tance of one-and-a-half miles, while a 2500-pound bell would not set the same sand in motion at a distance of thirty yards.

It has been frequently observed that a distinct echo is sometimes obtained from the ocean. Prof. Tyndall thinks the reflection is from surfaces of wind. Prof. Henry thinks it is from the surface of the waves of the ocean, and that the sound is afterwards refracted by the wind.

In a paper *On the Tails of Comets*, Mr. Henry M. Parkhurst endeavours to give data for predicting the form and appearance of these appendages.

Thermo-electric Properties of Minerals, by Professors A. Schrauf and E. S. Dana.—The interesting investigations of the late Gustave Rose, an eminent mineralogist at Berlin, have, during two or three years past, excited considerable interest in this subject. He began with the fact first announced by Hankel that some crystals of pyrite and cobaltite are electrically positive and others negative, and the endeavour to explain this opposite character on the assumption that it was connected with a condition of the right and left hemihedrism characteristic of both species. This touches a fundamental point in molecular physics, and if it could be sustained, Rose's hypothesis would be very valuable.

Schrauf and Dana, however, after the examination of a large number of minerals, comprising nearly all the metallic sulphids, have come to the conclusion that the cause of the variation of electrical character in this species must be sought elsewhere. They attribute it not to an opposite molecular condition shown in the hemihedral crystals, but to a change in chemical composition. They call their attention, in the first place, to the series of Seebach, where, for example, platinum occupies a varying position according to its degree of purity; moreover, they urge that the single case observed by Stefan, where some specimens of granular galena are positive and others of crystallised galena negative, is strong evidence against the influence of hemihedrism, as nothing of the kind can be assumed here. The force of their argument lies in the fact that they have found several other well-defined cases of minerals having peculiar varieties, and that among minerals crystallising holohedrally. Chemical analyses were here desirable to show how far the material under investigation varied in composition. In the absence of these, however, the specific gravity was resorted to as an indicator of the chemical character.

This afforded decisive results of plus and minus varieties of species, showing a decided difference in density and implying a corresponding change in composition. This was true also, in a marked manner, of cobaltite, and in a somewat less degree of pyrite, showing in each case where the explanation for the electrical character was to be looked for.

Several other conclusions were deduced from the long list of observations contained in the paper, but the foregoing will be sufficient to indicate its principal points.

Distribution of American Woodlands, by Prof. Wm. H. Brewer, of New Haven.—The flora of the United States, the author said, is believed to contain over 800 woody species, and over 300 trees. Of these trees, about 250 species are somewhere tolerably abundant, about 120 species grow to a tolerably large size, 20 attain the height of 100 ft., 12 a height sometimes of over 200 ft., and a few—perhaps 5 or 6—a height of 300 ft.

Notes on Tree Growth, by Prof. Asa Gray, of Cambridge, Mass.—Whether the trunk of a tree increases in length, in the parts once formed, is still an open question in the popular mind. From careful observations made by Prof. Gray and many others, the conclusion is that the trunks of trees do not grow in length.

Natural History at Penikese, by Prof. F. W. Putnam.—In speaking of the method of teaching at Penikese School, Prof. Putnam said:—"Text-books are not allowed. Our way was to give each student a specimen of fish and ask him or her to study that fish and tell the instructor what had been observed. Thus we developed their powers of observation upon the external character of the fish. After they had studied the fishes for about two days, they were called upon to state what they had seen. Then the anatomy of the specimens was gone into, and the students were led on step by step until they had secured a very firmly founded idea of the structure of a vertebrate animal. Then we asked questions as to the character of vertebrates, and finally they began to be original investigators. We really demonstrated in a practical way the subject, which is exciting so much attention now, of co-education of the sexes. We found that the ladies of the school were as capable in every way of making careful dissections and rendering careful accounts of the work they had done as the gentlemen, and, in fact, four or five of the ladies became original investigators before any of the gentlemen. This showed conclusively that the ladies had the power of becoming original investigators in science if they only would give the application."

