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Struthionida, it is not the strongest example of what a Bird's | the numer face of the drum cavity a large hole which leads skull may be. In a bird's-eye view we see the separate- to the two fenestree. The various bones of the palate are ness of the nasals, the nasal processes of the premaxillaries, the fore-end of the frontals, the top of the ethmoid, and the lachrymals (fig. 19, n.px., n., f., eth., l.). Below (fig. 20), the premaxillaries still have sutures with the palatines and maxillaries, and the latter has its jugal process, the jugal itself, and the quadrato-jugal, all distinct (px., pa., mx., j., q.j.)

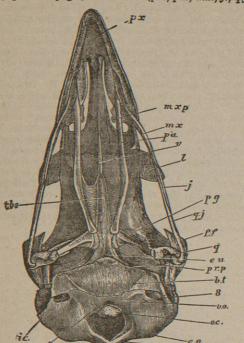


Fig. 20.—The same skull, basal view. Here the slenderness of the upper facial rods is in strong contrast with the massiveness of the skull itself. This skull is unusually schizognathous, the vomer (v.) being very small, and the maxiltopalatine processes (mx.p.) much aborted.

Moreover, the quadrate (q.), pterygoid (pg.), the palatines, and of necessity the mandible—all these retain their joints, and traces of the union of the mandibular splints are long retained (fig. 21, d., ar.). So also do the elements of the hyoid arch, soon to be described, remain separate.

The whole cranial box, and all the inter-orbital region, have become one bone, whilst the various fontanelles are filled in. In the specimen which has been figured the inter-orbital fenestra (i.o.f.) is partly open, but it is often obliterated. Also we see that free periosteal bony growths have bridged over the temporal fossa, the post-frontal or "sphenotic" having met and coalesced with a zygomatic process of the squamosal (p.f., sq.). In the lower view we still see the notochordal dimple on the transverse occipital condyle (o.c.), and the hinder margin of the basitemporal plate is still traceable in front of the passages for the vagus and the internal carotid burrows (i.c.) This thick bony mass is totally ankylosed to the basi-sphenoidal region above. The prootic and alisphenoidal regions are land-marked below by the foramen ovale (5), which is sometimes, as in Fishes, divided into two by a bony bar. So free is the bony growth that the basi-temporal has coalesced with the temporal wing of the exoccipital (b.t., e.o.), and in front of this bridge we see a number of passages, burrows, galleries, windows, &c., leading above to the upper tympanic recess, in front to the anterior tympanic recess,

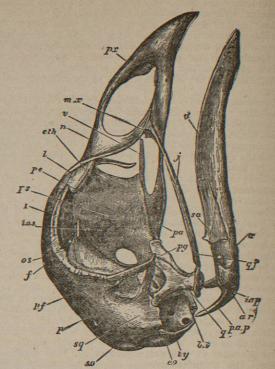


Fig. 21.—The same skull, side view, with the mandible a little dislocated. Hele the temporal fossa is bridged over by the junction of the post-frontal and squamosal processes (p,f,s_2) . The processes of the mandible (i.a.p., p.a.p.) are characteristic of this type, and of the Anserina.

scarcely in the least changed in form or relative size since the time of hatching (fig. 20), and the copious growths of cartilage belonging to the nasal labyrinth are always soft; these are not figured in the adult skull. There are, however, a few bony centres, the feeble representatives of the ossifications found amongst higher birds in this region. Thus, close in front of the broad wall-top of the ethmoid, in the substance of the septum nasi, there are two small ossicles, and on each side a similar bony point; the rest remained unossified, all save a small part of the attached margin of the pars plana.

.The attenuated remains of the second post-oral, and the larger third post-oral arch, contain persistent cartilage. The elegant "columella auris" (fig. 22) is bony where it fits into the fenestra ovalis (st.), and the shaft, up to its rays (m.st.), also; but the short, notched supra-stapedial (s.st.), the tongue-shaped and fenestrate extra-stapedial (e.st.), and the slender, combined infra-stapedial and stylohyal (i.st.), all these are still cartilaginous.1 The rest of the second post-oral is reduced to the arrowhead-shaped lingual bone, the coalesced and partly ossified cerato-hyals (c.h.), and an elegant ridged phalangiform basi-hyal (b.h.) The free end of the combined glossal piece is soft. There is no tympanic in the Fowl; only in the Peafowl have we found one, and it is behind the membrane. The next arch, the thyro-hyal (first branchial in Ichthyopsida), is composed of two almost equal rods; the upper is only ossified in its

distal third, and the lower is mainly bony; their basal gnathous, Ægithoguathous, and Saurognathous varieties piece is largely soft behind (fig. 15, e.br., e.br., b.br.).

