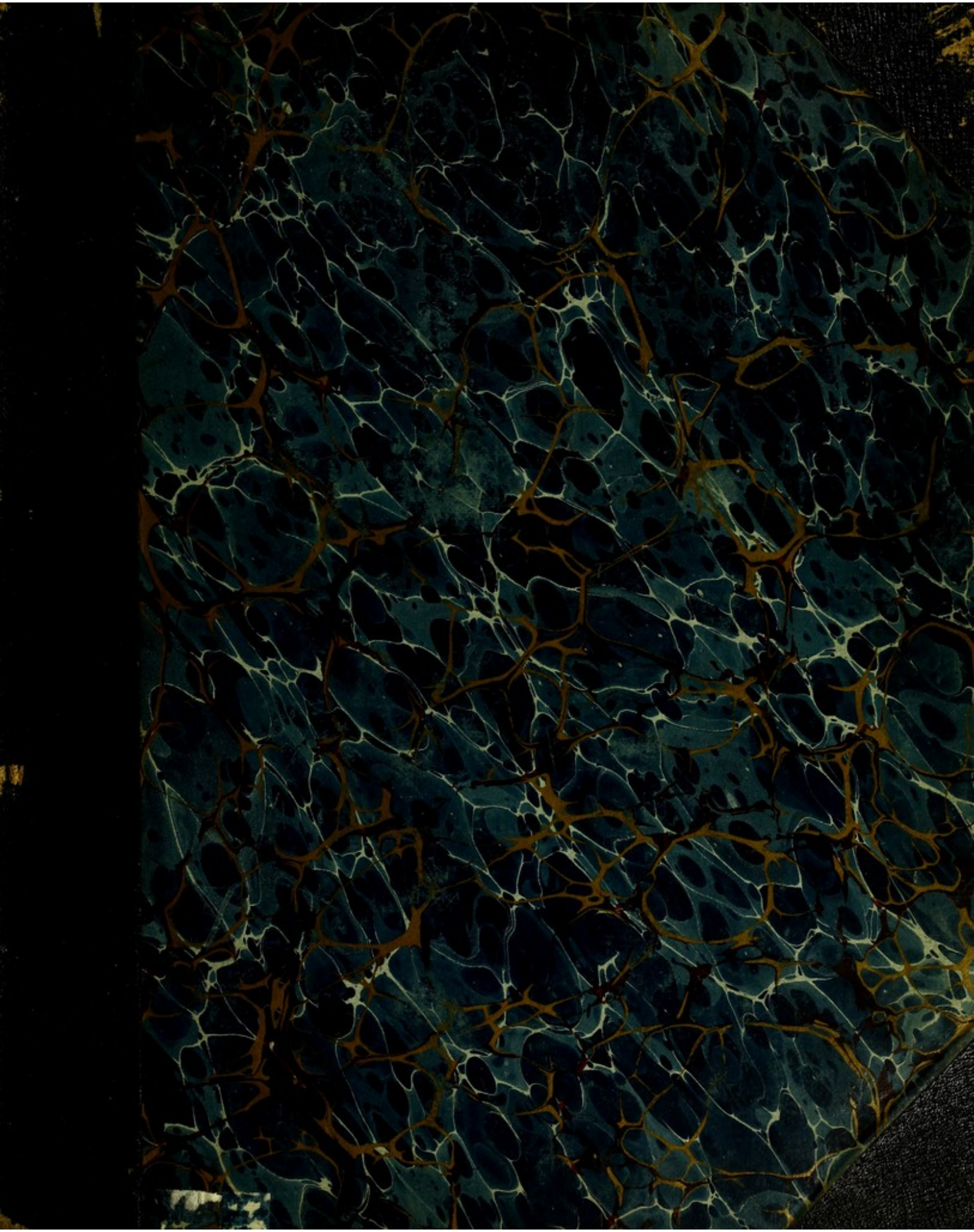
On Ægithognathus birds. Pt. I / by W.K. Parker.



TRANSACTIONS

OF

THE ZOOLOGICAL SOCIETY

OF LONDON.

V. *On Ægithognathous Birds* (Part I.). *By* W. K. Parker, *F.R.S.*, *F.Z.S.*

Read February 18th, 1873.

[Plates LIV. to LXII.]

Introductory Remarks.

THOSE who take pleasure in ornithology know well that systematists, working for the most part from external characters, are continually at a loss when some new and mixed type, which will not fit into their plan, is brought before them. The present race of ornithologists is a vast improvement upon the past, and, with greater catholicity of mind, are not unwilling to receive help from workers who, not devoted to birds alone, nor in any group to outward characters merely, are wont to dig deeper for diagnostics.

If any one shall say that taxonomic ornithology is full-blown and perfect, I would ask, Why then do no two systematists agree together? A hundred classifiers, a hundred so-called *systems*. I suppose that the most violent raid ever made upon a people quiet and secure was when Professor Huxley read his invaluable paper before this Society (April 11, 1867) "on the Classification of Birds; and on the Taxonomic Value of the modifications of certain of the cranial bones observable in that class."[1]

I am proud in the consciousness of having been of some service to the author of that paper, which is at once a model to work by and a platform to work upon. If such a production were perfect, it would cease to grow; but its large, sinewy, and rather awkward limbs give promise of something better than those full-grown but feeble "systems" the skeletons of which have filled this valley of vision with their bones.

I know it will be said—it has been said, that to take the palate merely as a means for diagnosis is to be extremely partial, and that such characters will be misleading. Such objections are natural enough to those whose minds are most richly stored with a knowledge of the exquisite modifications of the outward structure of a bird, but whose studies have not been based upon accurate morphological knowledge.

Even the outward form of the *face* gives the key-note to the whole bird; the human face looking out from above the neck of a Giraffe would scarcely be more absurd than a Hornbill's face mounted on the neck of a Swan. The head and face rule all things else. Every modification in the organs of progression must be in correlation with that deeper change which has taken place in the storied and labyrinthic walls of the head So also, with regard to the other organs, *chylopoietic*, *generative*, and the like; all these

[1] See P. Z. S. 1867, p. 415.

are ruled by, all these follow, those subtle early modifications of the primordial structure of the head.

But those who, with the new lights of morphological science, seek to help the *classifiers*, to whom they are so much indebted, do not look upon a bird as if it were a special creation, a new thing in the earth, standing alone, a plumy wonder. The bird is, as it were, but a metamorphosed hot-blooded reptile; and the reptile itself a step and stage upwards from a series of creatures still a little lower in the scale of life. And here lies the charm of the morphological study of birds, namely in the amazing metamorphosis which the simple facial arches and nasal sacs undergo. It is the condition of these parts especially that has engaged my attention of late. The postoral arches have, indeed, been studied by me less than those in front of and above the mouth; but the latter once determined and thoroughly made out, the others offer no difficulty.

In working out the trabecular and palatine arches and nasal capsules, however, every refinement of histological method has to be used, and light fetched in from the morphology of the same parts in the other Vertebrata.

In the present communication I have not been benefited alone by Professor Huxley's paper just referred to, but also by another with which he favoured us on the 14th of May, 1868—"On the Classification and Distribution of the 'Alectoromorphæ' and 'Heteromorphæ'" (see P. Z. S. 1868, p. 294). A careful study of this latter paper has opened my eyes to what seems to me a most vital part of these studies. I refer to the light they may throw upon the variation and distribution of types. This idea has been incubating in my own slower mind ever since Mr. Sclater put it into my power to dissect the Southern type of Crow, namely *Gymnorhina tibicen*. That was eight or nine years since; and the Crows have always, with that light, been to me divided into those of the "Notogæa" and those of the "Arctogæa."

Moreover the terrestrial habits and earth-born physiognomy of several of the larger and middle-sized Southern Passerines have attracted my attention for many years past; for I strongly suspected that these have had a much more direct and immediate struthious parentage than those highest results of metamorphic change, the songsters and Crows of our own hemisphere. This rooted belief has grown into something like certainty to me of late; for within the present year my friend Mr. Osbert Salvin has put his rich collection of southern specimens of skeletons into my hands: my own rather extensive series consisted principally of northern types.

These new treasures did not comprise many from Australia; but our excellent Senior Clerk (Mr. W. J. Williams) has given me several spirit-specimens from that part of the Notogæa, and these have turned out to be of the utmost value. Working lately at the face of embryo birds to supplement morphological deficiencies in my paper on the Fowl's skull (Phil. Trans. 1869), I stumbled upon the remarkable modifications of the embryonic passerine face which give to the adult the character denominated by Professor Huxley, "Ægithognathous." This type is characterized by

him in his usually terse and lucid manner; but he does not give any very definite explanation of the meaning of the parts. Speaking of the region to which I have recently given most attention, he says (p. 451), "The anterior part of the nasal septum (in front of the vomer) is frequently ossified in Ægithognathous birds, and the interval between it and the præmaxilla filled up with spongy bone; but no union takes place between this ossification and the vomer." So far, true; but this is a very meagre account of the matter; and whether the "spongy bones," mostly cartilaginous, belong to the same category as our own "inferior turbinals," or are the large ornithic "alinasal turbinals," is not stated; neither is it noticed what kind of union takes place between the vomer and these turbinals.

It is evident that nothing but the embryology of their parts, and their comparison through a huge series, can test the value of the group to which the term Ægithognathous is applied.

Neither does our author fairly superimpose his "Coracomorphæ" upon his "Ægithognathæ," although they come far nearer to fitting than any other of the groups characterized on the one hand by their general form, and on the other by their facial modifications. I have only found three families of the "Ægithognathæ" that cannot logically be placed amongst the "Coracomorphæ"—namely, the "Cypselidæ" in the crown, and the "Turnicidæ" and "Thinocoridæ" amongst the roots, of the great ornithic life-tree. But other facial groups, "Desmognathæ," "Schizognathæ," &c. turn up anywhere and everywhere; so that the ornithologist mindful of great groups of one especial form, the *Crow-form* for instance, and yet desirous of seeing all things in the light of facial morphology, must work with both hands earnestly, now surveying the thousands of types in conformity with that one pattern, and then using his knowledge of their anatomical analysis.

With regard to the *form-groups*, I have to complain that they are not of *equal worth*, but far from it; these self-same "Coracomorphæ" are, zoologically, worth four or five of other groups that might be pointed out, which yet have a like terminology: this must be remedied. Yet it is a fact that the Passerine birds are most potent of all in families, genera, and species, and that these, forming half the known birds, are, on the whole, wonderfully uniform. The limits of the ægithognathous group given here will not accord with those given by my friend. I reject his Goatsuckers and Humming-birds, retain his Swifts, and bring in from the lower kinds of Carinatæ the Hemipods[1] and *Thinocorus*. These low types, especially, make the harmony of the two *maps*, the facial and the physiognomical, impossible. But they do this: they make the investigation of the

[1] Professor Huxley did not, I believe, suspect that a family classed by him with the Fowls (Alectoromorphæ) was possessed of an ægithognathous face; yet this the "Turnicidæ" have, as I find, both by examination of the skull of the young and adult *Hemipodius varius*, and the skull of the young of *Turnix rostratus*.

Mr. Robert Swinhoe, F.Z.S., sent me the latter; my friend Mr. Osbert Salvin, F.R.S., has lent me the Hemipod and many others, vital to my work; and Mr. W. J. Williams, of the Zoological Society, presented me with six invaluable passerine forms from Australia.

whole matter very bewitching, suggesting that we are somewhat near the stock (phylum) from which the multitudinous Passerines have sprung.

Moreover every patient fellow worker will see eye to eye with me, that in the *south* we find the most struthious types, and in the *north* the highest, and that our bird-groups are as important for study in their geographical distribution as in their taxonomy or their morphology.

The "Trochilidæ" and "Caprimulgidæ" have to be treated of separately; and the "Celeomorphæ" (Woodpeckers and Wrynecks, classed together) may be designated, *facially*, as the "Saurognathæ." These latter are peculiarly *lacertian* in their face; the Humming-birds and Goatsuckers are schizognathous, not ægithognathous, as Professor Huxley supposed (*op. cit.* p. 454).

I find upon close examination that the "Ægithognathæ" admit of three morphological subdivisions, and the "Desmognathæ" of four; and as the remainder of this research may have to rest awhile, these subdivisions may be given here.

The "Ægithognathæ" present the three following modifications in their structure:—*a*, incomplete; *b*, complete; *c*, compound.

a. Incomplete.—Ægithognathism occurs in the "Turnicomorphæ" (*Hemipodius*, *Turnix*). Here the vomerine cartilages (cartilages to which the symmetrical vomers are attached)[1] are very large, and incompletely ossified, and the broad *double* vomer has a "septo-maxillary" at each angle; but these bones are only strongly *tied* to the "alinasal" cartilage, and do not graft themselves upon it: their union is with the vomerine cartilage.

b. Complete: Var. 1.—This occurs in some of the lowest harsh-voiced "Coracomorphæ." The vomers are developed in large vomerine cartilages, which they often only partially ossify; but these osseous tracts are distinct from those of the often bony alinasal walls and turbinals. A small "septo-maxillary," one each side, generally appears limpet-like, on the inturned angle of the alinasal cartilage, but does not run into it; this is well seen in *Pachyrhamphus*, *Pipra*, and *Thamnophilus*.

Var. 2.—This occurs in an immense group comprising the higher "Coracomorphæ" and also the *Swifts* (Cypselidæ). Here all the vomerine bones are grafted upon the nasal wall, and thus the bird loses its primary "schizognathism."

c. Compound.—This form of face occurs when, superadded to the perfectly ægithognathous face, desmognathism is produced by ankylosis of the inner edge of the maxillaries, with a highly ossified "alinasal" wall and nasalseptum. Examples *Gymnorhina tibicen*, *Paradisea papuana*, *Artamus leucorhinus*. Of this type a feebler form is produced when the maxillaries only coalesce with the ossified alinasal wall, as in *Dendrocolaptes albicollis*, *Thamnophilus doliatus*, and *Phytotoma rara*.

It may be as well to mention here the varieties of the "desmognathous" palate.

[1] These belong to the labial category, and can be identified with similar elements in the face of the Snake, Frog, and Shark.

a. Direct, as in the Falcons and Geese, when the maxillaries meet below at the mid line, as in the mammal: two subvarieties 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 Eagles, Vultures, and Owls; the maxillo-palatines are ankylosed to the nasal septum by their inner margin, but are separated from each other by a chink; this is well seen also in the fledgeling of the Falcon, which is indirectly desmognathous at that early stage.

c. Imperfectly direct.—This is when the maxillo-palatine plates are united by harmony-suture, and not by coalescence. Example *Dicholophus cristatus.*

d. Imperfectly indirect.—Here the maxillo-palatine plates are closely articulated with and separated by the "median septo-maxillary" bone, but these are not ankylosed. Example *Megalæma asiatica.*

A fifth variety might have been added, in such a case as *Podargus*, where the palatines as well as the maxillaries largely coalesce *below*; to a less extent this is seen in the gigantic species of Hornbills, e. g. *Buceros birostris* (see Huxley, *tom. cit.* p. 446, fig. 28).

Podargus carries this desmognathism to the greatest extent of any bird; in the Crocodile, and in the Anteater, a still more extended hard palate occurs, where the internal pterygoid plates form a lower bridge.

The unpublished materials from which I have made these extracts illustrate several forms of desmognathism, besides the early conditions of the ægithognathous palate and such schizognathous forms as *Trochilus* and *Caprimulgus.*

I have already given several figures of the schizognathous palate in my former paper, "On the Gallinaceous Birds and Tinamous" (Trans. Zool. Soc. vol. v. pl. 40). Here pl. 37 illustrates *Syrrhaptes* and *Lagopus*, and pl. 38 *Vanellus* and *Columba*; pl. 40 gives the *struthious* or dromæognathous face of *Tinamus.* But the most familiar and simple illustration of the schizognathous face is seen in the *Fowl* (Phil. Trans. 1869, pls. 81–87).

These details of morphology have to be mastered before the taxonomic value of these facial characters can be known, or in any way appreciated; and they are matters that lie somewhat deeper than the length or thickness of a primary quill, or the direction of the outer toe.

The materials out of which the ægithognathous face has been formed, exist, *in a raw state*, in the reptiles (Lacertilia, Ophidia) and, still nearer home, in the *Rhea.*

The counterparts of the cartilages in which the first osseous centre for each "vomer" is found in the "Ægithognathæ," were long since figured by me in the *Rhea* (Phil. Trans. 1866, pl. 10. fig. 14, *alate sections on each side of r.b.s* and *v*), and also were found in the common Snake (*Natrix torquata*) and in the embryo of *Eunectus murinus*; these studies of the Ophidian face have not, however, been published.

Besides these "vomerine" or labial cartilages, there is what I shall freely illustrate here as the "recurrent trabecular lamina;" this is formed by the apices of the recurrent trabecular cornua, which have coalesced.

The first group I now take up will make these matters clear to the reader, and will also give us the most rudimentary and reptilian condition of the nasal labyrinth—one very important part of the present subject.

On the Morphology of the Face in the "Turnicomorphæ."

I have had rare opportunities lately for studying this peculiar group of birds, and can correct some things in which I was misled in my former paper ("On the Gallinaceous Birds," Trans. Zool. Soc. vol. v. p. 172).

A few years since my friend Mr. Swinhoe, Consul at Amoy, sent me some young specimens of *Turnix rostrata*, from Formosa, in spirits; Mr. Salvin has put into my hands a very perfect skeleton of *Hemipodius varius*, in which the nasal cartilages are preserved in a dry state; and I have also the separate parts of the skull of a young *Hemipodius varius*, the gift of Dr. Murie.

If the palate of the young *Turnix* (Pl. LIV. fig. 1) be compared with that of the *Syrrhaptes*, Grouse, Plover, and Pigeon, already referred to as figured in my former paper, it will be seen at a glance that these birds have much in common; they belong, evidently, to one morphological stratum, or nearly so. But the *Turnix* is the lowest of these types; and it would seem as if he and his compeers were the waifs and strays of a large and widely distributed group of birds only a little higher in the scale than the Tinamous.

From such a group, largely extinct, the Sand-Grouse may have arisen; from such a stock the Plovers; and these old types may also be looked upon as zoologically paternal to several other modern families, the greatest of these being the Passerines. As to the relation of the Hemipods to existing types, I cannot do better than refer the reader to Professor Huxley's paper on the "Alectoromorphæ" (Zool. Proc. 1868, pp. 302–304).

There, however, no suspicion has been given as to the meaning of the broad "vomer" in relation to the Passerines; it is merely compared to that of the Grouse—not of *Lagopus*, but of *Tetrao urogallus* (see "On the Classification of Birds" Proc. Zool. Soc. 1867, p. 432, fig. 140). But even that vomer is a poor representative of that of the Hemipod, and for some years it has been a mystery to me because of its passerine form.

The flat-faced stump of the bone which in *Hemipodius* binds on each side the trabecular to the palatine arch—"basi-pterygoid process" (Pl. LIV. figs. 1 & 9 *b.pg*)—accords exactly in place and size with that of the Pigeon and Plover, and is less struthious than that of *Syrrhaptes*.

The parasphenoidal bar (fig. 1, *pa.s*) is rather massive in the young; but in the old

Hemipod (fig. 9) it is much more like that of the Ostrich family; and this trabecular underbearer of the ethmoid (fig. 11, *p.e*) is swollen and spongy as in the "Ratitæ."

The cranio-facial "hinge," however, is as perfect as in the Fowl; and the rest of the coalesced trabecular bar is unossified and forms the lower edge of a feeble septum nasi (*s.n*). As in the Crow and many of the "Coracomorphæ," the trabecular base of the septum is alate in its middle region (fig. 4, *s. n, tr*). The præmaxilla (figs. 1, 2, 9, 10, 11, *px*), even in the old bird, remains but little different from what is seen in the ripe chick of the Fowl ("Fowl's Skull," pl. 84), having a form common to Pigeons, Sandgrouse, and Hemipods.

The body of the bone is of small extent, the dentary processes thin and splintery (*d.px*), the palatine processes (fig. 1, *p.px*) very slender styles, such as we everywhere see in the feebler Coracomorphæ; and the early ankylosed nasal processes (fig. 2, *n.px*) are flat, splintery, and struthious. These processes retain their outline in the adult (fig. 10) after they have coalesced with their surroundings. But the greatest marvel in this bird's face is the peculiarities of its vomer, both in form and development. Very strange *in form* is the one figured by me in my earlier paper ("On the Gallinaceous Birds," &c. pl. 34. fig. 1, *v*), where it is described as the "little broad vomer," which is convex anteriorly, with a short horn at each angle, and ending behind in a slight style on each side for attachment to the palatine[1].

This species was not determined; but it had the most coracomorphic vomer of the three worked out by me; compare that figure with those of the young Crow (Monthly Micr. Journ. Nov. & Dec. pls. 36–39, *v*).

But *dry, adult* specimens give no idea of the true meaning of this vomer, which is composed of four osseous and two cartilaginous elements, as in the huge "family," or rather "order," of the Coracomorphæ. Amongst the birds that have uprisen from the Turnicine "stratum," the Plovers have a symmetrical vomer, formed of two sickle-shaped pieces, in indifferent tissue. The Sandgrouse and Pigeons, as far as I have seen, have no vomer ("Gallin. Birds," pls. 36 & 37); but the true Grouse, and all the "Alectoromorphæ" proper, have an azygous vomer formed in indifferent tissue (*op. cit.* pl. 36. fig. 6; and "Fowl's Skull," pl. 83. fig. 1, pl. 84. fig. 6, pl. 86. figs. 3, 4, 5, 10, 14, 15, and pl. 87. fig. 5, *v*).

Thus, starting from the truly struthious face of the Tinamou, with its immense symmetrical vomer, we suddenly find ourselves in the very midst of vomerine modifications which are only a little more specialized even in types the furthest removed from the base[2].

In the young of *Turnix rostrata* the broad part of the vomer (fig. 8, *v*) is very short,

[1] The "prævomers" there spoken of are the true "maxillaries;" the "prævomerine" ossicles or "septo-maxillaries" are the *separated* "horns" of the vomer, as I shall soon show.

[2] If the convenient fancy of our ornithic *life-tree* be kept in mind, to help the memory, then this *tree* must be one of many branches, suddenly starting from the root.

and the styliform crura long and delicate; the fore margin is clearly notched; it then suddenly widens, and on each shoulder there is a triangular snag with its projecting base looking outward and fixed and grafted upon a sigmoid spatula of cartilage (*v. c*). This compound lyre-shaped vomer is strongly attached to the nasal floor (*al. n*) by a broad and short ligament composed of connective fibres. In the adult (fig. 9, *v*) the angular snags have been segmented off as small "septo-maxillaries" (*s.mx*), the body of the bone has become very thick, and the crura stronger. The inferior surface is subcarinate, the superior scooped. Here the main difference between this vomerine arrangement and that of the Passerines is, that the bony substance has affected the cartilaginous segment, but not the nasal labyrinth. Yet the amount of metamorphosis seen in these birds is greatly in advance of the *pupal* simplicity of the *Rhea*; even where the vomerine cartilage occurs in a high type, as in the Celebesian Woodpecker (*Hemilophus fulvus*), there is no morphological union with the vomerine bones.

The pterygo-palatine arch is very strong in its posterior half, and of extreme tenuity in front. The suspensorial segment, "pterygoid" (figs. 1 & 9, *pg*), is not tip-tilted as in most of the Coracomorphæ, but agrees in this respect with the forms that lie in its own lower stratum, the apex being compressed and bilobate, so as to abut against the quadrate up to its orbital process. For the rest, its form is exactly that of a Pigeon or Plover; but it appears to be gallinaceous in one important aspect—namely, that the mesopterygoid spur is fore-shortened, and is here formed into a crest, convex without and concave within, where it forms a gliding joint on the swollen basifacial beam (fig. 11, *pg*, *pa.s*). But in the young *Hemipodius varius* it is a long separate bone (fig. 13, *ms.pg*); and what is unusual is its coalescence with the pterygoid again, and not with the palatine. This being the case, the narrow outturned postpalatine bar fits but loosely to that beam, but converges to meet its fellow below it, to form a fibrous commissure, symmorphic of a very early condition of the lyriform trabecular arch. The small "interpalatines," which are inbent snags, are of less extent than the overlying ethmopalatine laminæ, which articulate with the feet of the vomer (figs. 1 & 9, *i.pa*, *e.pa*, *v*). Opposite these the palatines bend gracefully round to pass forward as the long præpalatine styles (*pr.pa*); there is therefore no rudiment of the "transpalatine angle;" yet the groove between the outer and inner edge on the lower face of the bone is rather deep. In front these bones reach to the solid part of the præmaxillaries, and stretch themselves in front of their chief splints, the maxillaries (figs. 1 & 9, *pr.pa*, *mx*). These latter bones are simple models, out of which, by further extension of bony matter, the maxillaries of any kind of "Carinate" bird might be evolved. Each frail bony bar has the usual processes and parts, namely:—the main or dentary portion, fish-like in lying within the præmaxillary; the ascending facial process, which articulates with the descending crus of the nasal (fig. 11, *n.mx*); the conjugational "maxillo-palatine" hook (*mx.p*); and the retral jugal style (*j. mx*), or zygomatic process.