Organic Change produced in the Bee, by Sophie B. Herrick, of Baltimore.—This was a very interesting paper, containing the authoress's own observations and experiments on bees.

The Reversion of Thoroughbred Animals, by Prof. Wm. H. Brewer.—It is often claimed that if the care of man be withdrawn an improved breed will retrace the steps of its ancestry and revert to its original characteristics. For some years Prof. Brewer has been investigating this subject and seeking for proof of the alleged tendency to reversion. To carefully-worded inquiries in writing, following upon every report of such "reversion," Prof. Brewer has received very numerous replies, and they are unanimously in the negative. This is certainly remarkable, following upon the confident assertions that animals so frequently exhibited the alleged tendency. The inquiries were pushed in the specific localities where the reversion was said to have occurred; the questions have been put to a large number of stock-breeders, and finally have been made by means of a printed circular. But the result was always the same, except that a smile of incredulity extended over the faces of some stock-breeders when such inquiries were put to them, and they feared they were to be made the victims of a "sell." No instances of the alleged "reversion" having been authenticated in Prof. Brewer's experience, he asked the Association to aid in exposing and refuting the pernicious notion.

*REPORT OF PROF. PARKER'S HUNTERIAN LECTURES "ON THE STRUCTURE AND DEVELOPMENT OF THE VERTEBRATE SKULL"**

VII.—*Skull of the Snake* (Coluber natrix).

AMONG the most noticeable features of the Ophidian skull may be mentioned the ivory-like texture of the bones, the immense strength and compactness of the brain-case, and the equally remarkable mobility of the facial bones, the maxillary and palatine apparatuses and the lower jaw being arranged in such a way as to allow of the greatest possible extension of the mouth during deglutition. Another important characteristic is the bony completeness of the brain-case, which is as thoroughly closed in as that of a mammal, scarcely any part of its walls being formed in the adult either by cartilage or fibrous tissue; the inter-orbital septum, also, or laterally compressed anterior moiety of the basis cranii, so characteristic of the Sauropsida, is absent, the base of the skull being flat throughout, and abruptly terminated in front. But the most interesting and at the same time most anomalous feature is the persistence of the fœtal trabeculæ, in the form of two slender cartilaginous rods (Fig. 23, Tr), lying in grooves on either side of the parasphenoid.

The hinder part of the skull is formed by a well-ossified occipital segment, the four elements of which are firmly united with one another by suture; the single convex occipital condyle is borne chiefly by the basi-occipital, the exoccipital, however, taking a considerable share in its formation. The basi-occipital is continued forward by a broad, expanded, basi-sphenoid, produced anteriorly into a slender prolongation or rostrum (Fig. 22, Pa.S), which underlies the front half of the brain-case, and answers to the parasphenoid bone.

The parietals are completely fused together in the mid-line, where they are produced in the Pythons and Boas into a strong sagittal crest for the attachment of the temporal muscles. In their hinder half they are simply roofing bones, as in Lizards and Amphibia; but in front of the auditory capsule they extend downwards (Fig. 23, Pa^1) and meet the parasphenoid, forming with it a complete cylindrical cavity. The frontals, unlike the parietals, have only a sutural union with one another; but they, too, are produced downwards (Fr'), and, moreover, come into contact with one another below, above the parasphenoid, so as to form

* Continued from p. 250.

unaided the whole of the anterior third of the brain-case—roof, walls, and floor. There is yet another important feature in these curious bones—the cylindrical cavity which they enclose is divided in front by a double pillar of bone, to which each frontal contributes its own half, and on either side of which the olfactory nerves pass to the nasal sacs: in this way a remarkable resemblance, both in form and position, to the frog's "girdle-bone" is produced; an analogy, indeed, which only the study of

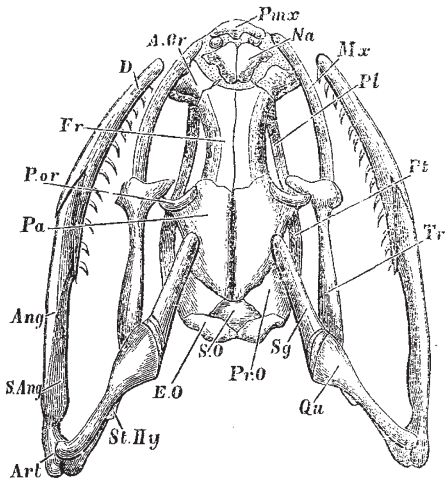

FIG. 21.—Skull of Snake (upper view). Tr, Os transversum

development can show to be as far as possible from a true homology.