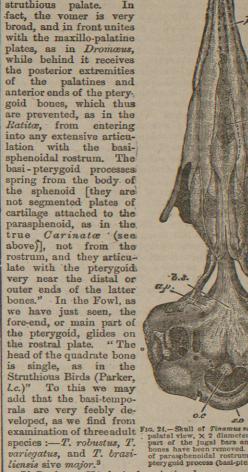
The skull of the Fowl, and of the Alectoromorphæ generally, differs in certain respects from that of other Schizognathæ. In the Gallinaceæ, as in the desmognathous Rapaces, the vomer is single; in Pigeons and Sand-Grouse it is absent; sst in all the others with open palates it is composed of two halves soldered more or less together. Some of the Schizoquathæ possess an "os uncinatum" -as the Albatross and the Gull-a bone to be described nereafter; and others possess a pair of bones attached to the double vomer, namely, the "septo-maxillaries," known in

Reptiles as the so-called "inferior Fig. 22.—Auditory "columella" of turbinals." These bones, very Chicken, ninth stage, × 6 diameters; lateral and basal views. small in all Birds, have been found by Mr Parker at the top and the bottom, as it were, of the schizognathous series; that it in the Humming-hird (Pata. is, in the Humming-bird (Pata-

gona gigas), and in the Kagu (Rhinochetus jubatus). The latter is a Gruine bird, lying on the margin of the group towards the Night-Herons, whilst the Hummingbirds are certainly amongst the most specialized types. All the Schizo-. gnathæ, except the Fowl tribe, have 'meso-pterygoids." In certain Schizognathæ there is an "inferior labial" on the edge of the mandible, namely, in the Rallidæ (e.g., Fulica atra and Gallinula chloropus). These were found by the writer many years ago. Upper labials have not as yet turned up in these types, although they have been figured carefully in the Rhea (Phil. Trans., 1866, plate 10, fig. 14, on each side of r.b.s., close under the inferior turbinal i.t.), and the Rhea is a much lower type than the birds under notice. As in the Gallinaceae. the Schizognathæ generally have little development of the tympanic ring, but in Egialitis hiaticula there is one large and three or four lesser bones on each side; they occur in Numenius arquata.

A full and adequate idea of the degree of the metamorphosis of a Vertebrate skull attained to in Birds can only be obtained by observation of what is to be seen in that of the higher arboreal types. But some of the Carinatæ are half Struthious, and they possess that low kind of skull which is called "Dromæo-swering to the first bashbranchial of a Fish; bbr., bash branchial of a Fish; bbr., bash branchial or a Fish; bbr., bash branchial, or un-byal, Emeu.1 This kind of skull once understood, the relation of that of the Fowl to that of types far above and far below it will be clearly seen; for we must describe the Desmo-

The DROMEOGNATHOUS Type-Cranium of Tinamus variegatus.—Professor Huxley (Clas. of Birds, p. 425) says, "The Dromæognathous birds are represented by the





of parasphenoidal rostrum; a.p., a pterygoid process (basi-pterygoid).

If Professor Huxley's description be compared with the accompanying figure (24) of the Tinamine skull this variety will be easily understood; the lettering is the same as in the figures of the Fowl's skull. For further details the reader is referred to Mr Parker's Memoirs above referred to, especially that on the Struthious types (Phil. Trans. 1866. plates 7-15).

The DESMOGNATHOUS Type of Skull .- This kind of skull occurs in such a variety of families that, notwithstanding its importance to the morphologist, it is not of so great a value to the zoologist. Nor indeed is it quite equal to some of the groups in value, being due to a

some future time; an embryo of Rhynchotus rufescens is treasured up

1 Phil. Trans. 1866. plates 11-12.

¹ Sometimes, even in the Fowl, the infra-stapedial has a spatulate panic recess, in front to the anterior tympanic recess, below that to the custachian opening, and on the middle of Soc., May 27, 1869, p. 399, fig. 5 B, I. S.)

