientific glossary. I will give a few of his terms:—"Neural-spine," "neurapophysis," "post-zygaphophysis," "præ-zygapophysis," "zygosphene," "zygantrum," "procœlous," articular cup of "centrum," posterior ball for next cup of "centrum," "neural canal," oval articular head for ribs on each "diapophysis," and oval concavity on head of rib.

Four hundred vertebræ, most of which have all these parts! Surely this creature was made by Nature herself, and by no "'prentice hand."

The sinuous cylindroidal facets, fore and aft, on the bird's centrum are not a whit more perfect than the cup-and-ball of the snake's vertebra; and in all respects the articulation of the serpent's spine is so exquisitely perfect as to beggar all human inventions of joints and hinges.

Only just a little motion of joint on joint is allowed, each joint set into the other, so that nothing can part them without crushing them entirely; and yet a most perfect and delicate motion of cup in ball, wedge in cavity, and of the oblique overlapping facet on the oblique facet beneath it—all these are harmonised together, and just allow a gentle bend of bone on bone, and a gentle rolling of vertebra on vertebra.

Multiply by 400 this limited motion, this arrested curve, and you get a motion such as would, if likely to be applied to you, personally, make "all your safety to lie in remotion, and your best defence absence." The curve, so small as made by one joint bending on another, would, in its sum total, be sufficient to engirdle a luckless anatomist several times over.

In the bird's head nearly all the fair details of its early architecture are plastered over by *periosteal* bone, by the ruthless processes of a steady *ankylosis* that removes landmark after landmark.

Not so in the serpent, although, with a wise prevision (enough to satisfy the most craving teleologist, who, wondering, asks you if you see no *design* in Nature), ankylosis comes in to perfect the "strong box" in which this wise [cunning] creature keeps its limited brain.[1]

The organ of its mind is thus safely lodged so that no foot may crush or wild beast break its casket; thus with its "cruel venom" the adder "bites the horse heels so that the rider falls backwards," and is in no fear of that heaviest of all feet, the foot of the *soliped*.

The (relatively) deaf adder has its ear-organs encased in adamant; they with the cranial bones are "shut up together as with a close seal. One is so near to another that no air can come between them. They are joined one to another; they stick together that they cannot be sundered."

So much for the cranium proper; but how about the *face*?

The *face* is a loose framework of bones tied together into one piece of work by an infinite amount of "yellow elastic tissue," and the opening of the capacious "maw" is surrounded and defended by bars of ivory-like bone, many of which are beset with *retral* teeth pointed like needles and sharp as lancets.

Your serpent, with all his wisdom, does not "mouth" his words; he only hisses; but he *mouths* his prey as no other creature does; and the "shirt of Nessus" was not a more dreadful robe to wear than the distensible body of a python, inclosing, ingulphing, suffocating, and digesting its limp and helpless prey.

With regard to the relation of the snakes to the existing lizards, it is a remarkable fact that, whilst they have no tympanic cavity, in which character they agree with *Sphenodon* and the chamæleons, yet a small *cochlea* buds out from the vestibule, and there is to it a "fenestra rotunda." The chamæleon is void of this structure, and thus in that respect is as low as a frog.

The lower jaw and its pier (quadrate) was altogether directed forwards in the early embryo of the snake; afterwards the pier and the free mandible are articulated at a very acute angle, the squamosal touches the temporal regions by its apex, and to its base the long rib-like quadrate is articulated.

The quadrate thus is made to pass over the "columella auris," which also is directed backwards; on that rod there was a small "stylo-hyal"; the quadrate picks up this *useless remnant*, and glues it, by partial ankylosis, to its inner face.

Thus the counterpart of the human "styloid process" is ankylosed to the bone that answers to the *head* of the "malleus."

W. K. PARKER

[1] I am frequently asked whether I believe in *design*, and am always at a loss how to answer the question, it seems to be to me so perfectly gratuitous. If the questioner would but give me time, I would promise to write him a book upon the fitnesses to be seen in a *frog* or even in a *flea* that should be as large as a family Bible.