Interposed between the anterior border of the ex-occipital and the posterior border of the descending portion of the parietal, is a stout irregular bone, which anyone studying the adult skull only would certainly look upon as the periotic or ossified otic capsule. As a

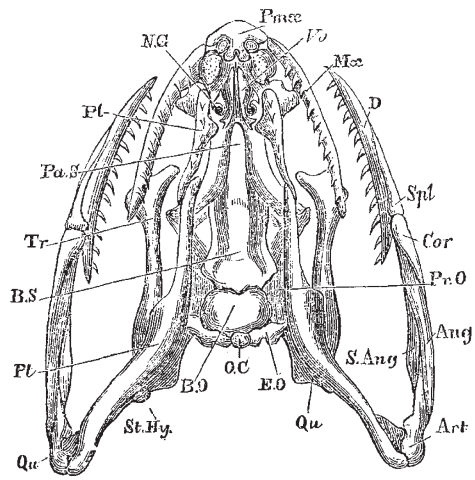

FIG. 22.—Skull of Snake (under view). Spl, splenial; Cor, coronary; Ang, angular; S.Ang, supra-angular.

matter of fact, however, it is both more and less than this. In the young state it consists of two perfectly distinct ossifications, between which the fifth nerve makes its exit. Now, this nerve (see NATURE, vol. x., p. 10) marks the line of demarcation between the posterior boundary of the parietal segment and the auditory capsule; the bone in front of it is, therefore, the alisphenoid, and that behind it the prootic, the latter being further determined by the fact that it lodges the main part of the vestibule, of the anterior and horizontal canals, and of the rudimentary cochlea. The remaining elements of the ear-capsule are, in the adult, quite undistinguishable; it is seen, however, that the arch of the posterior canal, as far forward as its junction with the anterior, extends into what appears to be the supra-occipital, and that the ampulla of the posterior and the hinder portion of the horizontal canals invade, in like manner, the ex-occipital. The explanation of this seeming anomaly—so common in the Sauropsida—is to be found in the snake at the time of hatching, when the pro-, epi-, and opisthotic elements are perfectly distinct from the neighbouring bones as well as from one another: as

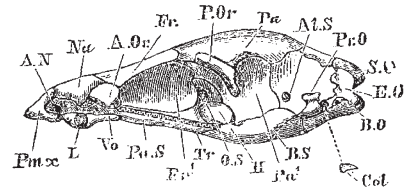

FIG. 23.—Skull of Snake (side view, with jaws removed). Col, columella, displaced from the fenestra ovalis, with which it is connected by a dotted line.

growth proceeds the epiotic becomes firmly anchylosed with the supra-occipital, and the opisthotic with the ex-occipital: the prootic, at the same time, remaining separate from the bones with which it is naturally related, acquires an intimate connection with the alisphenoid, forming with it the seeming "periotic" of the adult snake.

At the sides of the frontal region, and forming the anterior and posterior boundaries of the orbit, are two representatives of the "lateral line series" so prominent in osseous fish: these are the antorbital and the post-orbital. The antorbitals are large triangular bones, and between them lie the nasals, which together have a rhomboid form, and the inner edges of which are turned downwards, forming vertical plates similar to the inter-olfactory pillars of the frontals. In front of the nasals, and forming the termination of the snout, is the small toothless premaxilla, an azygos bone, with short nasal, maxillary, and palatine processes. The vomers are two hollow,