² A note is given below as follows:—"On the Osteology of Gallinaceous Birds and Tinamous (Transactions of the Zoological Society, vol. v. 1864). Sundevall, however, had already said of Tinamus, Rhynchotus, and Crypturus, 'Struthiones parvos referent.'" The last two are merely sub-genera of Tinamus.

3 The writer hopes to show the development of this type of skull at come future time; an embryo of Phynchotus subsecues is treasured up

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condition arising rather from an excess of osseous deposits | handling of the modifications of the desmognathous skull were, into this type; whilst it crops up among such simple others, for the observation of which the present writer has cera; and Talegalla Lathami in old age is nearly desmo- dwelt long on the subject. gnathous. So also on the Ardeine borders of the Gruida. the Kagu (Rhinochetus jubatus).1 is almost a Night-Heron. and nearly desmognathous. In another region Nyctibius able in this subdivision, viz., the Chenomorpha, the Amphialmost comes across to the gigantic Goatsuckers (Podargus) and the Oil-bird (Steatornis). (See Huxley, Clas. of Birds, p. 456.) In the paper just referred to (p. 453) the Desmognathæ are thus described :- "Those Cuvierian Grallæ and Natatores which are not schizognathous, the Accipitres or Raptores, the Scansores [excluding the Picidæ], and among the Passeres, most of the Fissirostres, all the Syndactyli, and Upupa, may be termed desmognathous. In these birds the vomer is often abortive, or so small that it disappears from the skeleton. When it exists it is always the union of the maxillo-palatines; the more or less ossified slender, and tapers to a point anteriorly. The maxillopalatines are united across the middle line, either directly or by intermediation of ossifications in the nasal sentum. The posterior ends of the palatines and anterior ends of the pterygoids articulate directly with the rostrum, as in the preceding division" [the Schizognathæ].

It is possible to make several important divisions in the kind and degree of desmognathism, as follows, namely-

a. Direct .- In Falcons and Geese, the maxillo-palatines meet below at the mid-line, as in the Mammal. Two sub-varieties of this form occur, as in the Falcon, where the nasal septum is ankylosed to this hard palate, and in the Goose, where it remains free.

b. Indirect.—This is very common, and is best seen in Fagles, Vultures, and Owls. The maxillo-palatines are must stand as the type of a division by itself. Thus the ankylosed to the nasal septum, but are separated from skull has the long lachrymo-nasal region, the basi-pterygoid each other by a chink.

c. Imperfectly direct.—This is where the maxillo-palatine Hawks the palate is at first indirect, is then imperfectly the maxillo-palatines are spongy [scarcely more so than direct, and at last perfectly direct.

closely articulated with, and separated by, the "median septo-maxillary," but there is no ankvlosis. Example-Megalæma asiatica.

e. Double Desmognathism. - This is seen in Podargus, where the palatines as well as the maxillaries largely coalesce below; to a less extent this is seen also in the larger Hornbills (Buceros). (Huxley, op. cit., pp. 445, 446, figs. 27. 28.)

f. Lastly, a compound form, in which the ægitho-Coracomorphæ (Gymnorhina, &c.), as will be shown below.

exists, is always slender, and tapers to a point anteriorly" like at first, and are attenuated in front. They coalesce (p. 435), is modified by a note he gives on the same page with regard to the broad emarginate vomer of Falco. It in their hinder part. There is a part separate from the has a similar, but not equal, enlargement in front in the rest in front, just where they begin to narrow; this is Sacred Ibis (Thresciornis æthiopicus), and the knife-shaped obviously the median septo-maxillary. Behind, where the vomer of the Duck tribe is often thick at the infero-anterior palatines shoot below the rostrum of the sphenoid, each angle, as may be seen in Edemia nigra, Querquedula caudacuta, and Mareca penelope, but the vomer of the fellow by fibrous tissue, and between these the vomer is Chenomorphæ is compound, and the antero-superior bone, wedged; the thin plate belongs mutually to the palatines whose lower angle in part is enlarged, is the median septomaxillary: this may be seen in young Geese, and in the the ethmo-palatine spurs are long; in Phoenicopterus adult Crested Screamer (Chauna chavarra).