In the young *Turnix* (fig. 1, *mx.p*) the former are very slender styles, blunt-pointed

at the end, and *f*-shaped; but they are thicker in the young and old *Hemipodius*, are bowed outwards, and have a process at the base: this is most marked in the adult; it is pedate, its broad end looking to that of its fellow (fig. 9, *mx.p*). As far as mere length is concerned, this is equal to what is seen in their counterparts in the Coracomorphæ generally; it is a state of embryonic simplicity. The jugal styles of the maxillary, the slender jugals and quadrato-jugals of the young (fig. 1, *j*, *qj*) are all coalesced together in the adult; so that whilst in *number* the bones conform to the Galline and Pluvialine types, in condition they approach the Passerines.

The same two-facedness is shown in the great tripartite ethmoid, which I will describe in the adult first, and then give the details of the nasal labyrinth in the young. Behind the very complete craniofacial "hinge" the trabecular base of the middle ethmoid is greatly swollen into an anterior and posterior mass, with a vertical sulcus between, a little in front of the pterygoid; for the pterygoids clasp the hinder of these swellings, and the ethmo-palatine laminæ that in front. Thus the trabeculæ give off a short pair of conjugationals as they converge towards their long and complete commissure; and then the two arches cling to each other by the reconsolidated mesopterygoids and the ethmo-palatines, the trabecular bar swelling towards them. But there is no "os uncinatum," and the conjugational process of the palatine (ethmo-palatine) clasps the splint, or parasphenoid, and the united trabecular bar.

The median ethmoid is continuous with the lateral masses, or "ecto-ethmoids;" and these have become *spongy bones* in another sense than their counterparts the upper and middle turbinals of Man. In us they infold themselves to give room for the olfactory mucous membrane; in the Hemipod they, by swelling into bony tubercles, exclude the olfactory tract (figs. 10 & 11, *e.eth*). This is seen in a lesser degree in Pigeons (especially the Dodo), in the Sandgrouse, and the Plovers; but the Hemipod has only one rival in this character, namely the Bell-bird (*Chasmorhynchus*), which I shall describe anon. The antorbital mass (*p.p*) is a rounded irregular cake of bone, and has no segmented angle answering to the "os uncinatum."

The frontals, nasals, and nasal processes of the præmaxillaries largely enroof the ethmoid, which, however, appears at the eave of the large orbit in front. That apparent subdivision into an antorbital and lachrymal, as described and *lettered* in my former paper, is a mistake, caused by my using *analogy* for my guide; *there is no lacrymal*; and in this respect the Hemipod differs from Plovers and Pigeons. In my former paper (p. 195) I supposed a lachrymal in *Syrrhaptes*; but it seems to be as apocryphal as in *Hemipodius*. In the great *Crow-group*, only the largest kinds have even a very secondary fore-wedged pupiform lacrymal; in most it is either absent or extremely small.

The nasal labyrinth of *Hemipodius* is neither struthious nor coracomorphic, nor does it correspond with what is seen in birds near its own ornithic level; it is a stepping-stone from the simplicity of these parts in the reptiles to their elegant labyrinthic con-

dition in the ordinary bird. That of the Fowl (Phil. Trans. 1869, plate lxxxvi.) may be taken as a medium form; and a comparison of these together will reveal the ornithic shortcomings of the Hemipod. Seen from above (fig. 2) and from below (fig. 1) the whole labyrinth is large and tumid, the "alinasal" region (*al.n*) occupying two thirds of the whole; and of the remainder much belongs, like the fore part, to the *air-sifting* region, that which is supplied merely by the nasal branches of the fifth nerve.

A transversely vertical section through the first third of the long narial slits (fig. 3) shows the sharp fore end of the nasal septum (*s. n*) and the "alæ" given off by it, the alinasal roof. Near the septum a flap of cartilage is given off as a secondary growth, which turns its hollow face outwards and thickens below; this is the "alinasal turbinal" (*a. tb*); it is very similar to what is seen in the Fowl (*tom. cit.* plate lxxxvi. figs. 1 & 2, *n. tb*). Letting the eye follow this series of sections it will be seen that the continuity of the various flaps has been destroyed by the first section, these divided cartilages being only apparently separate. If the whole labyrinth were separated out, and held with its fore end upwards, it would be seen to be two imperfectly closed tubes with three upper internal divisions, with the *under surface* split into four ribbons of cartilage, and having the base or the antorbital region closed in by a large sheet of cartilage, continuous with all but the infero-median flaps. The alinasal roof overlaps the wall; and at this part the wall is *coped* with a double outgrowth; it is also coiled upon itself into three fourths of a cylinder, the inner edge coiling towards the turbinal (*a. tb*): thus the *wall* becomes the *floor*. Over this section we have the thick root of the nasal portion of the præmaxillaries (*n.px*); against it the dentary part (*d.px*), the apex of the maxillary (*mx*), and, below, the præpalatine-spur (*pr.pa*).

In the next section (fig. 4), within these bony bars we have a changed condition of the labyrinth; the septum has its basal, trabecular (*tr*) thickening (rudimentary "subnasal laminæ"), and the alinasal turbinal (*a. tb*) bent knee-like at its upper third and much expanded below. The upturned nasal floor has become separate from the downturned nasal wall (*n. f*, *n. w*). In fig. 5 the fore part of the upper crus of the nasal (*n*) has been cut through, and the face has been severed where the skin of the forehead insheaths the skin of the beak, as we see in Ostriches and Tinamous. This sheath is indicated by a dotted line in fig. 2. This section is through the double valley between the alinasal and aliseptal swellings (fig. 2, *al.n*, *al.s*); and a branch of the nasal nerve (*n. n*) is seen piercing the thickness of the cartilage on each side of the septum, above.

As the alinasal region overlaps the aliseptal below, it (with its turbinal) lies lower in this section; its outgrowth (*a. tb*) has become more angular, or genuflexed, towards the septum, and thicker and upcoiled below. The uptilted floor-flaps (*n. f*) are brought closer to the turbinals (*a. tb*) and to the septum, and much further from the wall, the section of which is now largely hammer-headed. This section (fig. 5) is a front view; and from the short aliseptal region (*al.s*) we see a small ear-like process (outgrowth):

this is the anterior extremity of the true "inferior turbinal" (*i. tb*). This turbinal is shown in the next section at its fullest development (fig. 6, seen from behind), a mere foot-shaped outgrowth from the little extended "aliseptal" region, this part being almost aborted by the huge nostril-covers (alæ nasi). We shall see that in the Rook the "inferior turbinal" infolds itself two and a half times, in the Fowl twice, in the Rhea ("Ostrich Skull," pl. 10. figs. 14 & 15) and in the Tinamou (ib. pl. 15. fig. 9, *tb*) three times, whilst in the "Casuarinæ" (ib. pls. 10. & 12) this fold breaks up so as to be a veritable "arbor vitæ" in section. In this section (fig. 6) the septum (*s. n*) is thinning out towards the hinge; the alinasal wall is coiling inwards and thickening, still having its huge turbinal flap (*a. tb*); close behind this part the long submesial flap is tied strongly to the vomerine cartilage (fig. 8, lower view). The floor-flaps (*n. f*) are very large here; near their end their strongly bowed inner faces are very close together.

The next section (fig. 7) is viewed from behind; and the left antorbital plate or "pars plana" (*p. p*) is cut away: it is very large, as is shown on the other side. Between the alar and median parts of the fast-hardening ethmoid (*p. e*) and the antorbital wall there is a large open space, admitting the ingress of both first and fifth nerves (1, *n. n*).

This ecto-ethmoidal cartilage (upper ethmoid and pars plana) appears on the surface above and laterally; hence the abortion of the lachrymal, as in the Passerinæ. There is nothing to be called "upper turbinal" (*u. tb*) except the circular infolding of the aliethmoid (*al.e*) just in front of the antorbital wall; and the "inferior turbinal" shows a greater curvature just in front of that wall. The "middle turbinal" is only represented by a somewhat ridgy condition of the great posterior plate, between the other two. Having studied these parts in the highest Amphibia (*Rana*) and in the Snake, Lizard, Crocodile, and Turtle, I am enabled to say that the "Turnicomorphæ," although formed on the ornithic plan, yet have their nasal labyrinth very little in advance of what is seen in those cold-blooded types, and considerably below that of the "saurognathous" Woodpeckers. The postoral region presents a peculiarity which cannot be passed over, although the plan of the present paper does not strictly include those parts.

In my former Plates of these birds I figured in *H. varius* a large tympanic ("Gallinaceous Birds and Tinamous," pl. 35. figs. 1 & 2), and in the other species (pl. 34. figs. 1 & 2) a larger and a smaller bone; but in this invaluable skeleton, lent me by Mr. Salvin, I find *six* (Pl. LIV. fig. 12, *ty*)! and the last but one of this chain is much the larger, and is folded upon itself like a viper's tooth, as if to enclose some tube. I am not certain whether the "siphonium," which carries air into the lower jaw, is embraced by this bone or not; in my next instance it is, as I will soon show.

Considered by itself, the Hemipode is a low type of the "Carinatæ," more reptilian in some respects than the "Ratitæ" down below it. But if it be looked at as a remnant

of an ancient and almost extinct race, a race from which the most highly gifted and the most numerous of all the feathered tribes have probably sprung, then the interest increases ten-fold, and the morphologist will never rest until the relations of every branch to this simple stock are understood.

To this end a clear conception of what is *highest* in the facial morphology of birds is, before all things, necessary; and our Old-World Crows and Warblers will furnish us with "that which is most perfect in its own kind," and therefore fit to be "the measure of the rest."

On the Morphology of the Face in the Coracomorphæ.

Example 1. *Corvus frugilegus.*

Habitat. Great Britain and Europe. Group "Oscines," Müller; family "Corvidæ."

In all respects, physiological, morphological, and ornithological, the Crow may be placed at the head, not only of its own great series (birds of the *Crow-form*), but also as the unchallenged chief of the whole of the "Carinatæ."

The earlier stages of the skull-face of this type have already been given (see 'Monthly Microscopical Journal,' Nov. 1872, pls. 34–39, pp. 217–226). The figures of the fledgeling here given (Pl. LV. figs. 1–4) are a further working-out of the oldest figured in that paper (pl. 38). The dissected palate of this bird (*C. frugilegus*) is a full revelation of an "ægithognathous face." Once clearly understood, this will serve as a ready diagnostic in the discrimination of numberless species; by this they all may be judged, and then take the right or left-hand file—either to be classed with the Coracomorphæ, or take their room lower down with the less-specialized groups.

The parasphenoidal rostrum (fig. 1, *pa.s*) is short, and spreads into the symmetrical tympanic wings or "posterior pterygoid processes." Near the end it has a slight rudiment of the basipterygoid processes. At the opposite, distal end of the trabecular arch the coalesced præmaxillaries have a strong scooped triangular body; from this proceeds the dentary and palatine process, very close together, and, above, the combined nasal processes (*d. px*, *p. px*, *n. px*). The parasphenoid (*pa.s*) has completely coalesced with its endo-skeletal part, the proximal half of the fused trabeculæ; but the præmaxillaries have formed no such union with the anterior half. The azygous prænasal cartilage (*pn*) is still only half absorbed; behind it the coalesced distal ends of the trabeculæ are developed into a "recurrent process" (*rc.c*); behind this part they reappear in their originally broad flat form (*tr*), and then immediately in front of the "hinge-notch" they are compressed again: this part is seen in front of and above the vomer (*v*). But this foremost facial arch (the trabecular) cannot be studied here separately from the nasal labyrinth. In this palatal or under view (fig. 1) the alinasal laminæ (*al.n*) are continuous with the fore ends of the trabeculæ (cornua trabeculæ, *c. tr*), and also with the azygous prænasal

rostrum (*pn*), meeting beneath the axial parts; they are continuous with each other also; and this compound structure is one very important to be understood: morphologically the "recurrent trabecular cartilage" (*rc.c*) is formed by the free ends of the cornua trabeculæ.

The space between the front wings and their outer wall (*al. n*) is the external nostril (*e. n*). The outer wall of this nasal vestibule has in its inner side the large "alinasal turbinal" (*a. tb*); and this is separated by a narrow space from the subnasal (trabecular) laminæ (*tr*).

Behind, both wall and turbinal are continuous with the bony vomer (*v*). All this is made clear by the transverse sections.

The first of these (fig. 2) was made close behind the external nostril: the lateral and upper portions are here continuous. The razor has passed through the thick part of the nasal process of the præmaxillaries (*n.px*), the upper crus of the nasal (*n*), the dentary part of the præmaxillaries (*d.px*), the maxillary before it has given off the maxillo-palatine process (*mx.p*) and the præpalatine spur (*pr.pa*). Below, the nasal wall (*n. w*) rests in a groove of the maxillary; at its middle it gives off the "alinasal turbinal" (*a. tb*), which is large, and is thrice bent upon itself in an angular manner, giving off at the last two bends a slight secondary outgrowth. Above, the "alinasal" passes into the "aliseptal" cartilage (*al.s*, fig. 3); and here we have a section of the fore end of its turbinal, the "inferior"—anterior in the Bird, although below the others in Man. This is here scarcely more than half a cylinder. In this region the common wall between the nasal sacs is continuous with the crests growing from the flat, tilted, and coalesced "trabeculæ;" these are seen to be large and curved.

The next section (fig. 3) is through the maxillo-palatine processes (*mx.p*), which here are distinct in section from the marginal portion (*mx*); they form a pair of slanting planks, on which the compound vomer rests at its sides. The roof-bones (*n*, *n.px*) are here flattened out over the broad gently swelling "aliseptal" roof. At this point the wall has died out below; and the aliseptal lamina, after growing downwards and inwards for a short distance, folds itselt suddenly inwards, and is coiled two and a half times (*i. tb*). Between these large inferior turbinals a differentiating cleft has appeared, causing a dehiscence of the nasal septum (*s. n*) from the trabecular bar and crest (*tr*). The cartilages which lean towards this on each side are the common end of the alinasal wall and its turbinal; and the bony plate which is grafted upon both and binds them together is the vomer (*v*). The anterior face of the same somewhat solid section (fig. 4) shows more of the nasal cartilage; it is magnified twice as much.

The part of the trabecular commissure and crest (*tr*) seen here shows it to be small; it is not, however, far from the "hinge;" the trough formed by the vomer and the "inturned alinasal laminæ" (*i. a. l*) is very deep and large; and in the adult the bony matter, creeping along the cartilage to some distance, gives the vomer, in the macerated skull, the appearance of one very deeply scooped bone.

The bone itself (fig. 4, *v*) is concave above; it was formed from two symmetrical scythe-shaped moieties, each of which began as endostoses in the corresponding "vomerine cartilage:" they ossified it thoroughly, and then seized upon each alinasal wall, where they ended by turning inwards. But the broad cartilaginous band below (see fig. 4, *i. a. l*) has a separate bony graft, the "septo-maxillary" (fig. 6, *s.mx*); and this, with the extended bony matter in the nasal cartilages, gives the peculiar appearance the vomer of the adult bird has when viewed from below (fig. 6): it resembles the face of a bull, the ascending laminæ being little ears, and the outturned septo-maxillaries its short diverging horns. The septum nasi ossifies in the adult:—in front, from the ossification of part of the alæ; and the freed trabecular part (*tr*) by its own centre.

The compound "vomer" of the adult Crow has therefore been formed from:—

a. A pair of vomerine cartilages.
b. A pair of vomerine centres (endostoses of those cartilages).
c. A pair of septo-maxillaries—exostoses formed upon the following, namely
d. The end of each inturned alinasal wall, combined with the end also of its "outgrowth" the "alinasal turbinal."

Then, as if this amount of metamorphosis were insufficient, the crura of the vomer coalesce with the ethmoid processes of the palatines (*e.pa*), so that in each movement of the face the whole nasal labyrinth is carried forwards and backwards by the mobile pterygo-palatine arch. This second præoral arch has a short and stout suspensory segment, the "pterygoid" (*pg*), which, however, as the bird grows older, becomes slenderer, especially behind, where it acquires the epipterygoid hook or "hamular process." It flattens out horizontally in front, and then sends a spur to overlap the palatine. This becomes the "mesopterygoid"—separate in a young flyer (fig. 5, *ms.pg*), but soon to ankylose with the palatine.

The distal segment of this arch, the palatine (*pa*) is greatly longer than the pterygoid: with the fore end of the latter it tends to form a commissure, which is only completed by membrane; it is then bowed out on each side, and each moiety runs far forwards as a finely pointed style (fig. 1). Where it is overlapped by the pterygoid, there it is split mesiad into two laminæ; these end in front in sharp spurs, to the upper of which the vomerine legs are articulated; the lower or "interpalatine processes" are merely united by a ligament to the maxillo-palatine spatulæ.

If this were all, the palatines of the Crow would correspond with those of the Hemipod. But the first bony shaft does not calcify all the arch-moiety; it leaves an external outgrowth, which has *time to become* solid hyaline cartilage: this is the "transpalatine" element (*t.pa*), and it is a sure sign and correlate of *complete* ægithognathism. This free auricle of cartilage becomes, in a young summer-bird, a distinct bone (fig. 5, *t.pa*), ossifying at first by endostosis; and then, in the adult, it shows no sign of having ever been separate from the body of the palatine (fig. 6, *i.pa*, *t.pa*).

The fledgeling shows how ichthyic the maxillaries remain, even in this high type (fig. 1, *mx*); they wedge in below the dentary and palatine processes of the præmaxillaries, and then, growing broader, send inwards the great slanting spatulate maxillo-palatine spur (*mx.p*). This has a struthious coarseness now, but becomes elegant in its curves and scoopings afterwards (fig. 6), and acquires a distinct pedicle. That pedicle is much more slender and defined in many of the feebler forms that crop up around the true "Corvidæ;" and its form, ruder or more elegant, is very useful as a mark of high or low breeding in any type. The long jugal style (*j*) has no quadrato-jugal subdivision, but binds directly on the quadrate.

This latter bone and its relationships, although not coming within my stricter plan, has to be brought in here. It curves backwards (fig. 7, *q*) to be articulated with a raised facet common to the periotic and exoccipital regions: this "otic process" is merely the expression, morphologically, of the hooked form of the proximal end of every facial bar; its orbital process is the "pedicle" or *apical* process (*pd*).

Here, in the bird, instead of being enclosed in the tympanic cavity, it forms its crescentic anterior wall and boundary, and to it the rim of the membrana tympani is largely attached. Our ancestors called the quadrate the "tympanic"[1]; but younger eyes have beheld the true tympanic in another form: here it is seen divided into a fine chain of bones, seven in all; one of the seven, the largest, has a side duty imposed upon it, namely the walling-in of the "siphonium." This tube (fig. 1, *spm*) is membranous in the fledgeling; but afterwards in the Corvidæ, and in many of the singing-birds, the principal tympanic is coiled upon itself, the opposite edges uniting; thus the tube is quite enringed.

My demonstrations of these parts are from an old Carrion-Crow (*Corvus corone*); this is the example mentioned by Prof. Huxley (Elem. Comp. Anat., note to p. 249) as having six tympanics, as I had then informed him.

In fig. 7 the bone attached to the jugal (*j*) and that behind the articulare are "sesamoids" (*sd*) in the "external quadrato-articular ligament;" but the more massive bone running downwards from the tympanic ring to the upper surface of the "internal angular process" of the mandible is the "os siphonii" or principal tympanic.

In fig. 8 the pneumatic passage into the lower jaw is shown, a bristle passing into it; in fig. 9 the bristle passes also through the lower third of the insheathing tympanic, which is seen to be folded upon itself. Fig. 9 *a* is the upper or tympanic end of the bone, its edges perfectly closed in, forming an oval aperture. In the Crocodile (see Huxley, "On the Representatives of the Malleus and Incus," Proc. Zool. Soc. May 27, 1869, p. 391) the siphonium carries air from the quadrate into the articulare—but in the bird, from the tympanic cavity, as Nitzsch has rightly described it.

Correlated with the compound vomer, attached to the nasal vestibule, we have, with

[1] This fine old race of teleological anatomists is nearly extinct; only Owen remains of the remnant of the giants.

one notable exception, the ecto-ethmoid (*e.eth*) standing out flush with the rest of the face, and cropping up on the forehead, in this latter respect agreeing with Crocodiles and Monitor Lizards.

The great, gently scooped antorbital wall (fig. 5, *p.p*) is ossified in the young flyer by its own centre—a centre which backs the middle and lower turbinal regions. But the back of the upper turbinal region has, in the *Crow*, its own centre of ossification (fig. 5, *e.eth*). This "upper turbinal bone" is seen in the retired, smaller ecto-ethmoid of *Buteo vulgaris* and some other birds; but here, in the Crow, it forms the top of the outstanding "præfrontal" bone. The first and fifth nerves have each their own chink or passage, the pars plana growing into the aliethmoid between them.

The lacrymal (fig. 5, *l*), with one exception (the same as above, namely *Menura superba*), is, at its uttermost growth, a mere pupiform bar, thrust forwards by the huge lateral ethmoid, and wedged in between it and the nasal.

In a very large number of the Ægithognathæ the lacrymal cannot be seen at any stage; and in many of those in which it does occur it soon ankyloses either with the nasal in front or with the ethmoid behind. I find no orbito-sphenoid in the eye-socket of the Coracomorphæ, only a "præsphenoid."

Before passing to the next family, it may be mentioned that the vomer of the Corvidæ is not always typical; in *Fregilus graculus* its anterior half is a decurved, narrow, thick spoon, subacute terminally (Pl. LV. figs. 10–12).

Example 2. *Ruticilla phœnicurus* juv. Europe.

Habitat. Migrating in spring to Great Britain. Group "Oscines," Müller; family "Sylviidæ."

To me it seems evident that the genus *Sylvia* contains the highest or most specialized of the small Passerines, and this notwithstanding the corn-husking and fruit-crushing powers of the small conirostral Passerines, which are the result of secondary specializations; but in the fulness of their organization as to all that lifts a bird on high above a reptile, or above a reptilian bird, these types are, as to *family*, what a blood-horse is as to breed; they are of the highest and the purest blood. That these birds (the very aristocracy of the "Oscines" or songsters) are small does not much affect the question; for if we wish to look for a *low* bird of mean reptilian blood, we search for it amongst the ponderous giants, the small-brained, wingless, raft-breasted Cassowaries and Emues. It is as difficult to see the fundamental reptile in these refined ovipara as it is to discover the lineaments of the Caterpillar in *Vanessa io*.

In this pin-feathered nestling of the Redstart (*Ruticilla phœnicurus*) I have given as simple an expression of the two præoral arches and the nasal sacs (Pl. LV. fig. 13) as possible, omitting nothing important. Being the palate of a very young bird, it will differ less from what is seen in the adult of lower types than that of an old bird of this genus.

The trabecular arch, hidden behind by its under-beam the parasphenoid (*pa.s*), has no basipterygoid processes. Beyond the "hinge" it is soft, and, as in the Crow, is first narrow, and then spreads out as two oblique wings with a crenate and wavy margin (*tr*). The prænasal cartilage has been absorbed; and, beneath, the coalesced trabecular horns have grown into a triangular tongue of cartilage: this is the "recurrent lamina" (*rc. c*). The ox-faced vomer (*v*) has two crescentic emarginations in front; it is not uncommon to find a fore-looking projection at the mid line. This bone becomes pinched behind, its sharp legs converging; it has below a scabrous appearance from the loss of its periosteum, which was supplying it with new osteoblasts. On its shoulders it carries the great nasal vestibule; its moieties are grafted upon the "inturned alinasal laminæ" (*i. a. l*). Neither in the young Redstart, nor in the adult Whitethroat (*Sylvia cinerea*) have I been able to detect any lateral ossicles or septo-maxillaries. I have also searched for them in vain in the Wagtails (*Budytes rayi* and *Motacilla yarrelli*); but in the Willow-wren (*Phylloscopus trochilus*) they are very evident on each side in the substance of the nasal cartilage. This bird differs in some other respects, as we shall see. In the Redbreast (*Erithacus rubecula*) they are very small. The segmentation of the trabeculæ to form the cranio-facial hinge is, if the now absorbed prænasal be taken into the measurement, in the middle of the bar.