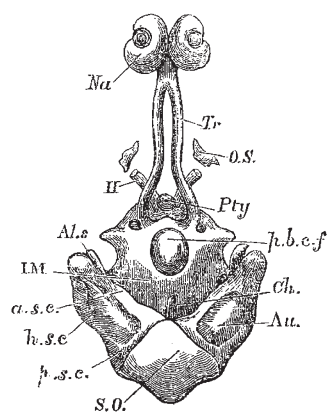

FIG. 24.—Chondro-cranium of Embryo Snake (upper view). p.b.e.f, posterior basi-cranial fontanelle.

scroll-shaped bones, bearing on their excavated upper surfaces the nasal glands; the ducts of these pass through a notch in the outer border of the vomers, which is converted into a foramen by means of a triangular ossification, the septo-maxillary, here attaining its greatest development. The duct of the nasal gland is also supported on the outer side by two labial cartilages (l).

The foregoing bones are all compactly united with one another; the remaining ones, forming the powerful manducatory apparatus of the upper and lower jaws, are articulated only by loose fibrous tissues, and are thus

rendered capable of the greatest possible amount of extension.

On the upper surface of the skull, clamping the lateral occipital region and projecting backwards for fully half its length beyond the latter, is the flat sabre-like squamosal (Fig. 21, Sq), articulated to the hinder end of which, and thus carried completely away from the auditory region, is the quadrate, a stout bone passing obliquely downwards and outwards, and giving attachment by a rounded pulley-like surface to the mandible. On the inner edge of the quadrate, and partly coalesced with it, is a small nodular ossification representing the stylo-hyal (Figs. 21 and 22, St.Hy). The palatines and pterygoids are well developed and bear large recurved teeth; the latter extend backwards to the quadrate, to which they are united by ligaments just above its articular surface. The maxillæ are large strong bones lying parallel with the palatines and the front half of the pterygoids, and forming an outer dentigerous arch. Between the hinder end of the maxilla and the centre of the pterygoid runs a stout bone, the os transversum, found in this distinct form in all Ophidia, as well as in Lacertilia and Crocodilia, and occurring as a rudiment in some birds.

The two rami of the mandible are united at the symphysis by elastic fibrous tissue only, and each consists of six separate ossifications more or less fused together in the adult. These are the articular (Art) coming into relation with the quadrate, the angular (Ang) and supra-angular (S. Ang) applied, one above and one below, to the outer surface of the articular, the dentary (D) bearing the teeth, and the splenial (Spl) and coronary (Cor) appearing only on the inner surface.

The columella or auditory ossicle is extremely small in the common snake (Fig. 23, Col), and consists of a plug of bone fitting into the fenestra ovalis by a rounded disc-like end, the stapes, and of an extremely short rod anchylosed with and projecting backwards from the disc, which is all that represents the stapedial bones of the frog. In many of the larger serpents, both venomous and harmless, the columella is a rod of very considerable length, tipped at its end, in some cases, by an expanded cartilaginous flap, the homologue of the extra-stapedial.

The earlier stages in the development of the snake's skull have been well worked out by Rathke ("Entwickelungsgeschichte der Natter"). Abstracts of his views will be found in Prof. Huxley's Croonian Lecture (Proc. Roy. Soc., 1858), and in the "Elements of Comparative Anatomy" of the same author (p. 237). The earliest stage described by the lecturer corresponds with Rathke's third period, when chondrification is already thoroughly established, and the slender trabeculæ have united behind with the investing mass, and in front with each other (see Fig. 24). The notochord (Ch) reaches only to the middle of the broad investing mass (I.M), a large membranous space, the "posterior basi-cranial fontanelle" of Rathke (p.b.c.f) being between its anterior pointed end and the "anterior basi-cranial fontanelle," or pituitary space. A large occipital ring is already formed by the growing up of the investing mass around and above the neural canal, and articulating with its edges are the sub-triangular auditory capsules, on which the elevations caused by the semicircular canals (a.s.c, p.s.c, h.s.c) are particularly well marked. The trabeculæ diverge strongly in the pituitary region, in front of it run almost parallel, having between them the tissue from which the parasphenoid is afterwards formed, and eventually unite and expand into the large reniform roofs of the nasal sacs (Na). The alisphenoids (Al.s) are already chondrified, but the orbito-sphenoids (O.s) are backward in development, being mere patches of indifferent tissue in front of the exit of the optic nerve (II). The mandibular arch is completely divided into a short quadrate and a long Meckel's cartilage. The hyoid arch is cartilaginous only in its upper part, and its apex is already fused with the stapes.