Here it will be necessary, in order to show the value of

1 See Trans. Zool. Soc., vol. vi. plates 91 and 92.

than from any very striking metamorphosis of primordial and the groups in which it is present. It is open to us elements. The skull of the Schizognathæ easily runs, as it however, to modify some statements of his and to superadd palates as those of the Fowl tribe, namely, in Crax globi- had much greater leisure, and the advantage of having

At page 460 (op. cit.) we read: "Not fewer than seven groups of families appear to me to be clearly distinguishmorphæ, the Pelargomorphæ, the Dysporomorphæ, the Aetomorphæ, the Psittacomorphæ, and the Coccygomorphæ."

1. The Chenomorphæ. "The lachrymal region is remarkably long [save in the Screamer (Chauna)]. The basi-sphenoidal rostrum has oval, sessile, basi-pterygoid facets, like those of the Alectoromorphæ. The flat and lamellar maxillo-palatines unite and form a bridge across the palate." Yet each of these plates has a large obliquelyascending process; the vomer lies on the groove formed by septum, in old age, coalesces, by its outstanding processes, with those plates. The internal, but especially also the posterior angle of the mandible is largely developed, and so also is the transpalatine angle of the palatine. The glossohyal is very large and spatulate, and the thyro-hyals are flat and broad where the two unite. A remarkable structure is found in Ducks and Swans, namely, an ossicle on each side between the palatines, and stretching towards the maxillo-palatine plate: these bones are the "interpalatines;" they tend to carry on the hard palate.

2. The Amphimorphæ.-"The genus Phanicopterus is so completely intermediate between the Anserine birds on the one side and the Storks and Herons on the other, that it can be ranged with neither of these groups, but facets [not so; see op. cit., p. 437, where they are truly said to be rudimentary—they are the merest prickles]. plates are united by harmony-suture and not by coalescence. the prolonged and recurved angles of the mandibles, Example—Dicholophus cristatus. In young Falcons and the laminated horny-sheath of the Chenomorphæ; but in the Swan et hoc genus, omne of the Anserines and d. Imperfectly indirect.—Here the maximo-palatines are Anatines], and the general structure of the rostrum is quite similar to that found in the Storks and Herons." The nasals are thoroughly Anserine, having their crura separated by a rounded notch; their palatines are quite Anserine, but are broader behind, being exactly like those of the Screamer; and yet they cut off the meso-pterygoid, which coalesces with the palatine. This the Storks and their allies do; the Chenomorphæ do not. The pterygoids are like those of Thresciornis and Platalea, but the vomer is intermediate between that of the Goose and the Spoonbill. gnathous skull becomes desmognathous, is seen in certain | The orbital processes of the palatines, or "ethmo-palatines," run together as arched laminæ from the body of the Professor Huxley's remark, that the vomer, "when it bone to the maxillo-palatine floor. They are very shelltogether, and send down a bony keel of exquisite thinness bone sends down a lamella; each of these is bound to its and the azygous vomer. In all the ordinary Chenomorphæ enormously so; in the Screamer they are very short. Hence the palato-vomerine structures of the Amphimorphæ these types of skull, to insert Professor Huxley's masterly are Anserine, but much modified. So also in the hyoid apparatus; and the huge glosso-hyal is, although cartilaginous the true counterpart of that of a Swan.

3. The Pelargomorpha. - "There are no basi-pterygoid | above the optic passage. The same structure is seen in the vomer is double, large, and charadrian.

In Ardea cinerea the vomer is coalesced behind with the the most gigantic, as the Adjutant, are evidently specializations of a type similar to the pluvialine Schizognatha.

apertures are very small. There are no basi-pterygoid pro- viz. :cesses. The palate bones unite for a considerable distance behind the posterior nares, and send down a vertical crest at their junction. The maxillo-palatines are large and spongy. The angle of the mandible is truncated."

The inferior crest of the combined palatines is largest in Pelecanus, above, in Phalacrocorax and Sula, this plate is grooved for the sphenoidal rostrum, but in the Pelican there arises a huge crest, and the rostrum of the sphenoid rises rapidly out of its way. Here the secondary palatine arch has the same habit as the primary trabecular arch-a modification constant in birds in the latter. All the parts in front of the very mobile cranio-facial hinge are molten together into one mass, and the nasal labyrinth is in its most aborted state.