On each side of the septum nasi the nasal wall bends in as a wavy-edged floor-plate (*n.f*), above which is seen the large alinasal turbinal (*a. tb*). The coalesced præmaxillæ are such as we see in the young of all these birds, the dentary portion (*d.px*) largely over-overlapping the maxillaries (*mx*), and the palatine spur (*p.px*) binding the outside of the præpalatal bar (*pr.pa*).

The large vomer almost wedges aside the moieties of the palato-pterygoid arch as much as in the "Ratitæ." Indeed the adults of the Coracomorphæ seldom form any thing like a "palatine commissure" such as is so common in other perching and climbing birds. The right and left bars are bound together by the inwedged vomers; and the practical commissure is made by the early fusion of these bones.

The long, slender, rounded pterygoids—more slender still in the adult—have but a little epipterygoidean process in the young (*e.pg*); but this is evident and well formed in the old bird. A "mesopterygoid" (*ms.pg*) is breaking itself off from the fore part, where it overlaps the palatine. But for the diagnostic transpalatine lobe of cartilage (*t.pa*), the body of the palatine would be the almost exact counterpart of that of the Hemipod (see Pl. LIV. fig. 1, *pa*), the main difference being the greater length of the ethmo-palatal spurs that bind the outer edge of the vomerine crura. The transpalatine element answers very exactly to that of the Crow, being a rounded auricle; but in the adult (at least in *Sylvia cinerea*) the periosteal layers grow backwards, and give it an angular finish behind. The maxillary (fig. 13, *mx*) ends in front as far forwards as the palatine, and behind almost reaches the quadratum. The delicate jugal (*j*) nearly reaches the angle of the præmaxillary in front. The maxillo-palatine process (*mx.p*) is

narrow, thickish, scabrous, and solid, very unlike the elegant pedunculated trowel of the adult bird, with its angular projections and pneumatic chamber. But it is very much like its symmorph in the lower types of the Coracomorphæ, which seldom become pneumatic, and are but little pedunculated.

In the figure the rest of the nasal labyrinth is indicated on the left side by dotted lines; in the adult (*Sylvia cinerea*) the "os uncinatum" is only obscurely marked out on the rounded lower border of the pars plana.

Having endeavoured to give both the contrast and the harmony of the lowest and the highest of the birds possessing the ægithognathous palate, it will help to keep both writer and reader from embarrassment if we take next the *lowest* forms of the *true* but *rough-voiced* Coracomorphæ, all of them belonging to the "Notogæa"—old types inhabiting the New World.

The lowest of these is the Lyre-bird; at least it is the most abnormal in relation to the ægithognathous type; and, supposing it to have had an ancestry amongst extinct "Turnicomorphæ," they must have been far less passerine, and much more related to Tinamous and ancient Cranes than the modern forms[1].

Example 3. *Menura superba*.

Habitat. Australia. Group "Tracheophonæ," Müller; family "Menuridæ."

What I have to say upon the affinities of this bird will be merely from what I see in its *fore face*. Other workers may see what can be done with all the rest of its organization.

Side by side with Mr. Salvin's specimen I put the skull of the Trumpeter (*Psophia crepitans*). The comparison of these two types causes the mind to waver; and however necessary it may be to place the Lyre-bird with the Coracomorphæ, yet it belongs evidently to the same ornithic stratum, and most probably corresponds in *time* to this ancient Crane, with its dense, almost ophidian bones, and its lacertian chain of "superorbitals."

The basipterygoid processes are thoroughly aborted; the parasphenoidal beam (Pl. LVI. fig. 1, *pa.s*) is of moderate thickness, it projects little, in front, below the hinge. That subdivision of the facial axis is nearly perfect (fig. 3). In this skull, of a female evidently old, the nasal labyrinth in front of the hinge is unossified: it has been lost by maceration; yet the remnants of it are very *thin* lamellæ. The præmaxilla

[1] I say "ancient Cranes;" and the probability is that these abounded in the Tertiary period. The *Eurypyga* represents one family, the Kagu another, *Psophia* another, and *Thinocorus* (and I suppose with it we must associate *Attagis*) a fourth.

All these are ancient types that have lost their nearest relations. They are altogether more struthious than the ordinary "Gruidæ." Professor Newton, in a letter to me, insists that *Thinocorus* belongs to the "Limicolæ:" as to its *body* it *does*; its *head* is a morphological mixture.

(figs. 1–3, *px*) is of that moderately developed kind which might be found in a feeble-faced bird of almost any great group: notably it is like that of *Hemipodius* (Pl. LIV. fig. 11, *px*). The large open nasal space in the dry skull, the feeble differentiation of the palatal process of the præmaxillaries, and the subcarinate, triangular form of the fore part of the vomer (*v*)—all these are like what is seen in the young of the Crow (Pl. LV. fig. 1, *p.px*, *v*). At first sight the vomer appears to militate against the bird being of the "kind" of the Crows; but what I show in the young Rook clears the thing up, and still better what may be seen in the Chough (*Fregilus graculus*). In this bird the vomer (Pl. LV. figs. 10–12) is seen to be scarcely at all more passerine than that of *Menura*; it is more downbent in front; and the scooped facets, from which the angle of the "inturned alinasal lamina" (*i. a. l*) has been macerated, are somewhat larger.

As the relation of the vomer to the nasal capsule is my proper *text*, I think it will be seen that I have here pointed out the true diagnostics in *Menura*[1].

The vomer of *Menura* (Pl. LVI. figs. 1, 3, 5, *v*) is lanceolate, rather solid, carinate below, and ankylosed by its crura to the ethmo-palatine plates. It is bent downwards in front (fig. 3), but not so much as in *Fregilus* (Pl. LV. fig. 12, *v*). The nasal *scars* (fig. 5, *i. a. l*) are shallow-rimmed cups, as in *Fregilus*. In neither of these types does the vomer encroach so much on the nasal cartilages; and in neither of their adult skulls can any septo-maxillary centres be seen: they may have existed near the vomer on the nasal cartilages.

The pterygo-palatine arch is almost typical; the pterygoid itself is short, but neat and well-shaped, having a large "epipterygoid" hook, a well-formed cup for the quadrate, a large anterior lobe clamping the basifacial beam, and a well-detached large "mesopterygoid" (fig. 3, *pg*, *e.pg*, *ms.pg*). The palatines (figs. 1 & 3) have an evident transpalatine territory (*t.pa*), which, being uncinate, makes the angle almost as much developed outwards as in the Rook (compare Pl. LVI. fig. 1, with Pl. LV. fig. 6, *t.pa*). The interpalatine spurs (*i.pa*) are stout, and are exactly like those of the young Rook (Pl. LV. fig. 1, *i.pa*), being larger than those of the adult (fig. 6). The thin conchoidal ethmo-palatal laminæ (figs. 3 & 5, *e.pa*) do not extend further forwards than the interpalatine spurs; they rise and attach themselves to the upper edges of the vomer, exactly as in *Fregilus*. The angle on the outer edge of the palatine, where it suddenly narrows into the præpalatine bar (*pr.pa*), is precisely like what is seen in the Rook (Pl. LV. fig. 6); and so is the thickening of the edge at that part. The præpalatine bar remains distinct from the præmaxillary and maxillary (figs. 1 & 2).

The sides of the broad part of the palatines are much steeper than in the Corvidæ; the sulcus between the side and the interpalatine edge is deeper: and the interpalatine

[1] I have very long been familiar with the peculiarities of the passerine palate; but my recent paper, in the Monthly Microscopical Journal (Nov. 1872), on the Crow's skull is the first matter published by me directly on this subject.

laminæ grow much nearer together, and more perfectly enclose the nasal tube. The maxillary (figs. 1 & 2, *mx*) is a long, narrow bone, elbowing out very little at the angle of the mouth, and widening very slightly where the maxillo-palatine process (fig. 4, *mx.p*) is given off. This process has a very delicate, flat pedicle; and the broken root of this, in Mr. Salvin's specimen, appeared to me to be the whole process, very small. But, happily, at the last moment, Professor Garrod has corrected my mistake; and in his specimens, kindly lent to me, they are seen to be unusually large and pedate, quite like their counterparts in the Corvidæ. They are not pneumatic; but in *Corvus* they are very slightly so.

The long slender jugals are ankylosed to the jugal process of the maxillary. The nasals (*n*) and the large external nasal opening are altogether and thoroughly coracomorphous. Let these parts be compared with those of a Robin or a Wren, and their close correspondence will be seen.

But the ethmoid and its surroundings are the real stumbling-blocks in this bird; and if this part had been placed in my hands as an unnamed fragment, it would have taken a place close by *Psophia*. Yet the antorbital plate fits much more closely to the large spongy lacrymal (*l*) in *Menura* than in *Psophia*. In both there is, in this bone, a large superorbital portion, joined by a narrow waist to a pedate base, close to the jugum. In *Psophia* the antorbital runs into the osseous back wall of the upper turbinal; in *Menura* it is quite distant from the roof; a large oblong space, through which the olfactory and nasal nerves (1, 5, 5′) pass, extends from the meso-ethmoid to the inner face of the lacrymal.

The antorbital is wholly ossified (fig. 3, *p.p*), it is square, entirely lies within the orbit, and has a rounded infero-external angle, with no sign of an "os uncinatum;" this is aborted by the pedate base of the lacrymal; yet there is in that bone, *in front* of the angle of the antorbital, an elegant pyriform lobe, with its narrow end looking inwards, whose direction is towards the ecto-ethmoid. This is undoubtedly the same as the distinct "os uncinatum" of many birds. At the brow-edge of the great lacrymal there is a larger anterior and a smaller posterior superorbital. In *Psophia* there are seven such bones on one (the left) side; on the other they are ankylosed so as to form only five.

All the three orbital bones of *Menura* come up flush with the broad, flat frontal region (fig. 2, *f. l, s.ob*). There is one superorbital perched on the end of the long spur of the lacrymal in Eagles and Hawks; but a chain of bones, reduced here to three counting the lacrymal, is very rare; *Psophia* and the Tinamous are all I have seen with such a chain[1].

And now it may be asked, If *Turnix* be taken as a sort of *stock form* for the whole of the "Ægithognathæ," how is it that *Menura* is in some respects lower than *Turnix*?

[1] Since the above was written I have received from James Wood-Mason, Esq., his paper on the Arboricolæ (Wood-Partridges). He has found a perfect chain of superorbitals in four out of the eight known species of that genus (see Journ. Asiat. Soc. Bengal, vol. xliii. part 2, plate 2, 1874).

To this I answer that the existing "Turnicomorphæ" are most probably a few remaining wanderers, that still exist from Europe to Australia, of a huge family of birds of all sizes, in great variety of shape, and specialized to all sorts of life. We may imagine innumerable kinds of Struthionidæ, Tinamidæ, Turnicidæ, and that "by these was the whole earth overspread," and that amongst all this variety of "Ratitæ," and of "Carinatæ" with almost keelless breast-bones, there arose from time to time birds with new characters, the stocks and forefathers of walking, wading, swimming, diving, perching, and climbing types: hence came the Dodo and the Solitaire; and from the same ancient bird-world sprung the gigantic Rails of New Zealand (*Aptornis defossor*, Owen, and *Notornis Mantelli*).

The direct ancestors, in the wide paleontological sense of the word, of the Lyre-bird would most likely have a huge body, feeble wings, a less exuberant tail, an almost keelless breast-bone, bony eye-brows, and a vomer more pointed and relatively larger than in the recent bird; and that vomer would, like the same bone in *Turnix*, be attached to the nasal walls by a ligament, and not grafted upon it.

Then, on that level, possessing *incomplete* "ægithognathism," such a bird might have belonged to a family allied to the "Turnicomorphæ."

Example 4. *Pipra auricapilla.*

Habitat. Guiana. Group "Tracheophonæ," Müller; family "Cotingidæ."

This bird may be said to stand on the direct road from the lower Carinatæ to the Crows, and not on the *bridle-path*, like *Menura*.

The bat-shaped swollen basitemporals (*b.t*) underlie a thick parasphenoid (Pl. LVII. fig. 1, *pa.s*), with no trace of basipterygoid process; then the beam becomes gradually narrow to the cranio-facial hinge. In front of the hinge, which is as complete as in the Crow, there is an alate septal base (*tr*) also perfectly corvine. A fenestra partially separates the trabecular from the nasal part of the septum; below and behind the fenestra this part of the first arch had its own bony centre; in front and above, the bony matter belongs to the median part of the nasal labyrinth. A perforate nostril is here formed by the round deep notch below the alate septum (*tr*) and the recurrent fold (figs. 1 & 3, *rc. c*). Although the septum is so well ossified, the rest of the nasal labyrinth, in front of the hinge, is soft.

The gently curved beak has an almost triangular outline (fig. 1); and although its elements are ankylosed together, the various processes can be made out; the palatine bars of the præmaxillaries (*p.px*) end in a sharp point; the dentary processes (*d.px*) overlap the maxillaries (*mx*) at the angle of the mouth; and the nasal processes have shortened ends to articulate with the frontals. Here, again, the vomer (figs. 1 & 2, *v*) is the most important part.

The vomerine moieties are broadish and very thin in front, and become filiform behind. This part is three fifths the length of the whole; and their crura are very near

together; they coalesce with the ascending palatine plate. The thickened shoulders of the vomer are bevelled off; and here it is seen that the bony matter has ossified only the posterior clavate portion of the vomerine cartilages (compare Pl. LVII. fig. 2, *v*, *v.c*, with Pl. LIV. fig. 8, *v*, *v. c*). The bony substance of the vomer is in immediate contact with the inturned alinasal lamina (*i. a. l*), but does not run into it; the same may be said of the small, triangular, apiculate "septo-maxillaries," which are attached (one on each side) to the posterior border of the nasal cartilage, where it overlaps the vomerine cartilage. These modifications form an exact half-way between the Crow and the Hemipod. These form the first variety of "complete ægithognathism," these parts in this type being quite distinct, the septo-maxillary grafting itself on the scarcely ossified vomerine cartilage, and not on the inturned alinasal wall (Pl. LVII. fig. 2, *i. a. l*, *v. c*, *s.mx*, *v*).

The "maxillo-palatine processes" (figs. 1 & 2, *mx.p*) are simple, flat, pedate outgrowths of the maxillaries; and in *Pipra* they do not bind tightly against the vomer, as in those next to be described, but lie on a considerably lower plane. Behind these processes, the maxillary continues broad for some distance, and then becomes filiform, running without any suture into the jugal (*j*).

In the endo-skeletal elements of the second arch we have a subtypical condition of the parts. The epipterygoid process of the pterygoid (*e.pg*, *pg*) is not much developed; but the bones themselves are thoroughly passerine, the flat anterior head articulating with its own segment, the mesopterygoid, which is now confluent with the palatines.

The palatines (fig. 1, *t.pa*, *pr.pa*, *pt.pa*) are very instructive; they are strongly bowed out behind the short, straight præpalatal portion; but the *angle* is small, square, and notched. This transpalatine process (*t.pa*) was evidently formed in a very slight angular cartilage; and I much doubt its having had a separate bony centre.

The interpalatine spurs (*i.pa*) are very large and spinous; and the concave bridge of bone between these and the angular process is of greater extent than the upper or ethmo-palatal lamina, which sends a small spur along the outer edge of the vomer. The postpalatal laminæ (*pt.pa*) meet each other below the parasphenoidal rostrum (*pa.s*), and are greatly enlarged, orbitally, by the mesopterygoid segment.

The lacrymals are, I believe, corvine (but are lost in this specimen); and so is the ethmoid (*p. p*). As in *Menura*, the passages for the first and fifth nerves are not distinct, one broad roadway, very wide on the inside, existing between the upper edge of the thick spongy antorbital and the ethmoidal roof.

The vertical width of the antorbital is small inwards; but it is flush with the face, and very massive outside and below (see fig. 1, *p.p*, where it is indicated by fainter shading). I have not found any separate "os uncinatum;" it may have been lost with the lacrymal.

Example 5. *Pachyrhamphus* ——?

Habitat. Guiana. Group "Tracheophonæ," Müller; family "Cotingidæ."

This skull, at first sight, might be taken for that of a Tanager; but it is widely different: it corresponds in all essentials with that of *Pipra*. Notwithstanding the great expansion of the face in front, the palatine region is less divergent behind, and in some respects we get here a truer repetition of *turnicine* characters than in *Pipra*.

The bat-shaped basitemporal region has a broader middle part (Pl. LVII. fig. 4, *b.t*); the basifacial bar (*pa.s*) has no basipterygoids. The hinge is not quite perfect; a bony isthmus connects the ossified septum nasi and perpendicular ethmoid above.

There is no fenestra in the deep, stout, thoroughly ossified nasal septum separating the nasal from the trabecular portion (*s. n, tr*); and thus this type is, in this respect, intermediate between the Tinamou and *Syrrhaptes* ("Gallinaceous Birds," pl. xxxvi. figs. 1 & 4; and "Ostrich Skull," pl. xv. fig. 8, *s. n, c.f. c*). The triangular expansion at the fore part of the base of the septum is due to the coalescence with it of the "recurrent lamina." The *depth* of the septum brings it into immediate contact with that retral process; and the nose is not perforated as in *Pipra*, with its alate, shallow septum (fig. 3).

The vomer (figs. 4 & 5, *v*) keeps its breadth better than in *Pipra*; its less convergent crura are ankylosed to the ethmo-palatine spurs. As in *Pipra* (see fig. 2), the ox-faced vomer has only utilized the clavate hinder part of the "vomerine cartilages" (*v. c*), which converge towards the septum, and are separated from the inturned laminæ (*i.a. l*) by a very moderate distance (fig. 4). The alinasal wall with its turbinal is ossified throughout by endostosis. It is not so hard as the vomer; but these two bones keep their own proper morphological territory; and the line of junction of the two is at the roof of a deep rounded sulcus (fig. 5, *i. a. l, v*), covered by the curling inwards and downwards of the inturned angle of the alinasal. Exactly where the two osseous tracts meet at their inner side, a small limpet-like bony centre stands, looking forwards, and forming a boundary-stone between the alinasal and vomerine regions: this is the septo-maxillary (*s.mx*). It does not, as in the higher Coracomorphæ, form an ectosteal patch to the alinasal wall, which has ossified independently of it. The shoulders of the broad, stout vomer are strongly thickened and downbent to articulate with the maxillo-palatine plate (*mx.p*), the whole build of the palate being stronger than that of *Pipra*.

Thus the inferior face of the vomer is excavated in front, and its fore edge has a squared emargination. Another *upper* palatal element, the os uncinatum, or "palato-trabecular conjugational bone," is here beautifully distinct (figs. 4, 6, 7, *o. u*), but has been displaced outwardly by the *corvine* lacrymal (*l*) from its earlier ecto-ethmoidal relationship (*p. p, e.eth*). This small seed-like bone has a rounded outer edge, and articulates by an inner suture with the lower and outer edge of the lacrymal; its mother substance was a secondary bud, growing from the outer edge of the trabecula. In this type the great lateral ethmoids, although less swollen than in *Hemipodius*, have a greater lateral development; indeed they carry this to a greater extent than any known bird (figs. 4, 6, 7). The very narrow frontals covering the great outspread ethmoids ("præfrontals")

give this part of the head a very crocodilian aspect. The spongy *inner* part of the pars plana (fig. 6, *p. p*), however, is of small vertical extent, as in *Pipra*; and the nerve-passages run freely into each other. Part of the alinasal is ossified on the outside round the external nares (figs. 6 & 7, *al.n*); this gives, in the dry skull, a notched appearance to these wide passages. The small semi-lacertian inferior turbinals are ossified by endostosis. Every thing hitherto shows *Pachyrhamphus* to be a very generalized bird in its own great family or suborder; the lower palatine structures will yield like evidence. The pterygoids (fig. 4, *pg*) are stronger and more arched outwards than in *Pipra*; but the epipterygoid spur is bound close to the front of the quadrate, as in the Turnicidæ and Gallinaceæ. The whole bar, by ankylosis, has relapsed into unity; for the pterygoid, mesopterygoid, and palatine have lost all their sutures (fig. 6, *pg*, *e.pa*, *ms.pg*). Between the postpalatine descending lips (*pt.pa*) there is more of the parasphenoid seen than in *Pipra*; and these inferior lip-like laminæ soon cease, passing into the interpalatine spikes (fig. 4, *i.pa*), which are spongy and have ragged edges.

The body of the palatine is but little bowed, and sends only a few toothlets backwards as rudiments of the transpalatine region (*t.pa*); thence the bar is narrow, feeble, bowed in, and then curved outwards a little before it ends, converging towards its fellow. The upper lamina or ethmo-palatine (fig. 6, *e.pa*) is of the same extent; but its spike, ankylosed to the vomer, is smaller than that of the lower or interpalatine lamina.

The præmaxillaries and maxillaries together form an elegant leaf-like rostrum (figs. 4, 6, 7), not unlike that of the Boatbill (*Cancroma*). The whole structure is extremely light, and coarsely spongy; and the coalescence of the maxillaries, præmaxillaries, nasals, and jugals is all but complete; a little remnant of the suture is seen above the hinge.

On each side, close inside the angular process of the præmaxillary, are seen the large, broad-based, *struthious*, maxillo-palatine processes (figs. 4 & 5, *mx.p*): these are pneumatic, somewhat hooked, and bind by their inner edge on to the downturned shoulder of the vomer. These processes also show that this form is more generalized than *Pipra*; the palatines and septum nasi show the same thing.

Example 6. *Thamnophilus doliatus.*

Habitat. Guiana. Group "Tracheophonæ," Müller; family "Formicariidæ."

This strong-billed bush-bird shows the "Formicariidæ" to be on the same ornithic level as the "Cotingidæ." They have both cleared the turnicine boundary *by a long distance*; but they are metamorphosed in the face much less than the typical Crows, Warblers, and Finches. A mere glance at the figures (Pl. LVII. figs. 1, 4, 8) of the palates will show how near *Thamnophilus* comes to those last described, especially to *Pachyrhamphus*; in some respects this form comes nearest to the Hemipods, in others the latter.

The basitemporal and parasphenoidal regions are precisely like those of the "Cotin-

gidæ;" and the nearly perfect hinge is bounded in front by a knife-like septum, as in *Syrrhaptes*, *Hemipodius*, and *Pachyrhamphus*; but this is not ossified; it is not alate in the middle, but has in front two triangular laminæ of bone underpropping it; the lower of them is a median process of the præmaxillary; and the higher is the "recurrent lamina" of the trabeculæ (*rc. c*); this is largely edged by unossified cartilage.

In *Thamnophilus* we have a pertinent instance of the occurrence of intense ossification in a low type, showing that arrest of ossification is not of itself a sign of low position[1]. The whole nasal capsule is ossified, with the exception of the margin of the very large recurrent laminæ and the septum, and had better be considered along with the vomerine structures.

The alinasal turbinals (*a. tb*) are very large and bony, and they articulate by their convex end with a concavity on the horns of the enlarged vomer (fig, 9, *a. tb*, *v*). The alinasal wall (*al.n*) is not even flush with the facial bones (fig. 10), but sinks in, and is thoroughly ossified; below and within it is seen to have coalesced completely with the maxillo-palatine process (fig. 9, *i. a. l*, *mx.p*), and is of very small extent in the floor of the nose, which is here open, exposing the alinasal and inferior turbinals (*a. tb*, *i. tb*). Here the bony growths are much in conformity with the morphological regions, save that the ankylosis of the alæ nasi with the palatine plate of the maxillary has produced a form of desmognathism.

In *Thamnophilus* the vomerine moieties are as much indebted to hyaline cartilage for the formation of their wings and crests as in the Crow, but the *source* is different: here the cartilage is the vomerine spatula; there, in the Crow, that cartilage is soon used up, and then the bone grows into the nasal capsule to a certain extent. In this instance the vomerine cartilages are themselves large enough to form a substratum for all the outgrowings of the vomer, so large and massive in the adult.

Not only does the alinasal turbinal form a cup-and-ball joint with the vomer, but the vomer itself has an elevated subconvex facet on each side, which fits into a subconcave facet on the upper surface of the corresponding maxillo-palatine plate. Altogether this ægithognathous palate is developed into a very complex kind of desmognathism. At first sight the septum would seem to be ossified; but a side view shows that it is only the inferior edge which is bony, and the bone is quite free from the cartilage; it is, in this state, merely a membrane bone, a "median septo-maxillary" (fig. 8, *m. s.mx*). We shall soon meet with this element again.

The præmaxillaries form the strong, narrowish, decurved beak, and are thoroughly ankylosed to their surroundings.