In the second stage all the bones of the adult have appeared with the exception of the alisphenoid, orbito-sphenoid, columella, stylo-hyal, and otic bones. The basi-occipital arises in the same manner as the urostyle of a frog or osseous fish,* as a bony deposit in the sheath of the notochord, affecting subsequently the surrounding cartilage; the basi-sphenoid makes its appearance as a pair of ossific centres, one on each side of the apices of the trabeculæ, where they join the investing mass. The parietals and frontals are quite normal in their development, arising as symmetrical ossifications in the supero-lateral region of the membranous cranium, and only acquiring their anomalous adult character by downward extension towards the base of the skull at a later period. In this stage a segment has separated from the hyoid arch and attached itself to the inner border of the quadrate: this is the stylo-hyal, the remainder of the arch now constituting the columella.

In the third stage, consisting of snakes at the point of hatching, all the ossifications have appeared, with the exception of the orbito-sphenoid, which is unusually late and uncertain in its development. Besides the three chief otic centres, which are perfectly distinct from the occipital regions, a plate of bone is to be seen in this stage within the lower edge of the squamosal: this answers to the ectosteal plate of the pterotic, so largely developed in osseous fishes. Lastly, the jaws have acquired their adult character by the loosening of the quadrate from the auditory capsule and its retrogression to its adult position, articulating with the hinder end of the backward-turned squamosal.

NOTES

A MOVEMENT which has been for some time on foot for establishing in London a School of Medicine for Women is now so far matured that the school will be opened for the winter term on Oct. 12, in commodious premises, 30, Henrietta Street, Brunswick Square. The full staff of lecturers has not yet been appointed, but among those who have already consented to take part in the instruction are Dr. King Chambers in the practice of Medicine, Mr. Berkeley Hill in Surgery, Mr. A. T. Norton in Anatomy, Dr. Sturges in Materia Medica, Mrs. Garrett Anderson in Midwifery, Mr. Critchett in Ophthalmic Surgery, Dr. Cheadle in Pathology, Mr. Heaton in Chemistry, and Mr. A. W. Bennett in Botany. The following gentlemen have, in addition, consented to serve on the Council:—Dr. Billing, Dr. Buchanan, Mr. Ernest Hart, Prof. Huxley, Dr. Hughlings Jackson, Dr. Murie, Dr. F. Payne, Dr. W. S. Playfair, and Dr. Burdon-Sanderson, as well as Dr. Elizabeth Blackwell. A fair number of students are already enrolled. It is intended to build a detached dissecting-room in the garden attached to the house.

DR. WILLIAM RUTHERFORD has been appointed to the Professorship of Physiology at the University of Edinburgh, vacated by the resignation of Dr. J. Hughes Bennett. Dr. Rutherford, in accepting his new appointment, vacates the Professorship of Physiology at King's College, London, the Assistant-Physicianship at King's College Hospital, and the Fullerian Professorship at the Royal Institution. The duties of the first of these will most probably be undertaken, during the coming session at least, by Dr. David Ferrier.

DR. ADOLF BERNHARD MEYER, the recent explorer of New Guinea, has been appointed director of the Zoological Museum at Dresden, in succession to Dr. Reichenbach, who has retired.

* In these types a variable number of vertebræ at the termination of the column undergo a process of absorption, and a single ossification appearing in the sheath of the notochord constitutes the urostyle or coccyx. In the head a similar process takes place at the anterior end of the notochord, where a number of vertebræ may be considered to have been suppressed, forming what may be termed a "cephalostyle": the bony deposit spreading from this into the investing mass, gives rise to the basi-occipital.