In Phalacrocorax the perpendicular ethmoid is of small antero-posterior extent. There is no presphenoid, but merely a small V-shaped orbito-sphenoidal band of bone

processes, and the palatines usually unite for a greater or Himantopus and Eurypyga. In the Cormorant an oblong less distance behind the posterior nares; but they send ossicle lies on the commencement of the zygoma. It is down no vertical plate from their junction." In the large in P. carbo, and small in P. graculus. A still larger Ardeidæ they do not unite; in all these forms the coalesced ossicle has heightened the zygoma in Sula alba. This is part is short as compared with that of the Cormorants and the "post-maxillary." In Sula alba the basi-temporals are Pelicans; in both Scopus and Balaniceps the ankylosed as little developed as in the Dromaida, less than in any part is carinate below (Trans. Zool. Soc., vol. iv. plate other Carinate bird. Behind each moiety there is a large 65, fig. 1, pal.). "The maxillo-palatines are large and oval opening, not far in front of the occipital condyle; spongy. The angle of the mandible is truncated," except this exposes the loose diploë within. The small eustachian in Platalea and Ibis. The vomer is smallish and cultrate tubes open at a little distance from each other, in a wide in Ciconia nigra; larger by far, cultrate, and pedate at shallow fossa, on the part where the three elements of the the end in Thresciornis athiopicus; as large in Platalea | parasphenoid meet. In both the Pelican and the Cormoleucorodia, but pointed in front and carinate below. Even | rant there is an elegant, crescentic, lipped, free margin to in the last of these forms, in a half-grown individual, no sign the very Ardeine basi-temporal plate. In Sula alba the of a median suture was seen. The vomer of Scopus is columella auris is very long and bent. It has a small cartilsharply cultrate above and rounded below; it reaches aginous extra-supra-stapedial process, and a long attenuated beyond the maxillo-palatine mass. In Balæniceps (op. cit., | cartilaginous infra-stapedial, terminated by a bony fusiform p. 308, plate 65, fig. 1, v.) the vomer is like that of Scopus stylo-hyal. The hinge for the mandible is very far back and Ciconia, but it is actually smaller than either. In most in Sula, whose cranio-facial hinge almost rivals that of the of these Ciconian and Ibidine types the vomer is evidently | Parrot and Toucan. In the Cormorant the mandibular azygous, but in all the skulls of Ardeidæ now before the articulation is almost carried as far back as in the Crocowriter, viz., one or two species of each of the following dile. In Sula alba the zygoma is very thick in front, and genera, Ardea, Botaurus, Nycticorax, Garzetta, Tigrisoma, is suddenly reduced to an extremely thin bar, where it passes into the upper beak.

5. The Aetomorphæ.—"The rostrum is more or lesslong, elegant, bicarinate palatines, and in front runs its arched and hooked at the tip. Basi-pterygoid processes point in between the free retral lobes of the maxillo-palatines. | may be present or absent. The maxillo-palatine processes The moieties have each a rounded keel, and those keels | may be concavo-convex lamellæ, or may be spongy and run parallel at first and then run into each other in front; fill up the base of the rostrum; but they are always above, the two halves form a deep fossa, in which the | [except in Dicholophus, a genus which the writer adds to sub-carinate parasphenoid glides. The edges of this the group] united with an ossification of the septum. trough are roughly tuberculated and turned over, like the rim of a cup; the primary suture between the halves is the quadrate bone is greater than its length, the outer retained behind for half the length of the bone. In condyle extending about as far downwards as the inner." several Ardeidae an additional maxillary bone—the "post- This is best seen in the Cariama (Dicholophus), and in maxillary"—is formed behind the angle of the maxillary. | the Owls, Hawks, and Falcons; in the larger Old World It is small in Ardea garzetta and Botaurus stellaris, and of | Vultures (e.g., Gyps fulvus) it is not so well seen. "The good size in Botaurus viridis and Nycticorax ardeola. angle of the mandible is never recurved." At pp. 441 and This bone was first found by Mr Parker in the Emeu. 442 op. cit. it is stated that "the maxillo-palatines unite In Tigrisoma leucolophum there is a pair of "inter- with one another and with the extremity of an ossified palatines," as in the Duck tribe. In the Pelagomorphæ septum, so as to fill up the maxillo-palatine valley." In the the charadrian type reaches its culmination; yet the most carefully prepared specimens before the writer, it is found exquisite forms, such as the Egrets and smaller Bitterns, and that there is a space between the right and left maxillopalatine, not only in the Cathartidae, where it is evident, but also in Gypogeranus, where it is least. Intermediate 4. The Dysporomorphæ,2-4" The rostrum is long and between these types come the Old World Vultures and pointed, and more or less curved; and the external nasal the Eagles. The skulls at hand give the following results,

a. Perfect indirect Desmognathism.
Sarcorhumphus papa, Aquila (sp. pl., including Helotarsus
ecaudatus), Gyps fulvus, Neophron percuopterus, Asio otus,
Asio accipitrinus, Aluco flammeus, Ketupa ceulonica, Athene noctua, Štrix stridula. Elanus caruleus. b. Imperfect direct Desmognathism.