The pterygo-palatine arch has a typical apex, the epipterygoid hook (*e.pg*); it is longer than is usual even in the higher forms. The pterygoids are rather long, elegantly bowed, and have given off a large mesopterygoid, which has become ankylosed to the upper edge of the palatine; the pterygoids remain distinct. The palatines are extremely like those

[1] Neither intense ossification nor pneumaticity of the bones are signs of "high degree."

of the "Cotingidæ," having a long, sharp, inferior postpalatine keel on each side, between which a small tract of the parasphenoid is seen. The middle palatine region is suddenly dilated, but is of very small extent—the band connecting the base of the præpalatine bar with the interpalatine spur being very narrow (fig. 8, *i.pa*), and the transpalatine rudiments very small and gnawed (*t.pa*). The middle nasal passage is made very wide by the large rounded fold of bone which connects the "ethmo-" with the "interpalatine" (figs. 8 & 9, *e.pa*). The præpalatine band is narrow, feeblish, a little bowed outwards; and ankylosed, in part, to the præmaxillary. Here, with very typical pterygoids, the palatines are the simplest and most turnicine I have hitherto seen in this great group, with the exception, perhaps, of *Pitta*.

The maxillaries and jugals are ankylosed together; the maxillo-palatines (*mx.p*), partly described already, have a very broad, pneumatic root, and are as struthious as in the "Cotingidæ." I miss the lacrymal, seen in the last family; but the lateral ethmoid is very similar; both above and below it is more than flush with the rest of the face; it shows no separate os uncinatum; yet the *foot* of the antorbital is very large (fig. 10, *p.p*). Above that plate there is, as in the "Cotingidæ," a large common chink for the nerves going to the nose; but the proximal part of the pars plana is much deeper (compare figs. 6 & 10, *p. p*).

Altogether this bird's face is of extreme interest, as instructive as that of the last type.

The structure of the face in *Thamnophilus atricapillus* is precisely like that of *T. doliatus*.

Example 7. *Pitta melanocephala*.

Habitat. Borneo. Group "Tracheophonæ," Müller; family "Pittidæ."

This form is closely allied to, and yet differs considerably from, the last.

The basitemporal and parasphenoidal regions are the same as in *Thamnophilus*; but the fore face is straighter, and the angles of the mouth expand more, so that the dentary part of the præmaxillaries is more outturned (Pl. LVI. fig. 6, *d.px*); the general structure of the bone is coarser; and altogether there is something more struthious in the stiffness of form and general inelegance of build. Instead of the intense ossification of *Thamnophilus*, the outer nasal structures are but little ossified, principally the septum. The vomer (*v*) is very flat below, and, above, rises towards the mid line, its groove receiving the large septum, which is not notched off from the ethmoid; the upper lobes, in front, are moderately developed; and the lower are swollen, so as to give a heart-shaped appearance to this part: these latter lobes (fig. 7, *v*) are strongly articulated to the maxillo-palatines (*mx.p*). The vomer has evidently grafted itself upon the alinasal turbinal, although it owes nothing, or scarcely any thing, of its size to that cartilage. Yet this intimate union of the vomer with the nasal capsule puts *Pitta* into the typical division; in this respect it has "complete ægithonathism" of the 2nd variety.

Thus this genus is very interesting as leading upwards towards the typical forms. In this macerated specimen, the septo-maxillaries have evidently been lost; for the angle of the alinasal turbinal has been removed.

The second arch has its hinder segment less, and its fore segment more typical than in *Thamnophilus*.

The epipterygoid is feeble; and the rest of the bone (fig. 6, *pg*) is like that of *Pipra* (Plate LVII. fig. 1, *pg*), short and straight; but it is thicker and coarser.

The mesopterygoid element has coalesced with the palatine, leaving the pterygoid itself free. The postpalatine keels (fig. 6, *pt.pa*) are deep, as in these low Coracomorphæ generally; and the broad part of the palatine is attached to the præpalatine region at right angles, so that the appearance is that of a pair of hatchets stuck into the basis faciei, opposite each other. The transpalatine portion (*t.pa*) is a badly developed snag; the interpalatine spurs (*i.pa*) are very small; and the two laminæ end in front, one above the other, very nearly—the ethmo-palatine swelling out as in *Thamnophilus*, and passing a little in front of the interpalatine plate (Pl. LVI. fig. 7, *e.pa*). The præpalatine bar is very flat and broad in front; and the whole of this arch is stiff, coarse, and untypical. So also are these great flap-shaped maxillo-palatines (figs. 6 & 7, *mx.p*); broad-based, lathy, with a thickened inner edge, roundly notched for the vomerine joint, these ear-shaped processes are strong marks of inferiority of type. The zygomatic process of the maxillary is broad and flat proximally, and is thin and vertical where it becomes one with the jugal (*j*).

The lateral ethmoidal region is quite *Thamnophilinè*; but the pedate *processus uncinatus* of the thick pars plana is less marked. There is here, again, no lacrymal; and the 1st and 5th nerves pass through one wide, oval, very large cavity from the orbit to the nose: *Menura*, *Pipra*, *Pachyrhamphus*, *Thamnophilus*, *Pitta*, and *Grallaria* all agree in this character; and they do not agree by accident. This great open door will lessen, and be barred across, as we ascend. We have seen it to be so in the Rook.

Example 8. *Grallaria squamigera*.

Habitat. Andes of Columbia. Group "Tracheophonæ," Müller; subfamily "Formicariidæ."

In the palate of *Grallaria*, as compared with *Pitta*, two or three striking points of contrast are seen, modifying the great general harmony between the two.

The whole structure is less stiff and clumsy; the palatines are better developed; the angle of the mouth is not so wide; and the nasal labyrinth, in front of the vomer, is much longer. There is still less ossification of the interior nasal structures than in *Pitta*; but that this does not affect the zoological or even the morphological height of the type is evident; for in *Thamnophilus* below, and in the next higher than *Grallaria*, namely *Artamus*, ossification is intense, whilst in these two intermediate forms it is arrested.

As compared with *Pitta*, this form has the same gallinaceous epipterygoid (fig. 8, *e.pg*),

and an equally straight but slenderer pterygoid (*pg*); between these the parasphenoid (*pa.s*) is thick and without basipterygoid processes. Above the parasphenoid the thick perpendicular ethmoid (*p. e*) and the septum nasi are but parts of one continuous orbito-nasal septum, as in the Tinamidæ; for here the *cranio-facial cleft* is as imperfect as in *Tinamus variegatus* ("Ostrich Skull," pl. xv. fig. 8, *c.f. c*): even in that species there is a considerable "notch." There is this carinate character, however; and that is, that the ossification stops at the usual place, and the bony matter does not pass from the ethmoid, forwards, to ossify the nasal septum (*op. cit.* pl. xv. fig. 10, *p. e*, *s. n*). Yet in respect of this almost undivided orbito-nasal septum, this ground-bird is one of the most struthious of the carinate types; it has, however, a small oblique fenestra in front of the "meso-ethmoid" (fig. 10, *c.f. c*).

The anterior part of this vertical plate in *Grallaria* is principally hyaline cartilage, unchanged; but above, a septal bone appears; and below, a very frequent centre, the "postseptal" or *trabecular* bone (*tr*) has commenced. This is the bone which, in many typical Carinatæ, forms the postero-inferior angle of the septum nasi; and it bounds the great "hinge" in front. Here it is seen midway between the ethmoid and the fore part of the huge, deep septum. The symmetrical parts of the nasal labyrinth are supplied with arrested centres of ossification; on the inner face of the alinasal turbinal (figs. 8, 9, *a. tb*) there is a long, lanceolate tract of endostosis; and on the base of the posterior third of the left alinasal turbinal there is a patch (fig. 9, *a. tb*) both ectosteal and endosteal.

On the outer face of the "inferior turbinal" there is a large wedge-shaped, well-ossified tract, with its base behind; and on the outer face of the upper turbinal there is a squarish bony tract, the size of that on the inferior turbinal. Also the posterior half of the alinasal wall is ossified as in *Geeinus viridis* and many of the "Coccygomorphæ." All these bony centres are of great interest; for they represent the various commencements of the continuous bony growths seen in this region in such birds as *Gymnorhina*, *Artamus*, and also in birds that lie beyond the passerine boundaries.

Perhaps in the whole range of ornithic morphology there is no character more to be depended upon than that cleft in the trabecular commissure which, growing upwards, divides also the anterior nasal from the true olfactory region. Yet in *Pitta* and *Grallaria* this is almost absent, and their intense *struthiism* is combined with ægithognathism of the highest degree. The vomerine moieties have grafted themselves upon the end of the alinasal turbinals (fig. 9, *a. tb*, *v*); and, on each side, a septo-maxillary (*s.mx*) supplements this peculiar metamorphic union of diverse parts. The thick, massive upper lobes of the vomer evidently owe their great size both to the alinasal turbinals and to the proper vomerine cartilages. As in *Pitta*, the rest of the vomer is flat, and the crura are near together; they coalesce with the coiled ethmo-palatine.

The next arch is extremely like that of *Pitta* (see figs. 6 & 8); the pterygoids (*pg*), however, are slenderer, and the postpalatine keels longer: these are separate from the

pterygoid; but they are greatly developed above by a mesopterygoid segment, larger than that of *Pitta*.

So also we have in *Grallaria* slenderer præpalatine bars (*pr.pa*) and much more development of the transpalatine spike (*t.pa*), which is here in a state very common in the higher *Southern* Coracomorphæ. The arrest of the lower spike of the palatine (interpalatine, *i.pa*), the coil of the upper or ethmo-palatine (*e.pa*), and the narrowness of the band connecting these laminæ with the outer edge, these are all *pittine* characters; but this bond is oblique, and not transverse as in *Pitta*; in this, it agrees with the next and much higher type, namely *Artamus*. The elements of the upper jaw and zygoma are strongly soldered together; and from the maxillary region there grow *struthious* maxillo-palatines (*mx.p*), exactly like those of *Pitta*.

The nerve-passage above the antorbital is narrower than in *Pitta*; and the plate itself is thinner and more produced at its angle (fig. 8, *p.p*); but there is no sign of either a lacrymal or an "os uncinatum."

On the whole, the cranio-facial differences seen in these two types, whose habitat is so far apart, merely bespeak a subgeneric distinction. Close to the Struthionidæ in certain respects, in others they have made a stride past the lower Coracomorphæ generally. That the lower struthious characters are due to arrest at a stage which corresponds to the end of the second third of incubation in the true Crows (*Corvus*) and in the Fowl, does not affect the relationship of these birds to some lost forms of the "Ratitæ."

Example 9. *Artamus leucorhinus*.

Habitat. Celebes. Group "Oscines," Müller; family "Artamidæ."

The last instances were *two-faced*; they looked to the Ratitæ, and to the nobler Southern Coracomorphæ. My present instance is also one of these.

Looking at the palate of this "Wood-Swallow," it is difficult to say to which of these two types it is most related; it is in some things intermediate between them. This great similarity is modified by two things, namely by far intenser ossification and by complete ornithic metamorphosis. Although the growth of another branch, yet this bird culminates, as a southern type, at nearly the same level as the Piping Crow (*Gymnorhina*).

The basitemporal region (Pl. LVIII. fig. 1, *b.t*) is less evidently trilobate than in *Pitta*; and the parasphenoidal region (*pa.s*) is less bulky. The rostrum ends at an unusual distance behind the hinge; and the basis faciei shows no mark of its former compositeness.

The hinge, or cranio-facial cleft, is perfect, totally unlike its pittine prototype; and the fore part of the middle ethmoid shallows gradually, and is rounded in front. The trabecular and nasal elements are all ankylosed; and the bone here, as in the rest of the skull, is more elegantly light and spongy than in *Grallaria* and *Pitta*.

As in *Grallaria*, the nasal vestibule is of very great size; but here it is ossified to an unusual extent; and the nasal floor, so small in the types just described, but largely

developed in the Turnicidæ (Pl. LIV.), is here quite perfect, has undergone thorough ossification, and is ankylosed with all the surrounding parts (Pl. LVIII. figs. 1 & 2, *n.f*); hence the septum (which is here a crest to this strong, bony plate) is not seen in the palatal views. Yet, within, the posterior part of the alinasal turbinals, and, without, the hinder part of the alinasal walls are soft; and so also are the inferior turbinals. The extreme end, however, of the alinasal turbinals has a borrowed source of bony matter in the large upper spongy lobes of the vomer (*v*); these have evidently coalesced with the small lateral septo-maxillaries (see *Grallaria*, Plate LVI. fig. 9, *s.mx*). The upper and anterior vomerine lobes wall-in a deep sulcus, and are extremely beautiful and pneumatic; their air-passage is above, and is very large. The difference which can be detected in this very *Pittine* vomer is, that it is more spongy, has drawn more upon the turbinals, is subcarinate below, and has a larger space between its crura; in the shortness of its conjoined part it is like *Grallaria* and not like *Pitta*: this oscillation between these two relations is to me a very striking thing[1].

Of exactly the same pattern, yet the palate, like the rest of the face, is broader than that of *Grallaria*; and this outspread form of the whole face gives wider individual parts. In mere form, the pterygoids, with their arrested epipterygoid hooks, are not altered visibly; but they, and their mesopterygoid segment, have become ankylosed to the palatines: this is part of the generally intense ostosis of this bird. In the palatines a change is easily discerned; it is the lessened condition of the postpalatine keels (*pt.pa*), so large in the lower Coracomorphæ. The "transpalatines" (*t.pa*) are broader and altogether more developed; they are flatter and better-formed; and, having had a fuller matrix of cartilage, they are less like mere periosteal outgrowths.

The ethmopalatine lamina takes a less sweep; its spur is fused with the upper edge of the vomer; as in the two last, there is no interpalatine spur (*i.pa*). Strongly as all the fore palate is fused together, the broad præpalatal bars (*pr.pa*) are only ankylosed by their tips; they are flat, very elastic, and yet exquisitely pneumatic. At first sight, the maxillo-palatines (*mx.p*) would seem to be as large as in *Grallaria*; they are, however, enlarged by their bony union with the "inturned alinasal well" (*i. a. l*).

The process, however, has a broad base, and belongs to the simple type; the maxillary, behind the process, is broad and spongy, and is widened by the divergent angular process of the præmaxillary: the jugal bar is one continuous bone.

In the ethmoid we see an ascent in type; for the common nerve-passage is more chink-like, the antorbital has aborted the lacrymal as in the last two kinds, its angle is modified; it is præmorse, as in *Pitta*; but the outer angle of the bitten part turns inwards, and forms a very distinct "processus uncinatus" (fig. 1, *o. u*).

The antorbital is spongy, but it is thin, as in *Grallaria*, not swollen as in *Pitta*—another instance of that peculiar oscillation of this bird towards the Bornean and

[1] Here is a lesson for the palæontologist! Fragmentary fossils, the palatine remains of this bird, especially if the second arch had remained intact, could never have told any other than a *pittine* or a *grallarian* tale.

American types; it is as if its father had been a *Grallaria* and its mother a *Pitta*, but to become an *Artamus* it had risen higher in the ornithic scale than either of its parents.

Example 10. *Dendrocolaptes albicollis*, Vieill., ♂.

Habitat. Brazil. Group "Tracheophonæ," Müller; family "Dendrocolaptidæ."

Mr. Salvin's collection yields me five types of this kind of Southern passerine, in which the ægithognathism is of the first or distinct variety of the complete kind; the members of this family and of the "Tyrannidæ" seem to me to stand near to, but in reality higher than the "Formicariidæ;" I speak thus, however, rather of their facial morphology than as an ornithologist.

In some of these, as in my present instance, the basipterygoids are indicated by spurs of the basitemporal (Pl. LIX. fig. 1, *b.t*, *b.pg*). At first sight this seems a trifle; but morphology has no trifles: it is a Lacertian stigma. Every student knows that the *innermost laminæ* of the massive "parosteal" basitemporals of the bird become the practical symmorphs of the Lizard's basisphenoids—symmetrical ectostoses; also that, whilst in the bird the basipterygoids are ossified by the parasphenoidal rostrum, in the Lizard they are hardened directly from the basisphenoids. In our ascent from the less developed to more highly metamorphosed types, we constantly come across this "changing of hands," in the finish of a part. That *Dendrocolaptes* should have the Lacertian character is like a touch of "atavism;" it can scarcely be other than a delicate link in a long evolutional chain. The strong, rounded parasphenoid (Pl. LIX. fig. 1, *pa.s*) is short in this long-faced bird; it forms the underbalk to a very massive, non-fenestrate interorbital septum.

The ossification of the nasal labyrinth is very similar to that of *Grallaria*; but I find no trabecular bone; the upper septal ossification is less; and so is that behind, on the upper turbinal; that on the inferior turbinal is larger.

The alæ nasi outside are quite soft; but their turbinals have each a long endosteal tract, as in *Grallaria* (see Pl. LVI. fig. 9; and Pl. LIX. figs. 1 & 2, *a. tb*). I find no subnasal alæ to the thin knife-like cartilaginous septum nasi: the fenestra separating it from the meso-ethmoid (fig. 3, *p. e*, *c.f. c*, *s. n*) has become a "notch" by extension downwards of the cleft, such a closed cleft as is seen in *Grallaria* (Pl. LVI. fig. 10, *c.f. c*). In this respect *Dendrocolaptes* has risen above those "Formicariidæ;" but in its ægithognathism it is below them; for I cannot find any advance of the bony matter of the vomer into the turbinals; it stops quite short. The vomer (*v*) is very curious, its coalesced part being very wide and short, and its legs almost close together. A small septo-maxillary (fig. 2, *s.mx*) is seen intervening between the outer angle of the upper vomerine lobe and the extremity of the alinasal turbinal. The flat, broad, closely clinging vomerine crura are ankylosed to the ethmo-palatine plates; the angular process on each side, in front, is articulated obliquely and strongly to the maxillo-palatine, in the manner of a zygapophysis. The ankylosis of the secondary bones of the upper jaw

does not obscure this region; the dentary, nasal, and palatine processes of the præmaxillary are well marked (figs. 1–3); the body of that bone is of great length.

The palatine arch, like that of *Artamus*, has lost the distinction of proximal and distal segments; the pterygoids, as in the last three instances, are straight, stout bones, becoming alate in front; the epipterygoid hook (fig. 1, *e.pg*) is typically developed. The postpalatine crests (*pt. pa*) are less everted than in *Grallaria*, and are very close together; they are quite as large as in that type and in *Pitta*; the interpalatine spur is aborted, and the ethmo-palatine lamina is scrolled (fig. 3, *e.pa*). The mesopalatine region is becoming of greater extent; and the transpalatine snags have that remarkable development backwards seen in many Southern passerines. The præpalatines are very *pittine*, short, broad, fibrous, concave above, and convex below.

The maxillo-palatine laminæ are elegant little *ears* of bone, and are far apart, articulating with the angles of the broad-shouldered vomer; the strong but slender and compressed zygoma (*j*) is one with the rest of the fore face.

Dendrocolaptes is *above* the Formicariidæ in the condition of the maxillary palatal plates, as well as in the palato-pterygoid arch. As in many of the higher passerines, there is a small lacrymal (fig. 3, *l*) ankylosed to the upper part of the descending crus of the nasal. The antorbital (fig. 3, *p.p*) has a concave outer margin, and a very *uncinate* angle; below, it has a suture, dividing off the tip and the fore part of this bar from that which passes inwards to the meso-ethmoid (*p. e*). The angle and part of the outer face is the os uncinatum (*o. u*); and this has most probably coalesced above with an upper lateral ethmoid, the bone described in the Rook (Pl. LV. fig. 5). The foramen for the two nerves (figs. 3, 1, *v*) has lessened very much in size. The ecto-ethmoid is not flush with the face as in most passerines; and the frontal portion is small. This bird is not one of the highest of the Southern Coracomorphæ; it is an ascent, however, from the Formicariidæ.

Example 11. *Anæretes parulus*.

Habitat. Chili. Group "Tracheophonæ," Müller; family "Tyrannidæ."

This is one of the smallest of the family, and, like one of the smallest of our native Warblers (the Wren), shows a peculiarity not seen in larger forms, namely a development of the vomerine cartilages equal to what is seen in *Turnix*.

The bat-shaped basitemporal plates, and the rounded parasphenoidal beam (Pl. LIX. fig. 4, *pa.s*) are quite similar to those of the next example, *Synallaxis* (Pl. LIX. fig. 6, *bt*, *pa.s*); the hinge is perfect; and the septum nasi (*s. n*) is very large and thoroughly ossified; it is *alate*, as in *Corvus* and *Sylvia*.

The recurrent alinasal fold (fig. 4, *rc. c*) and the hinder part of the alinasal wall (fig. 4, *n. w*) are also ossified. The postero-inferior element of the septum nasi is entirely ankylosed with the bony matter from the roof and front of the septum; and the chink

between the septum and perpendicular ethmoid is very small above: it agrees, then, in this respect, with *Dendrocolaptes*.

The vomer (figs. 4 & 5, *v*) is very large, relatively; and anteriorly it is twice as wide as it is behind: this answers to *Dendrocolaptes*. Here the vomers proper do not unite with the inturned alinasal lamina (*i. a. l*), but form the ossified and coalesced hinder portion of the "vomerine cartilages" (*v. c*), which are longer, relatively, than in *Turnix*, and reach more than halfway along the sides of the septum nasi towards the recurrent lamina (*rc. c*).

This species and the Common Wren (*Troglodytes vulgaris*), where the two vomerine cartilages coalesce in front, and the Hemipod, are the instances which satisfy me that the vomerine cartilages are not merely the long extremities of the recurrent fold, detached, and separately chondrified, through the rapidly produced "prognathism" of the bird's face, but are a pair of upper labials. The broad shoulders of the vomer are formed by the addition of a square septo-maxillary (*s.mx*) on each side; and it is this bone which grafts itself on the inturned alinasal wall (*i. a. l*).

The pterygo-palatine arch is very similar to what I am about to describe in *Synallaxis* and *Muscisaxicola* (Pl. LIX. figs. 6 & 9). The pterygoid retains its distinctness (fig. 4, *pg*); and its "hamular process" is long and slender. As in *Muscisaxicola* (fig. 9) and *Dendrocolaptes* (fig. 1), the postpalatine ridges (*pt.pa*) are fined off; and as in *Synallaxis* (fig. 6), the slenderer transpalatine spurs (*t.pa*) are turned outwards as well as backwards. Of the laminæ that form the roof and the floor of the nasal passage, the latter ends in a long interpalatine spur, and the former is arched (fig. 4, *i.pa*, *e.pa*). The forward continuation of the palatines is very slender (*pr.pa*).

The lateral ethmoids are large, square, and have one wide, large opening above the antorbital, for the 1st and 5th nerves. The frontal region of the lateral ethmoid is moderate, the os uncinatum below not distinct; and there is no lacrymal, as far as I can see; the maxillo-palatines are not pedunculated (see fig. 4, *mx.p*, which shows the *root* of this process).

Example 12. *Synallaxis flavigularis*.

Habitat. Chili. Section "Tracheophonæ," Müller; family "Dendrocolaptidæ."

The skull of this bird is unrivalled for elegance and delicacy of structure; this is especially seen in the palate (Pl. LIX. fig. 6). The swollen, cellular basitemporal plate (*b.t*) is bat-shaped, and has the median part not much produced forwards. The parasphenoidal beam (*pa.s*) is very broad-based, and is without basipterygoid processes.

From the Eustachian opening (*eu*) to the solid part of the præmaxillaries, the basifacial axis is one continuous structure; but the posterior or upper third of the trabecular bar is separated from the ethmo-præsphenoidal bar by a very large interorbital fenestra; the rest of this coalesced arch is in a state of permanent fusion with the descending septal crest of the nasal organs.

Moreover it is evident that in these songless passerines we have not travelled far from the level of the great *pluvialine stratum*; for the "notch" is only marked out by bony tracts (fig. 8, *p. e*, *s. n*), the fore part of the perpendicular ethmoid being separated by synchondrosis, and not by fibrous tissue, from the postero-inferior septal bone—a trabecular tract; and this has in front of it two bones belonging to the common septum of the nasal sacs. The foremost of these, as usual, ossifies the recurrent lamina, and the alate region of the septum nasi (*tr*). Let this state of things be compared with what the reader will see in *Ocydromus australis*, *Gavia ridibunda*, *Uria troile*, and *Alca torda*, and he will see at a glance how near this elegant little Southern passerine comes to the more specialized *pluvialine* "Schizognaths." The lateral parts of the nasal vestibule are all soft; the part of the compound vomerine bone joined to the inturned alinasal wall is a distinct, transversely placed bone, somewhat reniform—the septo-maxillary (fig. 7, *s.mx*). The vomerine elements themselves have ossified the fore part of the vomerine cartilages; and these serrated blades of bone lie on a higher level than the thick part of the vomer, the commissural part of which is squared in front, and has a rounded notch behind. The shoulders of the bone pass gently into broad crura, which stride along the parasphenoid, and are welded to the coiled ethmo-palatine laminæ. This type is ægithognathous in a complete manner; but it belongs to the *first variety*.

The pterygo-palatine arch displays the same *southern* characters as the trabecular. The pterygoid has a long, delicate hook, a straight shaft, spreading in front; its fore edge is free; and the palatines, which, although typical in borrowing a mesopterygoid lamina, have long, rod-like transpalatines (*t.pa*); these spurs are turned outwards. The broadish floor of the nasal passage is twice notched, in a shallow manner, behind, and sends a sharp interpalatine spur (*i.pa*) forwards. The *roof* of the tube is elegantly arched, passing forwards to combine with the vomer; the postpalatine keels are large and divaricate (*pt.pa*).

The thick edge of the outspread mesopalatine region passes on into the præpalatine (*pr.pa*). This is a most slender bar, which, from a compressed, becomes a depressed band, ankylosed in front to the præmaxillary.

The external bones, præmaxillary, maxillary, and jugals, are all ankylosed together. The maxillo-palatine process (*mx.p*) is delicate and falcate; it is subpedunculated; the body of the bone, where it arises, is pneumatic. The palatine processes of the præmaxillary (*p.px*) are very well marked and extremely slender.

The lateral ethmoid (fig. 8, *p. p*) has a concave outer edge—an uncinate "lower angle" (*o. u*), a large common foramen above, and is not flanked by any apparent lacrymal.

On comparing this type with the large *Dendrocolaptes*, it is easy to see that most of the difference between the two arises from *mere size*. All that is independent of that cause, however, is of a very instructive nature; and much as this elegant little bird resembles our Old-World Chats, Wagtails, Pipits, &c., it is a creature of the "Notogæa," and belongs to a lower level.

Example 13. *Muscisaxicola mentalis.*

Habitat. Chili. Group "Tracheophonæ," Müller; family "Tyrannidæ."

This is a larger bird, and has a stouter face than the last; yet, on comparing the palates together, it is easily seen how near they are in nature. The character of the bony substance in the two is exactly alike, both in the cellular and in the fibrous parts; it is of the most delicate kind. The basitemporal projects more at the mid line under the Eustachian opening (Pl. LIX. fig. 9, *b.t*, *eu*); and the posterior part of the parasphenoid (*pa.s*) is not so thick. The hinge-notch is more perfect than in *Synallaxis*, and the septum much deeper and more largely alate (Pl. LIX. figs. 9 & 10, *tr*); it much resembles that of *Homorus* (see Pl. LX. figs. 1–4), but it is deeper, as in *Dendrocolaptes* (Pl. LIX. fig. 3, *s. n*). The alæ nasi are soft externally; but their turbinals are ossified (fig. 9, *a.tb*), as is also the nasal floor (*n. f.*) and part of the recurrent fold (*rc. c*). The inferior turbinals have patches of endostosis. On the whole, the anterior part of the palate is very much ossified for so small a bird. The vomer is large (figs. 9 & 10 *v*); and the inturned lamina (*i. a. l*), like the alinasal turbinal, is ossified by its own endosteal deposit, and *articulates* with the large swollen lobes of the vomer—that is, with its coalesced septo-maxillaries: this belongs to the 1st variety of "complete desmognathism."

The bony septum, behind its large subnasal alæ, is very solid and even bulbous; and it is almost embraced by the still more bulbous upper lobes of the vomer. The vomer is broad, flat, largely united at the mid line; and its flat crura are near together, and ankylosed to the ethmo-palatines.

The likeness and the unlikeness of the next arch in this type and in *Synallaxis* is very instructive, as showing very fine, and yet quite measurable and evident diversity. The delicate, arcuate, ascending apex of the pterygoid (*e.pg*) has here its fullest ornithic growth; the whole pterygoid (fig. 9, *pg*) is longer, more arcuate, and clings more closely to its fellow in front, where it sends upwards a flat, leafy lobe, which articulates in front with the mesopterygoid lobe of the palatine, once a separate bone.

The postpalatine laminæ are cut away, as it were, below; and the body of the bone is more spongy than in *Synallaxis*; the præpalatal bars are equally delicate, and form one continnous and almost straight bar with the edge of the broad part and the retral transpalatine (*t.pa*). The ethmo-palatal is dome-shaped, as in all these types.

The investing bones are all ankylosed together; the maxillo-palatines (figs. 9 & 10, *mx.p*) are like pruning-hooks, and are somewhat pedunculate.

The ecto-ethmoid is squarer than in *Synallaxis*, its outer side being less concave, and its angle less developed; it is a flat, spongy plate, appearing moderately above, and having over its antorbital region a huge doorway from the orbit into the nasal sac, through which both kinds of nerve pass.

Example 14. *Homorus unicolor.*

Habitat. Mendoza, La Plata. Group "Tracheophonæ," Müller; family "Dendrocolaptidæ."

My third example of these South-American "Dendrocolaptidæ," is twice as large as the others; it is likest *Muscisaxicola*, and is of great interest, inasmuch as it *underlies* the Piping Crow, just as *Grallaria* underlies the Wood-Swallow (*Artamus*).

If this should seem to be fanciful, I would request the most imaginative believer in *sudden, separate* creations, to compare the two as they have been drawn by me in Pl. LX. (figs. 1 & 5).

Moreover, if the same grave doubter of the unity of Nature will supply me with the *ripe chick* of a Piping Crow, I will promise to make a drawing of its palate that shall be superimposable on that of *Homorus*, and the twin drawings shall, for lack of difference, be undistinguishable.

On the whole, this type comes very close to *Dendrocolaptes*; and the first thing to be remarked is, that beneath the metamorphosed apices of the trabeculæ we come upon the basipterygoid processes, springing from the basitemporal bones, as in *Dendrocolaptes* (see Plate LX. fig. 1, and Pl. LIX. fig. 1, *bt*, *b.pg*).

The parasphenoidal rostrum (*pa.s*) is full behind, and narrows gently forwards; it scarcely projects below the hinge; the crest of the trabeculæ is of moderate height, below the interorbital fenestra. The septum nasi is well ossified, *alate*, and typical (Pl. LX. fig. 4, *s. n*); it is separated from the diminished front end of the meso-ethmoid (*p. e*) by synchondrosis, as in *Synallaxis* (Pl. LIX. fig. 8, *s. n*, *p. e*); so that the notch is only half through the ethmo-septal plate. The ossified septum sends its bony matter along the well-marked recurrent lamina (*rc. c*); and this process lying below the septal subnasal alæ (*tr*), a space is formed; this is the well-known *perforation* of the ornithic nostrils. Here the alinasal floor is large and unossified (*n. f*); and the *wall* (fig. 4, *n. w*) is partly ossified behind.

The alinasal and inferior turbinals are soft, or nearly so; behind the flat part of the septum, which is ossified—a true facial (trabecular) bone, there is a median ossicle, one of the "septo-maxillary" series (figs. 2 & 4, *m.s.mx*); we shall find this bone in the next higher type. The vomer (figs. 1 & 2, *v*), is of immense breadth in front, and very spongy; it soon narrows; and its crura are compressed and wide apart. A point of cartilage still unossified on the inner angle of the large upper lobe of the vomer shows that here this bone largely owes its size to the vomerine cartilages (*v. c*); they are also partly ossified by a pair of septo-maxillaries, which form large epiphyses to the vomer (figs. 2 & 3, *s.mx*). The groove on the upper surface of the vomer is narrowish and tolerably deep. In this type the alinasal turbinal is attached to the large septo-maxillary; and this kind of complete ægithognathism is of the first variety. The ethmoidal region is wholly dendrocolaptine: the falcate pars plana (*p. p*) is widely severed from the roof, and carries a seed-shaped "os uncinatum" (*o. u*) on its outturned extremity; this, as we have seen, is an endo-skeletal element of the first or trabecular arch.

The pterygo-palatine arch is true to the family character. The short, straight ptery-

goids (fig. 1) are elegantly hooked behind, and terminate in front by ankylosis; this element and the rest fall back into the original simplicity of this bar. The mesopalatine region (fig. 1, *pa*) is large, both fore and aft and transversely; the postpalatine ridges are moderately developed; and the transpalatine processes are strong, retral, somewhat out-turned spines; they are continued as an outer ridge to the broad part, and then the bone is passed forwards as a stiff bar, gently converging to its fellow: thus there is but a slight sinuosity from the terminal point of the bar and that of the retral process. The space between the outer ridge and the interpalatine ridge is well scooped; the spurs are short. The arched ethmo-palatine is notched in front. The investing facial bones are strongly ankylosed together; the maxillo-palatine processes (*mx.p*), like those of *Muscisaxicola*, are flat, gently curved, and knife-like; they do not form a strong connexion with the shoulders of the vomer.

Thus, with its own peculiarities and an evident tendency towards the Southern-Crow type, this bird is related very intimately, right and left, to the other members of the family "Dendrocolaptidæ."

The lacrymal (fig. 4, *l*) is very small in *Homorus*, as in many Coracomorphæ.

Example 15. *Gymnorhina tibicen.*

Habitat. Australia. Group "Oscines," Müller; family "Gymnorhinidæ."

Here is another *eastern* type, which is merely a more highly specialized, a more completely metamorphosed *dendrocalaptine* bird. Suggesting to the observer its own name (Crow) with the modifying epithet "Piping," this is yet a bird which is the culmination of a very different branch of the Ægithognathæ from that of the true Crows of the Old World ("Arctogæa"). There are not many internodes between this upper type and the Chilian and Brazilian birds that grow out below it. Two of the further specializations that characterize it from these are a greater intensity of ossification, and the metamorphosis of the *contractor tracheæ* muscle into the motors of the "syrinx."

Comparing the skull of this bird with that of *Homorus*, in a general way, as to form and strength, the difference is very similar to that between those of *Gecinus viridis* and *Picus major*; yet there is, altogether, in *Gymnorhina* a rise, both zoological and morphological.

The basitemporal and parasphenoidal regions (*b.t*, *pa.s*) in these birds would, to a hasty observer, seem to differ only in size; so much is one a repetition of the other. Yet a second look shows that in *Gymnorhina* the basipterygoid processes (Pl. LX. fig. 5, *b.pg*) have found their proper ornithic position, namely on the parasphenoid (*pa.s*). This bar itself is also more elegantly narrow than in *Homorus* (fig. 1). Yet the presence of these basipterygoids, even as prickly rudiments, is a rare thing amongst the Coracomorphæ, and bespeaks a nearer relationship to the plebeian types below than obtains in the true Crows of the Old World.

In the absence of the young of this bird no other type could have been found more apt

as a key than the far-western *Homorus*; for in *Gymnorhina*, ossification runs riot, and the very numerous osseous centres melt into each other, if not *here*, yet *there*; at some point or extremity, or jutting snag, they lose their individuality, making the morphologist wonder why this puzzle grew from so many pieces. The notch in the basifacial axis is a very large triangle, with its apex upwards; it is perfect, and the point of the parasphenoid does not reach it. In front of the notch, or hinge, is the well-ossified nasal septum, which is fenestrate and deep in front, and shallow behind; and its lower edge and subnasal alæ are ankylosed to the intensely ossified nasal floor (fig. 5, *n.f*); and this is a continuation of the solid, bony alinasal. Where they arise, there the alinasal turbinals are ossified; for the rest, they are soft, save at the end, where the upper vomerine lobes (figs. 5 & 6, *v*) have run into them, by grafting (fig. 7, *v*, *i. a. l*). So also the aliseptal has coalesced by bony union with the outer facial walls, as in the mammal, and has also, as in the young mammal, a top-shaped bone, formed by ossificatcn of its posterior end, the part attached to the bony "pars plana." Hence, in seeking in the adult for the "trabeculæ cranii," we find that foremost facial arch metamorphosed into a great variety of substructural bars and beams and outgrowths of periosteal bone. The apices of the two early coalesced bars are involved in the great "temporal wings of the parasphenoid," forming the "anterior tympanic recess" (fig. 5, *a. t. r*); then the narrowing portion forms the sides of the sella turcica; narrowing still, it forms the base of the interorbital fenestra, where the two primordial bars first formed their commissural union.

A continuation of this part substructs the septum between the functional part of the nasal sacs—the perpendicular ethmoid; there the notch severs the once double bar, and the rest of the trabeculæ form the base of the partition between the vestibular parts of the nose and also, where the trabeculæ keep flat, the floor of the nose between the outer nostrils. The azygous process of the trabeculæ (the prænasal cartilage) is absorbed, being aborted by the huge splints formed upon it, as upon a model: I refer to the foremost facial splints, the præmaxillaries. Yet this does not exhaust even the "endo-skeletal" parts of this arch; for the lateral ethmoid has a small os uncinatum (fig. 8, *p. p*, *o. u*) attached to its lower angle; this is the conjugational bone between the two præoral arches.

I have spoken of the dense and everywhere ankylosed præmaxillaries; these are the foremost splints: but five more *secondary* ossifications belong to the trabecular arch; these form a single bone in the adults. But these five osseous elements were brought into relation with a pair of "vomerine cartilages." All these things are hidden in the curious three-horned vomer of the adult; and this now single bone has lost its freedom, being bound to the ascending plates of the palatines behind, and *grafted* upon the alinasal turbinals in front (fig. 5, *v*, *e.pa*; figs. 6 & 7, *v*, *i. a. l*); also it is articulated strongly by a kind of zygapophysis to the maxillo-palatine on each side (figs. 5, 6, 7, *v*, *mx.p*). The stones and the cement used in this building, the strength and safety of which have

been "cared for with all this care," are illustratively shown in the more general type last described, namely *Homorus* (Pl. LX. figs. 1–4).

The septo-maxillaries have become fixed with the vomerine moieties to form the shoulders of the compound bone (compare figs. 2 & 7); but these paired ossicles do not account for the *spine* which grows from the middle of the vomer above (figs. 5–7, *m.s.mx*); this is not symmorphic with the long style in which the vomer ends in the Humming-birds, which is in them merely an ongrowth of the two halves of the bone; but here the membrane-bone seen separate in *Homorus* (figs. 1, 2, 3, *ms.mx*) has coalesced with the other vomerine elements.

But for *Homorus*, I should have spoken more cautiously of the median vomerine spine of *Gymnorhina*; but now I speak boldly, and can show the sceptical reader the same thing in many a type. It is, indeed, an ossification of the lower edge of the membrane that fills up the "cranio-facial notch," and is therefore peculiarly ornithic: he who would seek for it in other classes should consider that it *cannot* be there, as they possess no such cleft in their facial axis. In *Gymnorhina* there is in this bone a growth upwards, tending to fill the gap; this crest is fenestrate (fig. 7, *m.s.mx*).

There are differencing characters in the two types here compared; but the South-American bird is merely a more embryonic and smaller bird than the Australian Piping Crow, which in size and in specialization has stolen a march upon its meaner relative. The observer reads this in a moment in the two palates (figs. 1 & 5); and the portrayal of these parts on one scale makes the comparison easier. The short, stiff, uncinate pterygoids (fig. 5, *pg*) of *Gymnorhina* are not quite so alate in front as those of *Homorus* (fig. 1, *pg*); yet they are in both ankylosed to the palatines. This continuity of bone-matter makes a wall on either side of the posterior nasal canal, which is here much longer than in *Homorus*; and these ridges, belonging chiefly to the palatines, are not so strong and outstanding as in "Dendrocolaptidæ" and "Formicariidæ;" they are also more bevelled off towards the end. The ridges which enclose the basifacial balk are principally due to the coalesced mesopterygoids; and they end in front in a less arched ethmo-palatine, which is ankylosed to the vomerine crura. Both the interpalatine plates, with their aborted spurs, and the upper ethmo-palatine laminæ are of small extent, fore and aft, as compared with *Homorus* (fig. 1); hence the postpalatine region and the transpalatine spikes (*t.pa*) are much longer than in the lesser bird.

These peculiar styliform transpalatines are found, as far as I have seen, only south of, or upon the equator; and their very curious character, always correlated with other differences, might justify one in dividing the "Coracomorphæ" into two sections, the "Noto-Coracomorphæ," and the "Arcto-Coracomorphæ." With a most remarkable amount of harmony between the two types, namely *Corvus* and *Gymnorhina* (Pl. LV. figs. 1 & 6; and Pl. LX. fig. 5), this modification of the palatines strikes the eye at once; and looking abroad we find it characterizing the "Formicariidæ," "Dendrocolaptidæ," "Gymnorhinidæ," "Tanagridæ," and "Artamidæ," and in those exquisite little Australian types *Acanthorhynchus* and *Ptilotis* ("Meliphagidæ").

In the "Cotingidæ" and "Tyrannidæ" the transpalatine process is very rudimentary, and also in some of the "Formicariidæ" (as in *Thamnophilus*), also in the Australian *Menura*. In *Artamus* and in *Elainea* (Tyrannidæ) the process is flattening out; and they approach our own "Laniidæ."

In *Gymnorhina*, from the retral apex of the transpalatine process to the extremity of the palatine, in front, this bony bar is straight and stiff; from being obliquely compressed it becomes, further forwards, depressed, and is fast bound down to the præmaxillary in front (fig. 5, *pr.pa*); but, as in *Artamus*, it is quite free from the hard nasal floor, and is, indeed, some distance below it.

The palatines and maxillaries are only in contact in front, where they are ankylosed to each other and to the præmaxillaries; for the maxillo-palatine flaps (figs. 5 & 6, *mx.p*) are a good height *above* the strong elastic palatine bar. These processes are ankylosed to the inturned alinasal floor, the edge of the lower process of which fringes the antero-internal edge of the maxillo-palatine (*n.f*, *i. a. l*, *mx.p*).

The form of the maxillo-palatines is like an ear; and they are thin, sinuous, tooth-edged laminæ, shaped like those of the Crow (Pl. LV. fig. 6, *mx.p*), but not possessing the thickened inner edge which in that type borders a large air-cell. Behind these processes the maxillaries are developed inwards behind the angle of the præmaxillaries, still striving to floor-in the palate. In front they are ankylosed to the præmaxillaries, nasals, and ossified nasal sacs, and behind to the strong compressed jugal (*j*).

With the exception of *Pachyrhamphus* ("Cotingidæ"—Pl. LVII. fig. 7, *e.eth*), *Gymnorhina* has the largest frontal plate to its lateral ethmoid. The antorbital is very thick and spongy; it has a concave outer margin, an outward lower angle, a large common foramen above it (as large, relatively, as in *Homorus*), and, as in that species, the angle carries a small epiphysial *os uncinatum* (Pl. LX. fig. 8, *o. u*). As to the lacrymal, it is thoroughly corvine (fig. 8, *l*) both in position (jammed in below the præfrontal and nasal) and in shape and substance.

In short, to sum up the characters and relationships of the Piping Crow, it is a "Notocoracomorph," an ascent from the short-billed "Dendrocolaptidæ" of the western regions of the "Notogæa," a true singer, having large inferior laryngeal muscles; and it has a *fine voice*. It crops up in the great *bird-tree* like another and scarcely inferior "leader" to that formed by the Old-World Crows, Daws, and Magpies.

Example 16. *Hyloterpe sulfuriventer*.

Habitat. Celebes. Group "Oscines;" family "Sylviidæ."

This Malayan type (Pl. LVIII. figs. 3 & 4) strongly reminds one of the South-American "Cotingidæ," *Pipra* and *Pachyrhamphus* (Pl. LVII. figs. 1–7); and indeed it seems to me to be another eastern form which has undergone further metamorphosis than its western relatives. It appears to be related to the "Cotingidæ" just as the Piping Crow is to *Homorus* and the Wood-Swallow to *Grallaria*.

If this be the case, if these instances of *changed forms* in the Eastern "Notogæa," corresponding to unchanged (or less changed) types in the Western "Notogæa," can be shown to be common, it will go far towards the establishment of a true theory of the dispersion and modification of types[1].

Near this type I should place *Lanius* (Pl. LXI. figs. 3–6), and below it *Elainea* ("Tyrannidæ"—Pl. LXI. figs. 1 & 2); and I think the true order of these types upwards is "Cotingidæ," "Tyrannidæ," "Laniidæ," and "Sylviidæ."

The peculiarly soft spongy character of the skull in *Pachyrhamphus* and *Pipra* is replaced by a somewhat denser structure in *Elainea* and *Hyloterpe*; but this latter differs much from *Lanius*, the skull of which is much more dense and fibrous, like that of a true *Corvus*, only on a smaller scale. So also in these the basitemporal (Pl. LVIII. fig. 3, *b.t*, and Pl. LXI. fig. 1) region is bat-shaped, as in the "Cotingidæ;" and the strong rounded cellular parasphenoidal rostrum (*pa.s*), without a trace of "basipterygoid processes," is very similar. In *Hyloterpe* the notch is perfect in the basifacial axis, and the upper or nasal part of the nasal septum is ossified. Mr. Salvin's specimen does not show whether it is *alate*.

The alæ nasi have a bony patch on each side behind the nostril; and the large alinasal turbinals (figs. 3 & 4, *a. tb*) have a large patch on their inner face of an ectosteal character (*s.mx'*); it represents the anterior part of the ophidian septo-maxillary.

This bone articulates with another shorter bony scale, the proper septo-maxillary (*s.mx*), and this with the upper edge of the front of the vomer (*v*). This latter bone has its two halves thoroughly ankylosed for the first half of its length: it is now a large flattish bone with a sharp shoulder, a median and two lateral points below in front, and very flat gently diverging crura that are ankylosed to the palatines. The vomer is slightly carinate in front, that part dipping very evidently.

The os uncinatum is very evident and very instructive (Pl. LVIII. figs. 3 & 4, *o. u*): it is a sharp prickle with a broad bulging base, and appears as an outgrowth of the inner face of the swollen ecto-ethmoid (*p. p*); this latter element has a notched outer margin and a *common passage* for the olfactory and nasal nerves, as in the low types. I see no trace of a lacrymal in *Hyloterpe*.

The second præoral arch (fig. 3, *pg*, *pa*) may be seen at a glance to be intermediate, both in its primary and secondary elements, between a low Cotingine type and the high Corvines. The pterygoids (*pg*) are very similar to those of *Pipra* (Pl. LVII. fig. 1); but they have a better "hamular process," and are slightly arcuate. The laminate anterior end articulates with the leafy plate of the palatine—its mesopterygoid region. The palatines (*pt.pa*) have strong posterior keels, a large median portion with its post-

[1] If not, if every zoological species has been created as it is now, and fenced in by laws that cannot be broken, "a hedge set about it and all that it hath," then I trust, for the sake of true science, that this glamour will soon be removed from our eyes, and that we shall not be lured on further after evolutional Will-o'-the-wisps.

narial roof and floor, and a much more definite two-toothed transpalatine region. The roof-plate, or ethmo-palatine (*e.pa*), has lost its highly arched form, and has become more typical; it coalesces with the vomer. The præpalatine bars are narrow behind, flatter in front, and bowed like those of *Pachyrhamphus* (Pl. LVII. fig. 4); their apparent width in front is partly due to their coalescence with the palatine process of the præmaxillary. That bone, the maxillary, and the jugal are all ankylosed together. The maxillo-palatine processes (*mx.p*) are of great interest, as they retain the non-peduncular shape of the low types, and are large, broad-based, pointed knives of bone, less typical, indeed, than those of the "Formicariidæ" and "Dendrocolaptidæ." They are like those of *Lanius*, but simpler (Pl. LVIII. figs. 3 & 4, and Pl. LXI. figs. 3 & 4, *mx.p*).

Example 17. *Elainea* ——, sp.?

Habitat. Barbadoes. Group "Tracheophonæ," Müller; family "Tyrannidæ."

In comparing together the skulls of an old *Lanius collurio*, a young first-summer bird of the same species, and an adult *Elainea*, I saw clearly that I had before me three clear morphological strata (see Pl. LXI. figs. 1, 3, 4). The likeness in the fashion of these three palates, and their measurable degrees of difference, are neither fanciful nor accidental. If I can show that the skull of *Lanius* is, morphologically considered, a further metamorphosis of a *Tyrannine* type of skull, and that of *Tyrannus* the modification and ornithic improvement of a *Cotingine* type, then surely there must be some common root for all these. Below the *Cotinga* comes the *Hemipod*, and below the *Hemipod* the Tinamou and the terricolous *Ratitæ*; and here we have ground-leaves, stem-leaves, bracts, calyx, and corolla to our fanciful bird-tree: the metamorphosis is real, however expressed in words.