BIRDS

c. Perfect direct Desmognathism.
Falco peregrinus, Falco tinnuncuus, ralco æsalon, Accipiter
nisus, Buteo vulgaris, Circus cyaneus, Haliastur indus.

With regard to the basi-pterygoid processes, they are most aborted in Dicholophus, Helotarsus, and Gyps. They reappear as aborted prickles or knobs in some Eagles, in Neophron, Elanus, Circus, and Accipiter, and in the young of these they are rather large. In Haliastur indus they are large, rounded flaps, with no cartilage on their end. Then come Gypogeranus, the Cathartidæ, and the Owls, in which they are constant. In all the Owls, as in Pigeons and some of the Turnicidæ (see Trans. Zool. Soc., vol. v. plate 34, fig. 2, m.o.f.), the slow growth of the occipital region of the chondro-cranium leaves a membranous space over the foramen magnum. This is not, or is very rarely

^{*} Balaniceps has the head of a Stork, but its body is largely

³ Dysporus a generic name applied to the Gannets by Illiger.

^{3-25*}

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"median occipital fontanelle

tremely variable, and often having a supplementary bone attached. It is azygous. The palatines also, which have rounded posterior angles and double keels, often have a medio-palatine where they unite, and also receive the meso-pterygoid spur. In some types, as Gyps fulvus, the large rounded palatine flap is partly severed off as a "transpalatine." Where the ascending laminæ of the palatines meet below the sphenoidal rostrum, there a bony deposit takes place; this, if truly azygous, is a mediopalatine; if oblique, it is one of the meso-pterygoids, which, in the Rapaces, get between the palatines, coalesce with each other, and form a keystone, as in Ulula stridula. In others, as the young of Falco tinnunculus and the adult Helotarsus ecaudatus, there is one small, obliquely-placed ossicle in the front of the palatine suture. In Neophron percnopterus there is one free meso-pterygoid attached to the right hinder fork of the vomer. In Dicholophus cristatus there is a large medio-palatine wedged in in front, and to it the cultrate, fenestrate, and pedate vomer is attached. In the Falcons the vomer is pedate, and, in the larger kinds, fenestrate. In Ulula stridula there is a small vomer attached to a small medio-palatine, and having over it an equally small median septo-maxillary. The latter bone is large in Asio otus, and small in Neophron percnopterus, Circus cyaneus, and Haliastur indus. The vomer is most aborted in the Eagles and Vultures (often absent); but it is long in Neophron. We have found a small bony wedge (oblique meso-pterygoid) in Sarcorhamphus papa. Professor Huxley's figure of the skull of Gypogeranus is deficient in not showing a small vomer (fig. 24, p. 442). A specimen sent to him by the writer (after the paper appeared) has this little bone distinct. The frowning brow is obtained in these birds by a huge super-orbital process of the lachrymal in Dicholophus, Gyps, and Falco. In many kinds (Hawks, &c.) there is a distinct superorbital at its extremity. The eyeball, with its massive bony rim, is quite equal in Dicholophus to that of the diurnal Rapaces generally. Its hyoid also is thoroughly Raptorial. Its glossal (double) piece is spatulate, and, like that of its congeners, approaches the glosso-hyal of the Gull, Albatross, and many other birds.