The basitemporal region in *Elainea* is bat-shaped, and the well-shaped rostrum is of moderate size, and without basipterygoid processes (Pl. LXI. fig. 1, *b.t*, *pa.s*).

The cranio-facial hinge is perfect, and is bounded by bone both before and behind; that in front is a well-formed thoroughly bony nasal septum (figs. 1 & 2, *s. n*). This wall runs, in front, into the two recurrent laminæ (*rc. c*); it is then alate for the foremost half, and the hinder part of the base is alate also where the nasal nerves run. The posterior part of the alæ nasi is ossified; and the bony matter runs inwards above and in front of the maxillo-palatine process as the inturned lamina (fig. 1, *i. a. l*). The vomer (figs. 1 & 2, *v*), where it has utilized the vomerine cartilages and part of the alinasal cartilage, is formed of two swollen divergent lobes, each of which is open outside, (fig. 2), the hollow cavity within having a gaping air-passage. The rest of the double bone is flat and quite normal; no remains of the suture exist between the subsidiary septo-maxillary and the true vomerine piece. The thick spongy ecto-ethmoids are well seen above, have a straight outer margin, a huge common foramen above, and are scarcely pedate below.

The lacrymal (fig. 2, *l*) is pedate, and also shows a good face in the frontal region;

it is one of the largest, relatively, in the whole of the "Coracomorphæ," agreeing with *Pachyrhamphus* among the "Cotingidæ" at one end of the series, and with the "Corvidæ" at the other end.

I find no trace of a separate "os uncinatum," nor of a process that can be certainly claimed as its symmorph. Yet I suspect that the pedate base of the lacrymal is the real element disguised, as a long lacrymal in the Coracomorphæ will at times have an os uncinatum at its outer angle—for example, in *Sturnella militaris* (Icteridæ) and in *Phytotoma rara*.

The pterygoids (Pl. LXI. fig. 1, *pg*) are very similar to those of *Pipra* (Pl. LVII. fig. 1), but have the hamular or epipterygoid process much more developed; they articulate with the palatine and its borrowed mesopterygoid region. The palatines are bevelled off behind, as in *Pipra*; and in like manner the broad part is a mere isthmus of bone, uniting the almost equal and equally pointed ethmo- and interpalatines with the fore-stretching main bar. From this bar there is a jutting snag, outturned as in *Pipra*, but not denticulated: this is the very *embryonic* transpalatine (*t.pa*), very similar in form and proportions to that of the embryo Rook (Monthly Micr. Journ. Nov. 1872, pl. 35. fig. 1, *pa*). From thence forwards the palatine bar is rather broad and very flat, and at its extremity has coalesced with the præmaxillary (fig. 1). The palatine processes of the præmaxillary (*p.px*) are very distinct, as in embryo Crows; but the nasals, præmaxillaries, maxillaries, and jugals (*n*, *px*, *mx*, *j*) are all ankylosed together. The maxillo-palatine processes (*mx.p*) have the stamp of lowness upon them; they are broad-rooted decurved flaps of bone, essentially like those of the "Cotingidæ" and "Formicariidæ."

The importance of this type to the morphological zoologist will be best seen in the next, a more specialized and nobler form of the "Coracomorphæ."

Example 18. *Lanius collurio*.

Habitat. Great Britain. Section "Oscines," Müller; family "Laniidæ."

These rapacious passerines, the Butcherbirds, come next beneath the lesser Corvidæ, such as the Jay (*Garrulus*); they are not equal to them ornithically.

The whole structure of the skull is of a denser more fibrous bone than in the lower related types, and is very similar to that of the Jay. The basitemporal (Pl. LXI. fig. 3, *b.t*) region is now a low triangle with its base behind. The rostrum of the parasphenoid is slender and void of outstanding basipterygoid processes behind; it is thoroughly blended with the overlying trabecular beam. The notch in front of these parts is perfect; and in front of the notch there is an ossified septum nasi in the adult (fig. 5, *s. n*). Here, however, the ossification is not so intense as to mask the composition of the parts; for the large postero-inferior bone is separate from the anterior and upper part, which is not quite ossified below the large internarial fenestra (*i.n. f*).

In front of the fenestra the recurrent lamina (*rc. c*) is ossified (fig. 5); and behind its posterior boundary there is another, smaller opening—a posterior nasal fenestra (*p. n. f*).

The alæ nasi are not ossified, except where they turn inwards, behind; and here also the aliseptal lamina is partly osseous.

The fore part of the septal base is alate (fig. 4); and behind this the thick lower edge of the large deep septum is pneumatic; the large opening is seen from below (fig. 4, *s. n*). In the young (fig. 3, *v*) the vomer is almost exactly the counterpart of that of *Elainea*; but its lobes are not so divergent. In the adult it is a huge bone (figs. 4 & 5, *v*) alate laterally, and with large swelling pneumatic lobes above. So high are these lobes that they allow the posterior septal (trabecular) bone to ride in between them; for they rise as a wall on either side. The air-cell within opens on each side, looking also forwards; these foramina gape widely, and show through the fore part of the vomer, the diploë of which has been extensively absorbed to form this thin-walled, two-mouthed air-bottle. The septo-maxillaries are lost in the lateral alæ of the vomer.

The pterygoids (*pg*), as in *Elainea*, are long and slender, well hooked behind, and laminar in front. Even in the young the mesopterygoid has coalesced with the palatine: in the old bird the pterygoids and palatines coalesced. The palatines (*pa*) are of great interest zoologically. In the young (fig. 3) they have less of that weak outbent form seen in *Elainea*, and the præpalatine bars are wider; the bilaminar tract running from the outer angle to the mid line is much longer fore and aft, and ends in front in almost equal ethmo- and interpalatine spurs.

The postpalatine keel (*pt.pa*), running from the interpalatine, is bevelled, as in *Elainea*; and the transpalatine spur (fig. 3, *t.pa*) is exactly such as that of *Elainea* might have been if periosteal growths had gone on lengthening and sharpening the retral process. In the old bird (fig. 4) all this is intensified. And now, if the reader will refer to the figures of *Hemipodius*, *Thamnophilus*, *Pachyrhamphus*, *Pipra*, *Elainea*, *Lanius* young, and *Lanius* old, he will see a most perfect series, with the exception of the crowning typical form, namely *Corvus* (compare Plates LIV., LV., LVII. & LXI.)[1].

Near the fore end of the præpalatal band there is on the inside in the adult a broadening of the bone with a free retral spur; this is not, as in the Woodpecker, the end of the palatine process of the præmaxillary, but the end of the recurrent alinasal lamina, the right and left processes being wide apart and not near as in *Elainea* (fig. 1); the relation of the palatine to the præmaxillaries is quite normal (see figs. 1 & 3, *p.px*, *pr.pa*).

The dentate, bract-shaped maxillo-palatines (*mx.p*) are very elegant hooked flaps of bone, only pneumatic at their broad, non-pedunculate root: they are not typical. And here also I have to note the "Laniidæ" as being *below* the Crows.

[1] If this is accidental, then we search in vain for order, law, or Lawgiver in the Cosmos; for these gradational instances of relation are only culled haphazard from thousands of bird-forms.

There is in *Lanius*, as in *Gymnorhina* (Pl. LX. fig. 5), a tendency to fill-in the hard palate; for the maxillary keeps a good width behind its maxillo-palatine process, and, indeed, forms the rudiment of another and similar palatine spur. The pars plana (figs. 5 & 6, *p.p*) has the concave outline, externally, of the Formicariidæ; but the first and fifth nerves have separate passages (1 & 5'). There is no separate os uncinatum; but the lacrymal is moderately developed. Here also there is a curious gradation; for in *Elainea* (fig. 2, *l*) it is large and corvine and is seen above, in the young *Lanius* (fig. 6, *l*) it is much reduced in size, and in the old bird (fig. 5, *l*) it is still smaller. Here we see that an "investing" bone, which has a very precarious existence in the great group "Coracomorphæ," and is never full-sized except in a most exceptional form, becomes partly absorbed during age, as if to reduce it to the general level of these particular types.

Several Celebesian passerines claim attention now; they stand on the same general level as our familiar genus *Lanius*: some of these lean, however, more to the Crow side; and others look towards the Birds of Paradise. Two types from that island have already been described, namely *Hyloterpe* (Pl. LVIII. figs. 3 & 4) and *Artamus* (Pl. LVIII. figs. 1 & 2); my next instance, namely *Dicrurus*, seems to be almost equally related to the Shrikes, Wood-Swallows, and Crows: the ornithologists shall set me right, and place it where they list amongst these types.

Example 19. *Dicrurus leucops.*

Habitat. Celebes. Section "Oscines," Müller; family "Sylviidæ."

This genus comes very close to the last (*Lanius*); but there are some very interesting differences[1].

The basitemporal and parasphenoidal regions are quite corvine (Pl. LVIII. fig. 5, *b.t*, *pa.s*); the cranio-facial hinge is perfect, and is bounded by a high dividing wall of bone both before and behind; that in front is the very strong, thoroughly ossified, nasal septum (figs. 5 & 6, *s.n*). This bony mass is broadly alate below, as in *Corvus*; and of these alæ the right is notched and fenestrate, and the left fenestrate. The postero-inferior region is umbonate on each side behind and above the subnasal alæ; these *bosses* arise on the septum over the nasal nerve; and the septum is partly divided behind by a slanting, lanceolate fenestra, where the right and left nerves almost touch each other.

In front the septum has a large, elongated fenestra, which re-differentiates the tra-

[1] Here let me confess that I am studying these Celebesian passerines in profound ignorance of their acknowledged zoological position as to "families," "subfamilies," and the like. These invaluable specimens belong to my friend Osbert Salvin, Esq., F.R.S.; and the spirit-specimens from which they were prepared were named for him by the Viscount Walden, Pres. Zool. Soc. I am now (Dec. 5th, 1872) waiting for Mr. Salvin's help in placing these birds so that they shall please the eye of the systematist. I mention this to show that my little adjudications are unbiased.

becular crest from the true *nasal partition-wall*. The recurrent lamina is fused with the median part of the præmaxillary; the alæ nasi are slightly ossified at their edges above and below; the os uncinatum is not separate from the large, leafy, inturned base of the pars plana (*p.p*); above the pars plana there is a large opening, divided within by a small bar of bone into two nerve-passages. A lacrymal, the size of that of the *old Lanius*, is ankylosed to the upper region of the ecto-ethmoid.

The broad vomer (*v*) has strong crura, not far apart, ankylosed to the palatines; its solid anterior part is very remarkable. The part running by ossification into the semi-ossified alinasal turbinals is very large indeed (fig. 6, *s.mx*); and on the left side only one septo-maxillary can be seen; but on the right side, not only is the junctural part with the nasal cartilage separate, the upper edge has a small ossicle, and the shoulder and lower face another, much larger, osseous centre.

Thus, counting the ectosteal plate on the right alinasal turbinal, there are four bones on that side that correspond to the single septo-maxillary of the Snake. The pterygo-palatines are like those of the Shrike in form, but like those of the Crow in strength. The pterygoids and palatines are thoroughly ankylosed together; the postnasal keel and the internasal spars are well developed. The bridge connecting the great trans-palatine snag with the inner edge of the bone is less developed than in *Lanius*.

The maxillo-palatine processes are thoroughly *corvine*, being like those of the Jay (*Garrulus glandarius*), pedunculated, with a thick, rounded, pneumatic extremity; for the rest, the facial bars, internally, are all ankylosed together.

Example 20. *Enodes erythrophrys*.

Habitat. Celebes. Section "Oscines," Müller; family "Sturnidæ."

This bird is evidently not a distant relation of the last; and yet to the morphologist it yields certain very important characteristics. *Dicrurus leucops* is nearly the size of a Jay, and has a more arched and a stronger face; this bird is the size of a Song-Thrush, and their skulls are very similar; but *Enodes* has a stronger head and face, and is more *laniine*, and the arcuate bill and the palatines give it some claim to be related to the Birds of Paradise. In a wide sense of the word, it is *corvine*, as it belongs to the higher Coracomorphæ; but wherever placed, it must go near *Dicrurus*.

The basitemporal and parasphenoidal regions agree with the last; the nasal sac is very little ossified, and the nasal septum is soft.

The vomer (Pl. LVIII. fig. 7, *v*) is very emarginate in front, and it is altogether flatter and more fibrous than in *Dicrurus*; its lobes are less; and mounted on them are prickle-shaped septo-maxillaries (*s.mx*), one on each side.

The pterygoids are well uncinate behind, and are distinct in front, as also the meso-pterygoids (Pl. LVIII. fig. 8, *pg*, *ms.pg*). The palatines (*pa*) are intermediate between those of a Shrike and those of a Crow (Pls. LXI. & LV.), and, although feebler, are of the Paradiseine type (see Pl. LXII. figs. 2 & 3, *pa*). They have, in the depth of their

postpalatine keels and their ethmo-palatine scrolls (*pt.pa*, *e.pa*), likeness to the "Formicariidæ;" but the transpalatine process (*t.pa*) is halfway between the broad lobe of the Crow and the sharpened spur of the Shrikes and Wood-Swallows. The maxillo-palatines (*mx.p*) are not so delicately pedunculate as in the Thrush; and the free retral end is formed into a narrow air-bottle.

The nerve-passages (fig. 8, 1 & 5) above the huge lateral ethmoid (*p. p*) are distinct; and the lacrymal (*l*), like that of the Thrush, but larger, is an oval leaf of bone ankylosed to the descending crus of the nasal. There is no distinct os uncinatum. The upper part of the swollen lateral ethmoid appears free in the front of the wide frontal region.

Example 21. *Trichastoma celebense.*

Habitat. Celebes. Section "Oscines," Müller; family "Sylviidæ."

This bird is only three fourths the size of the last; but it has a stouter head, and with its large skull and straight beak reminds the observer of the Tits, the Nuthatch, and the lesser Woodpeckers; but in what is essential it belongs to these other Celebesian birds; and it is intermediate between a northern and a southern type. I should place it nearer to the Flycatchers than to our Old-World Thrushes and Crows. In the basal region it agrees with the last; and the nasal labyrinth in front, and the septum nasi, are unossified; the hinge is perfect. The vomer (Pl. LVIII. fig. 9, *v*) is similar to that of *Enodes*; but it has a projecting median region, and the parts attached to the alinasal turbinal (*a. tb*) are thin and scaly, and are indeed formed laterally of a large perforate scale-like septo-maxillary (*s.mx*) attached to the spiked fore end of the true vomer.

The palatines (*pa*) are altogether more slender, and have a still more southern character; they come near to what I have described in the "Formicariidæ" and "Cotingidæ."

The postpalatine keels are sharp and deep, the inter- and ethmo-palatines well developed; and the transpalatine is feeble, intermediate between that of *Enodes* and the more delicate triangular form seen in *Anthreptes* ("Nectariniidæ," Celebes). The præpalatine bar is slender, the pterygoid bone is slender, arcuate, and moderately hooked.

The maxillo-palatine processes (*mx.p*) are almost in their full degree of typical specialization, with long stalks bowed outwards and backwards, and with terminal pneumatic ladles, such as we see in Tanagers, Buntings, and Thrushes.

Example 22. *Lalage leucopygialis.*

Habitat. Celebes. Section "Oscines," Müller; family "Muscicapidæ."

This skull is the size of the last, being as much smaller than that of *Enodes* as that of *Enodes* is smaller than the skull of *Dicrurus*.

It agrees with these two, and not with *Trichastoma*, in having a curved beak. This is

more curved than in *Hyloterpe*; but that genus is a natural ally of *Lalage*, which stands between it and *Enodes* (compare Pl. LXII. fig. 1, with Pl. LVIII. figs. 3 & 7).

In this type there are prickly basipterygoids in front of the basitemporal lip (Pl. LXII. fig. 1*a*, *b.pg*, *b.t*). The pterygoids are slender, subarcuate, and with a short hamular process; they articulate with the deep postpalatine keels (fig. 1, *pt.pa*), and with the superadded mesopterygoid crest. The diverging vomerine crura, united to equally divergent ethmo-palatines, which are but little arched, show the rostrum clearly on the mid line. The interpalatine spurs (*i.pa*) are well developed; and the two lamellæ, upper and lower, are large fore and aft. They end externally in a thick edge, which runs backwards as a roughly gnawed transpalatine process, like that of *Hyloterpe* (Pl. LVIII. fig. 3), but better developed. The præpalatine bars are slender, but expand in front, where they are ankylosed to the præmaxillaries. The broad, flattish vomer comes very near to that of *Hyloterpe*; it is subcarinate, slightly apiculate in front, and has moderate and rather square upper lobes, in which the septo-maxillary is lost. The cranio-facial hinge is perfect, and the septum nasi (*s. n*) partly ossified. The maxillo-palatines (*mx.p*) are intermediate between those of *Enodes* and those of *Trichastoma* (Pl. LVIII. figs. 7 & 9), and are much like those of a Thrush and of the Flycatcher. The first and fifth nerves are divided by a delicate rod of bone, which lies forwards inside the upper turbinal; the pars plana (*p. p*) is squarish and moderately thick; there is a semidistinct seed-shaped os uncinatum (*o. u*) attached to the angle of the pars plana; and the lacrymal is very small and ankylosed to the posterior crus of the oasal[1].

The other Celebesian species examined by me, and to be described hereafter, are two of them of the family "Nectariniidæ," namely *Nectarophila grayi* and *Anthreptes malaccensis*; the other comes near the Tanagers, namely *Prionocheilus aureolimbatus*. The six just described are all very near akin; these are *Artamus*, *Hyloterpe*, *Dicrurus*, *Enodes*, *Trichastoma*, and *Lalage*.

All these are evidently more metamorphosed offshoots of some common southern "leader" of a lower type: *these* are "Oscines;" *that* was most probably of the section "Tracheophonæ."

The ancient non-singing passerines still abound in the American division of the "Notogæa;" and in the Malayan region they are not extinct, as, for instance, in the case of *Pitta*, a Bornean genus closely allied to *Grallaria*.

I have some Australian types to describe; but these, on the whole, come nearer to the Malayan forms than to the South-American. Yet, of seven genera dissected by me, *two* had the muscles of the lower larynx quite indistinct, namely *Petroica* and *Sittella*; these must therefore be classed as "Tracheophonæ."

[1] The skull of *Muscicapa grisola* will be treated of in the second part.

Example 23. *Petroica bicolor.*

Habitat. Australia. Group "Tracheophonæ;" family "Muscicapidæ."

This is the largest of those of this genus whose osteology is displayed in the Museum of the College of Surgeons. Its number in the 'Catalogue' is 1584; the other species there are *P. multicolor* (1584 A), *P. phœnicea* (1584 B), and *P. fusca* (1584 C).

Petroica bicolor is one of the strongest of the smaller Passerines in pelvis and hinder limb; its general osteology is as full of interest as that of the Australian type already described, namely *Menura*.

In its skull and face, however, it comes near the soft-billed passerines. Yet its affinity is not with our native Wrens and Sylviæ; but, in its palate at least, it approaches those types that are found in the Panama district of America, the "Mniotiltidæ," afterwards to be described, coming nearer to these, in some respects, than to *Muscicapa*. The pterygoids (Pl. LX. fig. 10, *pg*) agree with those of the "Formicariidæ," save that they are longer, and more arched, but little uncinate, and are elegantly expanded in a falcate manner in front.

As in *Grallaria*, the postpalatine keels (*pt.pa*) are deep, wide apart, and angulate, and the rostrum shows well between the right and left bone and the crura of the vomer.

The interpalatine spur is very short, the transverse part of the bone of the medium extent; and the transpalatine spur (*t.pa*) is arcuate, and of a width intermediate between that of a common and of a Piping Crow; it is bluntly pointed, as in *Anthreptes*. The vomer (*v*) is of great interest. The moieties of the true vomer are seen distinct for a long distance behind, and for a short space in front, where they end in two short horns, with a rounded emargination between them; this part is subcarinate below. But the outside of the bone is formed of the septo-maxillaries (*s.mx*), which are nearly as large as the halves of the true vomer, as in the Serpent. The upper lobes of this compound vomer are but little developed; the maxillo-palatine processes are obliquely handled spatulæ, as in many *high-class* passerines.

Example 24. *Petroica monticola.*

Habitat. Australia. Group "Tracheophonæ;" family "Muscicapidæ."

The palate of this smaller species (Pl. LX. fig. 9) differs from the last principally in slenderness; and the transpalatine processes come very near to those of the "Nectariniidæ."

The vomerine crura are more bowed, and the united part of much greater extent. The true vomerine bones (*v*) unite in front by a rounded point; and the sutures between these and the marginal septo-maxillaries (*s.mx*) are very distinct, as in the "Mniotiltidæ." A bone answering to the prævomerine portion of the Snake's septo-maxillary (*s.mx'*) has grafted itself on the inturned alinasal lamina (*i. a. l*). The maxillo-palatines are alike in both species.

There is a close affinity, one with another, in many of the lesser narrow-billed

Australian passerines, and that whether their *song-muscles* are developed or not. In this first paper I have only space for one more of these, namely *Pachycephala*; but afterwards *Sittella* and *Sericornis* will come under notice, besides those very unique types *Ptilotis* and *Acanthorhynchus*.

Example 25. *Pachycephala fusca* (?).

Habitat. Australia. Group "*Oscines*," Müller; family "Laniidæ."

Notwithstanding the superiority of this type over *Petroica* in the separation of the tracheal muscles for song, it is yet, I am satisfied, on the whole, only a slightly modified *Petroica*. Its large skull, shortish beak, and most remarkable vomer are the proofs of this. In some respects, *Pachycephala* is less specialized than *Petroica*—that is, in its palatine arch, both the primary and investing parts.

On each side of the basitemporal there is the tubular "tympanic" on the "siphonium," with one or two additional ossicles. The basitemporal (Pl. LXI. fig. 7, *b.t*) itself is bat-shaped, as in the "Cotingidæ" and "Formicariidæ;" and there are no basipterygoids on the rounded parasphenoidal beam. The hinge is almost perfect. The septum nasi (*s. n*) is alate in front; and the trabecular bone (*tr*) has appeared in this part behind the alæ. The recurrent alinasal fold (*rc. c*) is well marked, and the inturned alinasal fold (*i. a. l*) is narrow; mesiad of this we see the huge alinasal turbinal (*a. tb*) with two bony patches. The alinasal scale (Plate LXI. fig. 8, *al.n*) externally is unossified, but of large extent. The inferior turbinals are narrow and very long (*i. tb*): they are mostly soft; but there is a bony patch postero-superiorly.

A hasty observation might lead to the opinion that the peculiar form of the vomer (like baggy Turkish trowsers) was a mere freak of Nature; but its meaning lies deeper than this. In *Petroica monticola* (Pl. LX. fig. 9, *v*, *s.mx*), we have the same form, coupled with an alinasal turbinal ossicle close to the angle of the vomer. This curious outgrown form depends upon the very large size of the supero-lateral elements, the septo-maxillaries (*s.mx*), which here rival those of Lizards and Snakes. The vomer is subcarinate in front, but does not project at the mid line; the bone, especially at its edges, is thick and spongy; its upper lobes are scarcely developed: altogether it is a slightly masked reptilian structure.

The pterygoids (Pl. LXI. fig. 7) are like those of *Petroica*, but shorter; they have, like the palatine arch, altogether a very *cotingine* appearance.

The postpalatine keels are sharp and deep; the mesopterygoid and ethmo-palatine laminæ are low, the interpalatine spurs abortively developed, as is the transpalatine (*t.pa*), the bony bridge across of slight extent, and the præpalatine bar a narrowish subsinuous bar. The maxillo-palatine processes (*mx.p*) are broad-based, thick and clumsy, not so well developed as in *Petroica* (Pl. LX. figs. 9 & 10, *mx.p*), and on a level with those of *Pachyrhamphus* ("Cotingidæ") and *Thamnophilus* ("Formicariidæ"). The continuously bony jugum (*j*) is feeble and sinuous, and but little inturned behind. The præfrontal,

or ecto-ethmoid (fig. 7, *e.eth*, *p. p*), is a huge swollen mass of bone, perfectly *turnicine*, appearing well above, externally, and below; it sends a large kidney-shaped mass into the true olfactory region (Pl. LXI. fig. 8, *p.p*), as in *Hemipodius varius* and *Chasmorhynchus*. There is no separate os uncinatum; this is represented by the swollen lower angle of the pars plana; above that plate the 1st and 5th nerves pass through a large common opening. The lacrymal (fig. 8, *l*) is small; it has a high position, as in the Starling.