A description of the palate of the Sparrow-Hawk (Accipiter nisus, will illustrate that of Raptorial birds generally, and and they with each other. The palatine bones (pa.), strapalso the meaning of the term desmognathous.1 The speci- like, widen backwards, and then gently narrow to the end, men figured (fig. 25) was a half-developed nestling. Its leaving no sharp postero-external angle. The wedge of round occipital condyle, and the various foramina (8, 9), bone which has been fretted off from the fore-end of each are shown in the occipital region, and outside and above of the rod-like pterygoids (pg.) binds on the posterothis arch are seen the hinder face of the opisthotic (op.), superior edge of each palatine, and the inner plate of these and in front of the tympanic ala of the exoccipital (e.o.) bones covering the under surface of the sphenoidal rostrum there is an uncinate bone in relation with the prootic, Serpents only a film of ectosteal bone represents it, and in Lizards such a plate appears, overlapping cartilage which ossification in membrane belonging to the same category. has begun to calcify. It develops and becomes part of 6. The Psittacomorphæ.—The uniformity of this group the parotic process. The basi-temporal plate (b.t.), the of Desmognathæ is as remarkable as the variability of the rostrum, with its arrested basi-pterygoids (b.pg.), are last, and yet it is potent in genera and species. "The shown, and on each side the double condyle of the quadrate rostrum (see op. cit., p. 465) is arched and hooked at the

filled up by even the bony growths; it remains as the zygomatic process of the maxillary is, behind, bound up median occipital fontanelle." The vomer in this group is of great interest, being ex- into the upper dentary region, half overlapped by the

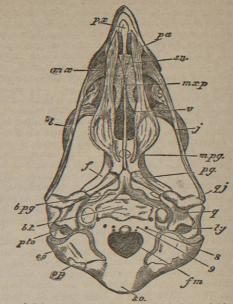


Fig. 25. Skull of nestling Sparrow-Hawk (Accipiter nisus), palatal view, × 2° diameters. The circular space on each side of the basi-temporal (bt.) is the opening of the anterior tympanic recess. The meso-pterygoids (m.p.g.) show part of their lower face on the post-palatine region; the basi-pterygoids (b.pg.) are mere knobs, and the common eustachian opening is seen between them. The maxillo-palatine plates (mx.p.) are dotted to show their spongy character.

dentary process of the premaxillary (px.) The dentary edge of the maxillary sends inwards the maxillo-palatine plate (mx.p.), which meets its fellow at the mid-line, and also grows retrally and superiorly into an elegant shell-like

The right and left plates lie edge to edge, as in the adult Cariama, and are imperfectly direct in their desmognathism. The palatine processes of the premaxillaries Parrots in breadth. Unlike its congeners, the Cariama bind the fore-ends of the palatines, which in turn bind that its nasal septum but little ossified; and it possesses under the maxillo-palatine plates. The gap in front is an "os uncinatum," propping up the pars plana, as in the filled with the fast ossifying septum nasi; it is pedate in front, and behind sends out a process on each side; these spurs ankylose afterwards with the maxillo-palatine plates, imperfectly, allows part of these bony wedges-the "mesoopisthotic, squamosal, and exoccipital, where they all meet | pterygoids" (m. pg.)—to be seen from below. The bird has together. This is the "pterotic" (pto.), a huge bone in all the periotic bony centres, viz., five, as in Osseous Fishes; Osseous Fishes, and walling in much of the labyrinth. In it has distinct cartilaginous orbital alæ, which are, like

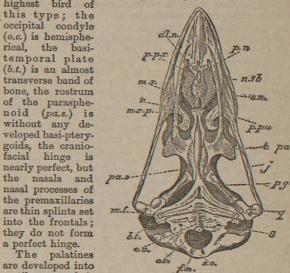
(q.), characteristically placed transversely. The zygoma extremity, and is regularly articulated with the frontal region of the skull." Therefore we find that the cranio-1 See Monthly Microscopical Journal, Feb. 7, 1873, p. 45, plate 5, qg. 2. A paper by the same writer in the Linnean Transactions, 1875, may be consulted for copious illustrations of the Desmograths, yet we can interpret the metamorphic results by other

convex from before backwards) for the mandible. The a rounded symphysis." The glosso-hyal is spatulate, and the basi-hyal is alate behind. In the fore-face are some The skull of a fledgling Rook (fig 26) illustrates the things worth noting. The septum nasi is a thick wall of highest bird of bone; the alæ nasi are soft in Psephotis multicolor; they have | this type; the an annular ossicle found in them in Melopsittacus undulatus: whilst in Palæornis torquata this part is largely ossified and ankylosed to the upper jaw, and the alinasal turbinal rical, the basiis partly calcified. In one small kind we saw the trace of temporal plate a small medio-palatine. The pars plana is narrow and (b.t.) is an almost ossified, and is ankylosed to the lachrymal; the inferior transverse band of turbinal is soft.