The *intermediate* position of this bird is self-evident; and it is also clear that the ascent, by metamorphosis, does not take place equally in all parts, but that some in one thing, some in another, become specialized and improved into nobler races and species. Moreover the existence of the proper organs for any special function in the life of the bird does not show that they are used for that purpose; *else why does not the Sparrow sing? Pachycephala* comes closer to *Elainea* than to *Lanius*.

It is no easy task to be a morphologist pure and simple whilst discussing the characters of the next type—the "Bird of Paradise." I shall endeavour to speak soberly, although treating of so beautiful a bird.

Example 26. *Paradisea papuana*.

Habitat. New Guinea. Group "Oscines," Müller; family "Paradiseidæ."

That which is peculiar to the bird's skull, namely ankylosis of part with part until nearly every land-mark has been removed, here attains its fullest possible extent, an extent only conditioned by the necessities of motion in certain parts of the face (Pl. LXII. figs. 2–4).

Setting aside for the time all side-relationships, I should place the Bird of Paradise in a position almost exactly intermediate between the *true* Crow of the Old World and the Piping Crow of Australia; its morphology and its geographical distribution agree alike with this view.

Yet the Malayan types just described, from Celebes, must be kept in mind; for any bird that should be like an exact *cross* between a Piping and a Common Crow, would not be a *Paradisea*.

The pterygoids (Pl. LXII. fig. 2, *pg*) are straight, strong, and have a flat, short hamular process; they articulate by a moderately laminar process with the posterior end of the palatine, the mesopeterygoid part of which (fig. 4, *ms.pg*) is small. The basipterygoid processes are absent from the rostrum (*pa.s*), which appears for a long distance along the mid line between the palatines and vomerine forks. The hinge is perfect; and in front of it the septum nasi (figs. 2 & 3, *s. n*) is solid bone, and very thick where the nasal nerves pass; this solid wide-winged part is seen in the front of the vomer (*v*). The rest of the septum still keeps its rounded inferior edge, the bony alæ on each side belonging to the "alinasal floor" (*n.f*), which, like the recurrent lamina in front, is one continuous mass with the surrounding facial bones.

The turbinals within this lamina, which is curiously dentate, are well ossified, as also are the true inferior turbinals (fig. 3, *i. tb*)—but not the alæ nasi themselves (fig. 4, *al. n*); these are the only soft part of the labyrinth. The rest of the labyrinth is very instructive; the ecto-ethmoid (*e.eth*) appears well above as an egg-shaped mass of bone, and it projects outwardly so as to reduce the lacrymal (fig. 4, *l*) to a small point of bone. The perpendicular plate, or meso-ethmoid, ends free behind the orbito-sphenoid, forming a postorbital band, with a rudimentary præsphenoid depending free. Thus the interorbital fenestra (*i.o.f*) is very large, and the separateness of the trabecular keel (fig. 4) considerable.

Laterally, the pars plana (*p. p*) returns inwards, and then appears to swell into an elegant egg-shaped mass of bone, which lies on the jugum (*j*). This bony egg (figs. 2–4, *o. u*), however, is separate, and belongs to the trabecular arch; it is the "os uncinatum," or "palate- trabecular conjugational" element.

The vomer (figs. 2 & 3, *v*) is very elegant, and is fashioned like a *Salisburia* leaf, spreading out, radiating its fibrous structure, and breaking into lobes, by notches that lie in the line of these fibres. The two principal notches are near the side; they half cut off the septo-maxillaries (*s.mx*).

Within, the vomer and the maxillo-palatines (*mx.p*) have been ankylosed to the inturned alinasal floor (*i. a. l*); behind, the twin stalks of the vomer run insensibly into the upper palatine lamina, the ethmo-palatine (*e.pa*).

These parts of the palatines are of moderate size. The interpalatine spurs are roughly pointed, like rusty nails, and they run into a ridge which becomes the postpalatine keel (*pt.pa*); it is pared away or bevelled, as in *Gymnorhina* and *Corvus*, and not sharp-angled, as in *Trichastoma* and *Thamnophilus*.

The bridge extending from this inner edge to the thick transpalatine portion is oblique, deep, and large; and thus the ear-shaped transpalatine snags (*t.pa*) are divergent. These subrotund lobes are flatter and more solid than those of *Enodes* (Pl. LVIII. figs. 7 & 8); they are not sharp spikes as in the Wood-Swallow and *Dicrurus* (Pl. LVIII. figs. 1 & 5). The whole fore beak (Pl. LXII. figs. 2–4) is very solid bone, riddled behind, at the sides, with large holes for the air-cells. Here are given off the characteristic maxillo-palatine processes (*mx.p*); they are like pruning-knives, are slightly bilobate at their end, and are not unlike those of *Artamus* (Pl. LVIII. figs. 1 & 2), being, as in that type, greatly enlarged by fusion with the intensely ossified nasal floor (*i. a. l*). This borrowed substance makes them look, in both these cases, larger than they are in reality. The same thing is seen in *Gymnorhina* (Pl. LX. figs. 5 & 6).

The continuously bony jugal is sinuous and moderately strong; it is but little incurved behind. This bird has the singing-muscles large and finely developed. It lived in the Gardens of the Society for some time, was dissected by me, and then put into the hands of Professor Flower for the Museum of the College of Surgeons.

I may remark that its digestive organs seemed somewhat aberrant: I only found one cæcum coli; and that was very small.

Example 27. *Chasmorhynchus nudicollis* (the Naked-throated Bell-bird).

Habitat. Brazil. Group "Tracheophonæ," Müller; family "Cotingidæ."

It would seem as though the "embryon atoms" of three diverse types had striven for mastery here: the Hemipod, the Goatsucker, and the Crow were put into the "limbeck;" the spirit that arose was the "Bell-bird."

The skull of this loud-voiced caprimulgine Crow is modified from the ordinary coracomorphous type far more than the skeleton generally; this is often the case in birds.

As far as the skull is concerned, this type has the same (but no more) right to be considered one of the "Coracomorphæ" as the Swift (*Cypselus*). In some respects it is truer to the Fissirostral type than the Swift itself; indeed, in the general texture of the skull, which is most exquisitely cellular and light, it comes close to *Caprimulgus*; whilst *Cypselus* has a thin fibrous skull, much more so than its passerine relatives the Swallows. Here, then, is a point on the great Coracomorphous circle which impinges on the circle containing the Frog-faced *Podargus*, the Oil-bird (*Steatornis*), and the Goatsucker; which latter forms the touching-point.

Still the *tracheophonous* Swift goes far away from the passerines, even those nearest to it, the Swallows, in all the structures behind the occiput. One of the lesser of the true Corvidæ, the Jay, being of the same size as the Bell-bird, is good for comparison; then let the student provide himself with the skull of a Goatsucker (*Caprimulgus europæus*) and of a Hemipod, and he will be able to follow the writer. Moreover our task, though asking delicate discrimination and familiarity with the bony framework of many birds, is yet a very easy one compared with that of tracing the atavistic germs of a Darwinian "Pangenesis." I may remark here, how smoothly the bone-surface has been polished and almost enamelled! the walls also being of the thinnest periosteal bone, and the diploë reduced to the uttermost degree of delicacy. The elegant two-winged basitemporal region (Pl. LXII. fig. 5, *b.t*) is everywhere completely welded to the surrounding parts, save in front, where the Eustachian openings (*eu*) are merely separated by a little wall of bone. Here the basitemporal lip is free; it is thick and spongy, like a *stonecrop* leaf.

The parasphenoid (*pa.s*) has spread abroad beneath the true posterior sphenoidal region, behind, facing most of the floor and sides of the "anterior tympanic recess," in which it is helped by the thoroughly continuous basitemporals. Like a true corvine, this bird has no basipterygoid processes, and the beam or rostrum runs forwards—thick, rounded, and solid—to the nearly perfect cranio-facial hinge. It is underfloored, all but its hinder part, by the palatine bones, as in *Caprimulgus*. The true nasal septum is ossified all along and directly in front of the hinge, in the middle; and in front the bony matter creeps down into the depth of the septum (fig. 7, *s.n*). Behind and below, a small tract of the septum is ossified (figs. 5 & 8, *tr*); this is the trabecular bone (belonging to the first facial arch); in front of it are two smaller bones, not united to the

cartilage (fig. 8, *tr'*, *tr''*). In front, the septal bone grows round the end and returns along the trabecular base, hookwise, up to the end of the expanded or alar portion (fig. 8, *s. n*).

The alæ nasi and their various outgrowths and processes are such as, being well mastered, will explain the peculiarities of a coracomorphous nasal labyrinth, as compared with that of the Fowl and Hemipod. Yet these parts, in the Bell-bird, are curiously intermediate between those of the Hemipod and the Crow; and only by comparing all these together shall we see their real meaning, or make out a harmony between them. If the parts in the Fowl (Phil. Trans. 1869, pl. 86) be compared with what I have described in the Rook (Pl. LV. figs. 1–3), it will be seen that the alinasal turbinal is given off from the *roof* in the Fowl, and from the *wall* in the Crow. In the Fowl, the alinasal wall is largely inturned; in the Rook, only at the end. In the Fowl, the *wall* having become the *floor*, coalesces behind with sides and base of the septum (*tom. cit.* fig. 3); in the Rook, this inturned part is continuous with, and ossified by, the compound vomer. In the Rook, the internasal part of the trabeculæ (Pl. LV. fig. 2) is largely alate; in the Fowl (*tom. cit.* figs. 1–4), the trabeculæ only caused the thickening to the base of the septum. But the most profitable comparison is to be made between the Crow and the Hemipod in these respects; and only by such a comparison shall we be able to see the meaning of these parts in the Bell-bird.

There is evidently, amongst birds, a primary difference in the manner in which the primary nasal slit (see "Fowl's Skull," pl. 81. fig. 1) becomes enclothed with cartilage, and drawn out into long, broken-up, labyrinthic passages.

In the Crow and Warbler (Pl. LV. figs. 1 & 13, *rc. c*) the alinasal scale of cartilage is, as it were, tucked in at its fore end, a broad flap on each side passing backwards and inwards to meet, and afterwards coalesce with, its fellow beneath the septum nasi. This I have worked out in the embryo of the Gorse-Linnet, and shall describe elsewhere; these retral parts are in reality the "cornua trabeculæ."

In the figures given of these parts in the young Rook and Redstart, these recurrent flaps have united at the mid line into a triangular tongue of cartilage (*rc. c*); but in a form to be given in my next part, namely one of the "Vireonidæ" (*Vireosylvia olivacea*), the part is twice the size of what is here shown, and nearly the hinder half is ununited, so that it is a large forked flap, the "tines" looking backwards: this is a step towards what I shall describe in the Bell-bird. Now it is evident that in the Rook (Pl. LV. fig. 1) the air passes in between the recurrent alinasal laminæ (*rc. c*) and the outer alinasal wall, with its ingrowing turbinal (*al.n*, *a.tb*), the turbinal being *lateral* in its origin, and not *superior* as in the Fowl (*loc. cit.*) and the Hemipod (Pl. LIV. figs. 3 & 4, *a.tb*); it arises, in the Rook, from the *wall* behind the external nostril, and not, as in the Fowl and Hemipod, from the *roof* in front of it. Here also note another important difference—namely, that instead of the recurrent flap being an ingrowth backwards of the forefront of the alinasal *roof*, in the Hemipod it is given off from the *wall* (Pl. LIV. figs. 1, 3–6, *n. w*, *n. f*). So there is an exact reversal as to the origin of

the recurrent laminæ and the alinasal turbinals in these two types, the "Turnicomorphæ" and the "Coracomorphæ." Moreover in *Turnix* these recurrent folds are of immense size; they are, as it were, the uptilted floor of the nose slit up from the *wall*, nearly as far as to the fore end of the long, linear, valvular nostril.

A far simpler form of nasal labyrinth may be taken as the common prototype of both these, namely that of the common Snake (*Natrix torquata*).

My unpublished figures of the morphology of this type show that the aliethmoid, aliseptal, and alinasal outgrowths of the short and simple ethmo-septal plate are all one common roof-scale of cartilage.

Where this scale ends in front, it sends backwards, or passes into, on each side, a large outcurved spatula of cartilage—the recurrent alinasal lamina or "cornu trabeculæ," which is jammed in, with the nasal gland, between the applied edges of the septomaxillary and the vomer of the same side. These two ribbons of cartilage have the same relative size as in the Hemipod, and generally coalesce with an upper labial, the counterpart of the "vomerine cartilage" of the Hemipod.

Now both the harmony and the disagreement of the Bell-bird and the Hemipod will be understood; the former is a true "Coracomorph," and yet has a certain turnicine *strain* in it.

The ala nasi (Pl. LXII. fig. 7, *al. n*) is a long oval scale; and the nostril is a low arched doorway: altogether this has a turnicine appearance. Part of the alinasal turbinal is seen in the narial opening; from below (figs. 5 & 8, *a.tb*) they are seen to be large flaps, bent on themselves, and underlain behind by a narrow, inturned cartilage (*i. a. l*).

As seen in figs. 5, 6, & 8, the alinasal and its turbinal end are cartilaginous *horns* to the large vomer (*v*), which grows into the cartilage for some distance. At the shoulders of this bone there is no appearance of a septo-maxillary; but a little in front there is a small suboval patch—a piece, as it were, of the fore part of the Ophidian bone. On the right side (fig. 6) it is ankylosed to the maxillo-palatine (*mx.p*); and on the left it is merely grafted on the nasal wall. These ossicles vary greatly; but the thing of interest here is the huge size of the recurrent laminæ (fig. 8, *rc. c*). These are long flaps, gradually decreasing in size backwards, and reaching close to the vomer, which has used up the lobes of cartilage that form the spatulate end of these long laminæ in the Snake. Here we have not the structure of the Hemipod exactly repeated, but a case of parallelism with it, as these bands are far larger than those spoken of as existing in *Vireosylvia*.

These laminæ adhere closely to the septum in their front half, and then are free for the remainder of their length; the larger and smaller trabecular splints (figs. 8 & 9, *tr*,' *tr*'') are formed in the fibrous interspace between these ribbons of cartilage. Our native Wren (*Troglodytes vulgaris*) rivals the Hemipod in its vomerine cartilages, and the Bell-bird in its recurrent laminæ. The *disjecta membra* of the Snake's septo-maxillary turn up everywhere in the tracts that are symmorphic with the membrane in which it is

produced; at the inner edge of the recurrent bands there is another ectosteal patch (fig. 8, *rc. c*, *s.mx'*). The vomer (figs. 5 & 8, *v*) is a copy of, or pattern for, that of the young sylviine (Pl. LV. fig. 13, *v*).

Very large, squared in front, subcarinate, rough and cellular, this bone has a low-type character; it has fully coalesced with the ethmo-palatine laminæ, and with them forms to a large extent a nearly finished floor to the basifacial beam. I note nothing more as belonging to the trabecular arch; for there is no appearance of the os uncinatum on either the larviform lacrymal or the bulbous pars plana (fig. 7, *l*, *p. p*). These latter parts are of extreme interest here; the lacrymal has a more than corvine development, and has the shape of a caterpillar when moving with its procession, erect-headed. Coming to the top, in front of the great ecto-ethmoid, it there is bent at a right angle, and then twists itself in a sigmoid manner to reach the jugum (*j*), first wedging in the angle of the pars plana (*p. p*). This lower part of the ecto-ethmoid is, like the upper or frontal portion, all swollen and spongy, like that of *Hemipodius varius* (Pl. LIV. figs. 9 & 10). The only room of any extent in the nasal labyrinth is in front, and is supplied by the nasal branch of the ophthalmic; the true olfactory region is occluded by the bilobate præfrontal mass, which is smoothed into flatness in front of the orbit.

The pterygo-palatine arch is, on the whole, corvine: but the pterygoids (*pg*) are extremely long and slender, and are elegantly arcuate; they are but little laminate in front, and but little uncinate behind (*e.pg*).

There is a long, overlapping process of the pterygoid on the upper edge of the palatine (fig. 7); and there *appears to be* no mesopterygoid. If this is so, we have a remarkable caprimulgine character; at any rate the segment must have been small, as the palatines are very little crested above, where they support the basis faciei. The post-palatine region is very *turnicine*, the ends being bevelled off instead of being crested and keeled; and the inner edges of the bone are closely approximated, hiding the parasphenoid below, but do not make a true commissure as in the great "Fissirostres." As in *Hemipodius* and *Turnix* (Pl. LIV.), the interpalatine ridges and spurs form a large, elegantly lyriform opening for the posterior nares. The upper or ethmo-palatine lamina is of less extent than the lower, and is thoroughly ankylosed to the vomer.

The transpalatine (*t.pa*), although at first view very caprimulgine, is not a general leafy breadth of the bone as in the Fern-Owl, but its true segment is shown as a square superaddition to the simple *struthious* or *turnicine* bar. The cartilaginous segment of the young Rook (Pl. LV. fig. 1, *t.pa*) needs only to grow further outwards and to be squared by periosteal growth, to be like what occurs in the Bell-bird; this bird has retained a certain embryonic distinctness in this particular segment. Whilst the pterygoid is a dense, *non-aërated* bone, the palatine, like that of *Caprimulgus*, is delicately spongy, and altogether thick and inflated.

From being very broad, it gets an extremely slender præpalatine bar, as in *Caprimulgus*; and this slenderness of the fore part corresponds with *Turnix*. The outline of

the maxillo-palatine processes (*mx.p*) is quite corvine; in texture they correspond with those of the Fern-Owl, and, indeed, are more spongy, the outer part of the distal process being a mere sieve of delicate bone.

The bowing outwards of the zygomatic process of the maxillary (*mx*), and its slenderness, are quite equal to what occurs in the Fern-Owl; but the *jugal* itself is a high compressed bone (fig. 7, *j*), unusually high for a bird, and having no other rival in this respect than the *Balæniceps*.

In other parts of the face, and in the skull, this bird is a *Crow* with *caprimulgine* leanings and isomorphisms. *Caprimulgus* itself, as I shall show in another paper, has narrowly escaped from the Coracomorphous territory; whilst the Bell-bird, being of a lower type than the Old-World Crows, is a nearer relation to the Goatsuckers than to the more passerine "Fissirostres." Even that for which this bird is famous, its voice, appears to me to be no mere *caw* of a true and proper Crow, but something akin to the mysterious sounds uttered by the Goatsuckers of the New World.

In concluding this instalment of my observations on the "Ægithognathæ," I cannot help remarking that the subject seems to me to be worthy of great extension.

As for the birds of South America, I shall be grateful to those naturalists who will in any way assist me in throwing light upon the various groups of the Coracomorphæ of that region, or, indeed, of the other natural divisions of the Class; for from that land of enchantment we have already the Palamedea, the Cariama, the Sun-Bittern, and the Trumpeter (*Psophia*), and numberless other types well worthy of careful study. My belief, being fairly expressed, is this, namely that there (in South America) we have representatives of the lost *Miocene* birds of our own geographical area.

Additional Remarks on the General Morphology of the Palate and Mandible.

I would beg of the reader to believe that the *limited region* here taken for comparison is not conterminous with the ground I have been digging.

This is not true of birds, as such, with regard to their structure throughout, nor of birds as a "topmost fruitful bough" of the Vertebrate life-tree.

Even the twigs of this bough have to be broken one by one, and not after they have been faggoted. This dark forest (Vertebrate morphology) may have the light let in upon it at some one spot by a laboured monograph of one type; or a fine line of light may be made to stream through it by the thorough working-out of one part or tract of the organization, the clearing being merely sufficient for the treading of the feet and for the peering of the eyes.

The utmost degree of modification of the facial parts that has been attained by a mere fish (a branchiate Vertebrate) has been shown in my essay on the skull of the Salmon (Phil. Trans. 1873); but a new stand-point has to be taken with regard to the air-breathers, most of which have their faces modified largely in relation to the function

of hearing, the first postoral cleft being converted into the cavity of the ear-drum, and the contiguous parts modified behind this air-space to wall it in, and to perfect it for the conveyance of the aërial vibrations.

Above the "Pisces Dipnoi," as soon as we reach the *Proteus* and *Siren*, a stapedial plug is formed in the osseo-cartilaginous ear-ball; above these, many of the tailless Batrachia utilize the first postoral cleft for an ear-drum, and the parts of the face around this opening become profoundly modified and metamorphosed to perfect this new sensorial apparatus.

But the simplest Amphibia are the best for comparison, as to their facial morphology, with the nobler types; and none of these is more instructive than the one treated of in the 'Proceedings' of this Society for 1874 (pp. 186–204, pls. 29–32), by Professor Huxley: this type is *Menobranchus lateralis*, one of the lowest of even the "Perennibranchiate Amphibia."

If the visceral arches of this form be carefully compared, as we slowly travel up through the types, with the Axolotl, Salamander, Frog, Chelonian, Non-carinate and Carinate Bird, we shall have a very adequate idea, at last, of the meaning of the multitude of bones that are to be found in the building of a bird's face,—during the growth of its face, rather; for Nature, ready with her cementing "osteoblasts," is incessantly obliterating the once distinct and shapely stones by which it was gradually built.

In the adult skull just referred to (Proc. Zool. Soc. 1874, pls. 29–31, pp. 186–204), the "chondrocranium" is in a condition of arrested ossification very similar to that of a chick at the beginning of the third week of incubation (see my paper on the Fowl's Skull, Phil. Trans. 1869, plate 83). It may sound like a contradiction; but this skull is nearly all *face*; for the axial structures are exceedingly feeble, and end between the huge ear-sacs (hinder *paraneural* elements). This aborted fore end of the axis, the ear-sacs, and the visceral or *pleural* arches are "by joints and *bands* knit together" into a sort of ground-plan for the higher types of Vertebrate skulls.

In these higher types the osseous metamorphosis, combined with the clefts (oblique, transverse, and longitudinal) that take place in the cartilaginous bands, or in their granular counterparts, give the results which we see in reptile, bird, or mammal.

The most important binders, with their subdivisions and their changes, are formed by the tops of the mandibular and hyoid arches; of the former only I wish to speak here.

In the bird, the mandible is articulated to the skull by a huge bone (the quadrate) which is the dorsal part of that arch, the mandible itself being the ventral part. But in this the bird conforms to all the Vertebrata with the exception of the Lamprey and his companions below, and the Mammalia above. In the early condition of the skull, whilst unchondrified (see Huxley, Elem. Comp. Anat. p. 138, fig. 57, F′), there is no discontinuity of tissue between the pedicle of the mandibular suspensorium and the trabecular band; but soon afterwards ("Fowl's Skull," pl 81. figs. 1 & 2) these tracts

become cartilage; and then the quadrate can be distinguished as a separate nodule, and the mandible as a separate bar. At that time the maxillo-palatine process of the embryonic mandible has a pith of tissue in it more granular than the rest, but no cartilage; the chick now corresponds exactly to the *Menobranchus*, save that the pedicle does not pass into the trabecula by continuous cartilage.

The same process may be traced in the Chelonia; and in them the free apex of the suspensorium, which, as in the bird, turns forwards as well as inwards, underlying the second and third branches of the trigeminal nerve, is pointed and permanently cartilaginous, even in the largest Sea-Turtles. That pointed soft end of the suspensorium is the orbital process of the quadrate bone; in the bird this free end is often broad and spatulate. Here I may remark that I once held the erroneous opinion that this part answered to the orbital process of the Tadpole's suspensorium—a cartilaginous leaf, folded over the *outside* of the temporal muscle, and only an evanescent structure.

The "otic process" is only one of two parts that join the ear-sac in the Amphibia (see Huxley on *Menobranchus*, pl. 30. fig. 1); for, besides the proper otic process which coalesces in most Amphibia with the antero-superior region of that organ, the pedicle gives off a facet below, which is well seen in the common Frog, gliding on the smooth antero-inferior face of the prootic region.

Now, in birds, the huge otic process of the suspensorium (the head of the quadrate) generally has an outer and an inner fork, and always, save in Ostriches and Tinamous, has two articular facets, even in the Gallinaceous birds and the Parrots, where the head is most undivided.

This inner facet does not, however, correspond with the otic facet of the amphibian pedicle, but is a mere fork of the "otic process."

So far we see that the suspensorium of the bird is altogether attached to the head (auditory region) by joints with joint-cavities, whilst in the Amphibia it is attached by bands and joints.

It is not an easy matter to harmonize the other parts of the palato-mandibular apparatus. The ascending process of the Urodela is a mere fibrous band in the Batrachia proper; and I do not think that Prof. Owen's view is tenable (see Huxley on *Menobranchus*, note to p. 189), namely that it answers to the epipterygoid columella of the Lizard. In Lizards and, as I have also discovered, in the Chelonia there are two pterygoid bones—one the broad flat membrane bone which forms so much of the posterior palate (the true pterygoid), and the other a rod-like bone lying above the great plate; this is the columella or epipterygoid.