7. The Coccygomorphæ.—This is another polymorphic of the parasphegroup, and is not in any sense, either zoologically or mornioid (pa.s.) is phologically, the equivalent of the last. Yet it is almost without any deimpossible to separate the families by any character of weloped basi-ptery-importance. If the *Podargus* must be linked with the goids, the cranio-Kingfisher, the Goatsucker and its allies cannot be re- facial hinge is moved, notwithstanding their schizognathous palate. Here, nearly perfect, but however, we are dealing with the desmognathous forms. the nasals and Professor Huxley makes four sub-groups, and then remarks | nasal processes of (p. 467): "It appears to me not improbable that it may the premaxillaries hereafter be desirable to divide this group into four." The are thin splints set characters of the skull are thus given (p. 466): "The into the frontals; rostrum presents very various forms, and may be movably | they do not form articulated with the skull. Basi-pterygoid processes are a perfect hinge. present in only one genus (Trogon)."1

The Oil-bird (Steatornis caripensis) has very large basi-pterygoids, thus connecting the Goatsuckers with Podargus. "The maxillo-palatines are usually more or less spongy. The palatines are not developed into vertical plates, but are, as usual, horizontally flattened. The distal end of the quadrate has the ordinary form." The vomer is small in Hornbills, Toucans, and Scythrops; but they have a second bone in front of the azygous vomer, viz., the "median septomegraphy as in the Googe tribe and (American Scott of the Scott the "median septo-maxillary," as in the Goose tribe and others. In Podargus, when the lower palatine floor-like that of a Mammal-is cut away, there are to be seen three small ossicles; the first of these is the vomer, the others are medio-palatines. In Megalæma the vomer is very large and forked in front. In the Kingfishers and Hoopoes there is no vomer: there is a trace in Corythaix.

types. "Basi-pterygoid processes [and vomers] are wanting. The palatines are vertically elongated posteriorly, while anteriorly they are horizontally flattened, and the **Egithognatha**, which, with a little cutting and contrivmovably united with the rostrum. The maxillo-palatines ing, may be made to cover the Coracomorphos entirely, are spongy. The lachrymal and post-orbital bend towards with enough at its corners also to be superimposed upon the one another, and frequently unite below the orbit." This | Swifts and the Hemipods, and that remarkable charadrian is by the intervention of a large "os uncinatum," which is | bird, Thinocorus.3 It is worth while to remember that best seen in small types, such as Psephotis multicolor and these types are actually the highest, the most metamor-Agapornis pullaria, where this part does not unite with phosed, and the most specialized; not so high in some the post-frontal. In Microglossa, Calyptorhynchus, Plycto- respects as the Mammal, yet no Mammal comes near them lophus, Melopsittacus, &c., the temporal fossa is also bridged | in adaptive modification, not even the one which has the over by junction of the zygomatic process of the squamosal with the os uncinatum. "The orbital process of the from no less an authority than Mr G. R. Gray that of quadrate bone is very small, and its distal presents only | the 10,000 known birds half belong to this group; the Old one facet (which is compressed from side to side, and World types of which, more especially, are such accomplished creatures. The Nectarinia is the smallest, and the rami of the latter are deep, and pass into one another by Raven the largest of this huge, but morphologically very



cartilage at their

(t.pa.); the pterygoids (pg.) are phalangiform, and lose their meso-pterygoid spur, which soon coalesces with the palatines. The maxillo-palatine processes are hooked and flattened, and often enlarged at their inner extremity, so as to become pneumatic.

But the distinguishing character of the type is the union

The palatines may be rounded behind as in Cuculus and Buceros, have a retral spur to the transpalatine part as in Rhamphastos Alcedo, and Upupa, or be very broad, with a large passerine transpalatine angle, as in Podargus.

1 For a figure of this skull, see Professor Reinhardt's paper on the "Os uncinatum" ("Om en hidtil ukjendt Knogle I Hovedshallen hos Turakoenne Musophagides, Sunder," Setricple of "Videnskabelige Meddelelser fra den Naturhistoriske Forening & Kjöbenhawn," 1871). In this paper figures are given of the skull of Corythaix, Musophaga, Schizorhis, and Trogon.

2 See Professor Huxley's figures, those of M. Reinhardt just referred to, and Dr Murie's valuable papers "On the Skeleton of Todus," Proc. Zool. Soc., May 21, 1872, plate 55, pp. 663-630; "On the 1874, plates 61, 62.