In the Chelonia, when recently hatched, this bone is seen to be the separate ossification of the only part of the pterygo-palatine arcade which acquires any thing like a cartilaginous consistency: it is the postero-superior extremity of the arcade; and its hinder *tilted* end articulates with the apex of the free pedicle, joining it at right angles, and altogether in front of it; it cannot, therefore, answer *accurately* to the Amphibian

"ascending process," which is due to bifurcation of the pedicle itself; it is rather analogous than homologous.

In birds the pterygoid is single. In the Ratitæ it approximates in character to the lower Chelonian bone, being a large fibrous slab; in the Carinatæ, especially the higher aërial types, it is most like the lacertian *columella*; but the true homologue of that bone is the ascending or epipterygoid process. This corresponds to the "hamular process of the internal pterygoid plate" of Man and the other Mammalia, and is the apex of the *secondary* pterygo-palatine arch.

In the Lizard the pedicle of the suspensorium is quite lost in the adult, the facet or facets for the quadrate with the outstretched ear-sacs being formed on the "otic process." In the Chelonia the otic process, instead of being solid as in the bird, is hollowed out to form the large drum-cavity, the roof of which is largely formed by the "tegmen tympani" and its bony roof-tile (the squamosal).

The most instructive series of types for these comparisons would be found in this order, namely *Menobranchus*, *Dactylethra*, *Chelone*, *Dromæus*, *Tinamus*, *Turnix*, *Pipra*, *Coccothraustes*.

Such a comparison would yield much more than a view of the procession of the forms of the palatine and mandibular regions; the relations of the rest of the skull would force themselves upon the mind of the observer.

DESCRIPTION OF THE PLATES.

PLATE LIV.

Turnix rostrata (young).

Fig. 1. Lower view of palate, × 4 diameters.
Fig. 2. Upper view of face, × 4 diam.
Fig. 3. First section of face, × 10 diam.
Fig. 4. Second ditto, × 10 diam.
Fig. 5. Third ditto, × 10 diam.
Fig. 6. Fourth ditto, × 10 diam.
Fig. 7. Fifth ditto, × 10 diam.
Fig. 8. Vomer and cartilages, lower view, × 10 diam.

Hemipodius varius.

Fig. 9. Lower view of palate, × 4 diam.
Fig. 10. Upper view of face, × 4 diam.
Fig. 11. Side view of ditto, × 4 diam.
Fig. 12. Tympanics and quadrate, × 4 diam.
Fig. 13. Pterygoid and mesopterygoid of young, × 14 diam.

PLATE LV.

Corvus frugilegus.

Fig. 1. Lower view of palate of young, × 2 diam.
Fig. 2. Anterior section of face of ditto, × 4 diam.
Fig. 3. Posterior ditto, × 4 diam.
Fig. 4. Part of a similar section to last, × 8 diam.
Fig. 5. Side view of face of one more advanced, × 3 diam.
Fig. 6. Part of palate of adult, lower view, × 3 diam.

Corvus corone.

Fig. 7. Tympanic region of adult, × 4 diam.
Fig. 8. Internal angle of lower jaw, × 3 diam.
Fig. 9. Ditto, with part of "siphonium," × 3 diam.
Fig. 9*a*. The upper end of "siphonium" ossicle, × 3 diam.

Fregilus graculus.

Fig. 10. Lower view of vomer, × 4 diam.
Fig. 11. Upper view of ditto, × 4 diam.
Fig. 12. Side view of ditto, × 4 diam.

Ruticilla phœnicurus (young).

Fig. 13. Lower view of palate, × 17 diam.

PLATE LVI.

Menura superba ♀.

Fig. 1. Lower view of palate, × 1½ diam.
Fig. 2. Upper view of face and frontal region, × 1½ diam.
Fig. 3. Side view of ditto, × 1½ diam.
Fig. 4. Part of fig. 2, × 3 diam.
Fig. 5. Upper view of vomer and part of palatines, × 8 diam.

Pitta melanocephala.

Fig. 6. Lower view of palate, × 2½ diam.
Fig. 7. Part of ditto, × 4 diam.

Grallaria squamigera.

Fig. 8. Lower view of palate, × 2½ diam.
Fig. 9. Part of ditto, × 4 diam.
Fig. 10. Sectional view, showing septum nasi and part of ethmoid, × 2½ diam.

PLATE LVII.

Pipra auricapilla.

Fig. 1. Lower view of palate, × 4 diam.
Fig. 2. Part of ditto, × 7 diam.
Fig. 3. Side view of face, × 4 diam.

Pachyrhamphus.

Fig. 4. Lower view of palate, × 4 diam.
Fig. 5. Part of ditto, × 7 diam.
Fig. 6. Side view of face, × 4 diam.
Fig. 7. Upper view of ditto, × 4 diam.

Thamnophilus doliatus.

Fig. 8. Lower view of palate, × $3\frac{1}{2}$ diam.
Fig. 9. Part of ditto, × 6 diam.
Fig. 10. Side view of face, × 4 diam.

PLATE LVIII.

Artamus leucorhinus.

Fig. 1. Lower view of palate, × $2\frac{1}{2}$ diam.
Fig. 2. Part of ditto, × 5 diam.

Hyloterpe sulfuriventer.

Fig. 3. Lower view of palate, × $3\frac{1}{4}$ diam.
Fig. 4. Part of ditto, × 6 diam.

Dicrurus leucops.

Fig. 5. Lower view of palate, × 2 diam.
Fig. 6. Part of ditto, × 4 diam.

Enodes erythrophrys.

Fig. 7. Part of lower view of palate, × 4 diam.
Fig. 8. Part of side view of face, × 4 diam.

Trichastoma celebense.

Fig. 9. Part of lower view of palate, × 5 diam.

PLATE LIX.

Dendrocolaptes albicollis.

Fig. 1. Lower view of palate, × 2½ diam.
Fig. 2. Part of ditto, × 4 diam.
Fig. 3. Part of side view of face, × 3 diam.

Anæretes parulus.

Fig. 4. Posterior two thirds of palate, lower view, × 6 diam.
Fig. 5. Part of ditto, × 12 diam.

Synallaxis flavigularis.

Fig. 6. Lower view of palate, × 4 diam.
Fig. 7. Part of ditto, × 10 diam.
Fig. 8. Septum nasi, × 4½ diam.

Muscisaxicola mentalis.

Fig. 9. Lower view of palate, × 4 diam.
Fig. 10. Part of ditto, × 10 diam.

PLATE LX.

Homorus unicolor.

Fig. 1. Lower view of palate, × 3 diam.
Fig. 2. Part of ditto, × 5 diam.
Fig. 3. Ditto (upper view), × 5 diam.
Fig. 4. Side view of face, × 3 diam.

Gymnorhina tibicen.

Fig. 5. Lower view of palate, × 1½ diam.
Fig. 6. Part of ditto, × 4 diam.
Fig. 7. Vomer and cartilages (lower view), × 3 diam
Fig. 8. Pars plana and lacrymal (side view), × 3 diam.

Petroica monticola.

Fig. 9. Hinder part of palate (lower view), × 7 diam.

Petroica bicolor.

Fig. 10. Hinder part of palate (lower view), × 8 diam.

PLATE LXI.

Elainea.

Fig. 1. Lower view of palate, × 4 diam.
Fig. 2. Side view of middle of face, × 5 diam.

Lanius collurio.

Fig. 3. Lower view of palate (young), × 3½ diam.
Fig. 4. Greater part of palate (old), × 5 diam.
Fig. 5. Side view of middle of face (old), × 5 diam.
Fig. 6. Ditto (young), × 5 diam.

Pachycephala fusca (?).

Fig. 7. Lower view of palate, × 3½ diam.
Fig. 8. Side view of face, × 5 diam.

PLATE LXII.

Lalage leucopygialis.

Fig. 1. Hinder part of palate (lower view), × 6 diam.
Fig. 1*a*. Part of basis cranii, showing "basipterygoids," × 6 diam.

Paradisea papuana.

Fig. 2. Lower view of palate, × 2½ diam.
Fig. 3. Part of ditto, × 4 diam.
Fig. 4. Side view of face, × 2 diam.

Chasmorhynchus nudicollis.

Fig. 5. Lower view of palate, × 2 diam.
Fig. 6. Part of ditto (upper view), × 4 diam.
Fig. 7. Side view of face, × 2 diam.
Fig. 8. Part of fig. 5, × 4 diam.

N.B. The terms used here are the same as those in my paper on the Fowl's skull (Phil. Trans. 1869, pls. 81–87, pp. 755–807). A few new ones, however, will be found—namely, "recurrent alinasal lamina" (*rc. c*), "inturned alinasal lamina" (*i. a. l*), "vomerine cartilage" (*v. c*), "median septo-maxillary" (*m. s.mx*), and perhaps a few more.

VII. *On the Skull of the Ægithognathous Birds.*—Part II.

By W. K. Parker, *F.R.S., F.L.S., F.Z.S., &c.*

Received January 1st, 1876. Read February 15th, 1876[1].

[Plates XLVI.–LIV.]

In this second division of my account of that variety of the bird's skull which Professor Huxley terms "Ægithognathous," I give a Table of the types examined, illustrated, and described, both in this and in the first part, which appeared in the 'Transactions' of the Society in 1875 (vol. ix. pls. liv.–lxii., pp. 289–352).

Any thing but exhaustive, yet I flatter myself that both the zoologist and the anatomical student will find a sufficient variety of types of palate worked out to enable them to form a very tolerable idea of the most important modifications to be seen in so multitudinous and yet so greatly diversified a group of the Carinate Birds.

It will be seen how nearly the two terms given to these birds by the author just referred to are applicable to the same ornithic territory; his "Coracomorphæ," are all Ægithognathous,—and how the latter territory just overlaps the true Corvo-passerine region.

For, below, the simple Hemipods *begin* the Ægithognathous palate; and, above, it hinges on to the Swifts, beyond the Swallows, the former interdigitating with the Goat-sucker and Humming-birds. Probably the Cypselidæ have as much right to be called Coracomorphæ as some of the Southern Tracheophonæ, which are considered to be undoubted members of the great Passerine group.

In the annexed Table the Hemipods and the Swifts are called "Tracheophonæ;" for the term is applicable to all birds not possessed of the complex *syrinx* of the Songsters and Crows. It is a term difficult of application within the Passerine group; for many of those which possess the instrument have no knowledge of its use, and have merely harsh voices. In the Nuthatch (*Sitta europæa*) Macgillivray (Brit. Birds, vol. iii. p. 49) found "the inferior laryngeal muscles forming a small knob, and apparently single." In the Australian *Sittella* I could discover no breaking-up of the contractor muscles of the trachea into separate bundles on the syrinx. I have therefore put both these genera among the Tracheophonæ.

I do not see how such forms as *Gymnorhina*, *Cracticus*, *Coronica*, and *Vanga* can be placed with the Old-world Coracomorphæ; I have shown in my former paper (pl. ix.

[1] Since the sending-in of this paper several valuable contributions to the anatomy of the Passerine Birds, by Prof. Garrod, have appeared in the 'Proceedings' of the Society. See P. Z. S. 1876, pp. 506–519; 1877, pp. 447–452, and pp. 523–526. In the latter volume (pp. 413–418) there is an important paper, most welcome to me, on *Attagis*.

figs. 5–8, p. 325) that the skull of the first of these is altogether of a *Notogæan* type. It differs from that of a common Raven or Rook just as the skull of a Tanager differs from that of a Sparrow, or the skull of *Synallaxis* from that of a Redstart.

These large *Austro-corvines* may be called "Gymnorhinidæ," from the kind most familiar to us, the Piping-Crow of Australia.

The principal morphological steps taken by the lowest Coracomorphæ above the *super-Tinamine* Hemipods are (1) the abortion of the "basipterygoids," (2) the development of the "transpalatine" spurs, and (3) the direct union of the double vomer with the nasal wall and floor.

How slight and easy these modifications are only the morphologist rightly knows: the fitness for arboreal life, the differentiation of the syringeal muscles, the arrest of the cæca coli—these and other modifications follow in order.

Example 28. Skull of *Tanagra cyanoptera*.

Habitat. South America. Section Oscines; family Tanagridæ.

The skull of this species, as of others of its family, although no larger than that of the more robust kind of Finches, yet resembles that of the Old-world Crows quite as much as it does the same region in the lesser typical Conirostres (Plate XLVI. fig. 1).

The facial apparatus is altogether feebler than in the Fringillidæ; and the palatine bones have the slender directly retral transpalatine spurs of the Southern type. Thus the face at once suggests a frugivorous rather than a graminivorous bird; the periosteal outgrowths of bone and the strength of the hinges seen in the stouter Finches, whose skulls at once resemble those of the Fowl and of the Parrot, are not seen in the Tanagers.

Yet these feebler and more generalized skulls are thoroughly Passerine (*Coracomorphous*); and, as the Fringillidæ are closely related through the Larks (Alaudidæ), the Titlarks, and Wagtails to the soft-billed songsters (Sylviidæ), so the Tanagers are related to New-world forms with slender and yet slenderer bills, such as the Mniotiltidæ and Cerebidæ (compare Plate XLVI. with XLVIII.).

The occipital and basitemporal regions (*oc.c*, *b.t*) are quite normal, and the parasphenoidal beam (*pa.s*) of average strength. The pterygoids (*pg*) are long, rounded, pedate in front and having a goodly epipterygoid hook (*e.pg*) behind. Compared with their counterparts in the Finches, the palatines are frail, the præpalatine bar is wide (*pr.pa*); the interpalatine ridge is not spiked in front (*i.pa*); the ethmo-palatines (*e.pa*) are frail shells of bone confluent with the vomerine crura. The main bar narrows towards the transpalatine (*t.pa*), which is a fine spike, outbowed, and with its apex turned towards the mid line a little. The præmaxillary mass is, although broad, rather corvine than Fringilline; it is grooved sublaterally, and in the middle; the dentary regions are distinct and cultrate; the palatine processes are aborted (*d*, *px*, *p.px*).

Where the latter processes existed in the embryo, a falcate spicule of bone appears, a

separate "palato-maxillary (*p.mx*)." This is a character to be found in several families of the Coracomorphæ, as I shall soon show. Its presence suggests some delicate bond of affinity between the families where it is found [1].

The maxillary is but a feeble bone, ending in a long, slender jugal style, formed by its own process and by the free jugal (*mx*, *j*). The maxillo-palatine processes (*mx.p*) are bent both backwards and inwards, in the usual manner, and end in a directly retral club, which is large, pneumatic, and has two inferior air-openings. The large vomer (*v*) has the ox-face shape, and is grafted on the inturned alinasal lamina (*i. al*) without showing any distinct septo-maxillary; its distinctness, however, may be sought for too *late*, or too *early*. The recurrent laminæ (trabecular horns) could not be seen; but the fore part of the trabecular bars (*tr*, *s. n*) showed a fine foliation in front, making the septum nasi broadly alate. These alæ remain soft; but the septum, which is fenestrate, is ossified. There is no distinct "os uncinatum;" but clinging to the front of the antorbital is a thoroughly *Corvine* lachrymal (fig. 2, *p.p*, *l*); its head rests against the descending crus of the nasal (*n*), and its foot upon the jugal process of the maxillary and the jugal apex (*j*). The open (bony) nasal passage (*e. n*) shows, now that the cartilaginous nasal labyrinth has been removed, an elegantly oval space, as in the Crows.

Example 29. Skull of Violet Tanager (*Euphonia violacea*).

Habitat. Barbadoes.

This small bird shows, very instructively, the Tanagrine type of skull (Plate XLVI. fig. 3). The flat, strap-shaped præpalatine bar (*pr.pa*) narrows greatly backwards, and the processes sent from the main bar to the skull-balk are of small antero-posterior extent; these are the lower or interpalatine keels, and the upper or ethmopalatine shells (*i.pa*, *e.pa*); the latter are confluent with the vomer (*v*).

The interpalatines run into large, steep, almost semicylindrical postpalatine plates (*pt.pa*), as in so many *Southern Passerines*; the transpalatine spur (*t.pa*) is slenderer, straighter, and longer than in *Tanagra cyanoptera*. Beneath the root of the clubbed maxillo-palatine (*mx.p*) there is a small spicular palato-maxillary (*p.mx*), partly confluent with the outer edge of the palatine bar. The vomerine moieties show a septo-maxillary (*v*, *s.mx*, *i. al*) confluent with the substance of the inturned alinasal lamina, which is soft beyond that bone. These thick wedges of bone are scooped antero-inferiorly and dovetailed with the diverging vomerine crura. Here the vomer is unusually emarginate and cloven.

Example 30. Skull of *Stephanophorus leucocephalus*.

Habitat. Brazil.

The skull of this Tanager (fig. 4), which is a little smaller than *Tanagra cyanoptera*

[1] In the Woodpeckers and Wrynecks this bone exists, but only on the left side (see Trans. Linn. Soc. 1875, ser. 2, vol. i. pls. 1–5, pp. 1–22.

and one third larger than *Euphonia violacea*, is intermediate in character between the two. It shows, in a charming manner, that subgeneric modifications of the outer bird are correlated with, or attended by, changes of structure in the most fundamental skeletal parts.

The palatines are feebler than in *Tanagra*, and the transpalatine spike (*t.pa*) straighter and more slender. The interpalatine spike (*i.pa*) is well developed; and the ethmo-palatine laminæ (*e.pa*) have a projecting process, and are thin and fenestrate. The thin, lathy, palato-maxillary (*p.mx*) is larger and more distinct than in the other kinds already described; and the maxillo-palatine outgrowths (*mx.p*) are terminated by elegant, arcuate, pneumatic "ladles" opening by a large, single, inferior mouth.

The rest of the skull presents no important modification of what is seen in the genus *Tanagra*. In these three specimens (of *Tanagra*, *Euphonia*, and *Stephanophorus*) the "os uncinatum" is not distinct.

Example 31. Skull of *Pyranga rubra*. Fam. Tanagridæ.

Habitat. South America.

This type is introduced to show the presence of the palato-maxillary (Plate XLVI. fig. 5, *p.mx*) in another (fourth) genus of the "Tanagridæ;" it is confluent, however, with the præmaxillary in my specimen.

Example 32. Skull of *Prionochilus aureo-limbatus*. Fam. Nectariniidæ.

Habitat. Celebes.

I give the family of this elegant little conirostral bird on the authority of my friend Mr. Salvin. However that family (the Nectariniidæ) may differ from the Tanagridæ in external characters, osteologically they interblend.

The palate (Plate XLVI. fig. 6) shows nothing that is not Tanagrine in its modifications; and this bird coming from the very equator, it is of the greatest interest to find how close is its correspondence in cranial structure with the members of that family, whose home is the Western Notogæa. It is only one, however, among the many instances to be noted.

The bony framework of the palate here attains its utmost degree of delicacy: no Warbler or Sylviine type shows this more. The depth of the postpalatine keels (figs. 6 & 7, *pt.pa*) is here at its greatest; and the trans- and præpalatine regions are mere needles of bone; the isthmus connecting these, where they meet, with the inter- and ethmo-palatine regions is very narrow (*i.pa*, *e.pa*). The half-coiled ethmo-palatine is quite confluent with the corresponding vomerine crus (*v*), although my specimen is the skull of a young bird. The proof of this lies in the perfect distinctness of the meso-pterygoid wedge (*ms.pg*). No air-cell has, as yet, appeared in the maxillo-palatine (*mx.p*). The vomer is perfectly Tanagrine: it is emarginate; for the osseous matter has

crept some distance into the end of the inturned lamina of the nasal wall (*i.al*). I do not see a distinct septo-maxillary; most probably this has been already added to the horns of the vomer. The extent of the nasal labyrinth is, both in width and length, much greater than in *Tanagra* (compare fig. 6 with fig. 1); but, as in that genus, the trabeculæ make the base of the nasal septum alate (*tr*, *s. n*). In this, evidently a first-summer specimen, the whole labyrinth is soft. And the immaturity of the bird has been of great use morphologically; for not only are the mesopterygoids distinct, but we have also a perfectly distinct seed-shaped lacrymal and os uncinatum (fig. 7, *l*, *o. u*), the former capping the projecting ecto-ethmoid, and the latter clamping the foot of the pars plana (*e.eth*, *p.p*). There is a lunate fenestra in the perpendicular ethmoid (fig. 7, *p. e*), besides the pear-shaped interorbital fenestra, the fore part of which is seen in the figure (*i. o. f*). Above the ethmo-presphenoidal bar there is, on each side, a huge fenestra, which largely occupies the orbital region of the frontal. This is common in small Passerines.

Example 33. Skull of *Phytotoma rara*. Family Phytotomidæ.

Habitat. Chili.

This type of skull stands out amongst those of the Tanagridæ more than that of *Coccothraustes* does amongst those of the Fringillidæ. Yet to the former it is most evidently related, although unique in many of its characters, and as a whole a most remarkable and evidently *ancient* form.

This skull, like that of the Grosbeak, is an isomorph of that of the Parrot, but it is not so Psittacine as that of the Old-world bird [1]. I have purposely placed the figure of the palate in this type side by side with that of *Tanagra* (Plate XLVI. figs. 1 & 8): thus their agreement and their disagreement will be plainly seen.

A general view of the skull shows it to be more like that of a large Finch and less like that of a small Crow than the skull of *Tanagra*. The proportional relation of the nasal labyrinth to the hinder palatal region is very small in *Phytotoma*, medium in *Tanagra*, and very large in *Prionochilus* (figs. 8, 1, & 6. The unusual length of the pterygoids (fig. 8, *pg*) is Psittacine; and this is correlated with a small and slender orbital process of the quadrate, as in the Parrots; but both the quadrate and pterygoids are thoroughly Tanagrine in this rare form. The epipterygoid (*e.pg*) and the dilated fore end of that bone, which has given up a large mesopterygoid piece to the palatine (fig. 10, *ms.pg*, *pg*, *pt.pa*), these parts are precisely like those of *Tanagra*. The postpalatine keels (*pt.pa*) are much larger in this type than in *Tanagra* and its relations, scarcely more so, however, than in *Prionochilus* (fig. 6). The Parrot-like modification of the palatines is most seen in the strong and *oblique* (not *steep*) trans-

[1] But that sort of modification by which a conirostral bird of the Passerine type becomes like a Parrot in certain respects does not in any way affect its true relationships; like the desmognathism of the palate in many types, it is a morphological peculiarity, and not a zoological bond of affinity.

palatine spurs (*t.pa*); but these have a Tanagrine feebleness still, as compared with those of *Coccothraustes* (Plate L. figs. 1, 2). Moreover, in the latter the palatines and the jugal bars are roughly hinged off from the fore beak, as in Parrots, but not to the same degree. There is nothing like this in *Phytotoma*, which retains, even in the most modified parts of its face and skull, the more *generalized* condition of the birds of the Notogæa. The short præpalatine bar is broad, and so is the transverse isthmus which runs into the thin laminæ of the inter- and ethmo-palatine regions (*i.pa*, *e.pa*): the latter is of less extent than in the Tanagers, and is completely fused, as usual, with the vomerine crus (*v*).

The large, steeply-arched rostrum (figs. 8 & 10) is ossified throughout to an extent only found in certain Southern Passerines, as *Artamus*, *Gymnorhina*, and *Paradisea* (Part I. plates lviii., lx., & lxii.); and the peculiar manner in which the broad maxillo-palatines are articulated by a flat facet to the vomer gives to this face a peculiar kind of *Passerine* Desmognathism. In this respect *Phytotoma* agrees with *Pipra*, *Thamnophilus*, *Pitta*, *Grallaria*. Now this type shows relationship with the Cotingidæ, Formicariidæ, and Pittidæ (Part I. plates lvi., lvii.): it is thus linked on to the most generalized forms found even in the Notogæa.

But, superadded to all these marks of ancientness, this bird shows, more than any living type, the remains of what are apparently but recently lost *teeth*—that is, speaking palæontologically.

These bony denticles may be faint memorials of such a *confluent* dental armature as we see in the Chameleon: they are not the less of interest, seeing that, as yet, we have nothing else intervening between them and the teeth of *Odontopteryx* (see Owen, Quart. Journ. Geol. Soc. xxix. p. 511[1]). It is impossible to compare the anterior part of the palate in *Tanagra* and *Phytotoma* without seeing their close correspondence; and yet we miss in the former the row of clearly defined denticles, both along the dentary and palatine ridges of the præmaxillary (figs. 8 & 10, *d.px*, *p.px*). Moreover, in *Phytotoma* the end of the beak is pinched off in some degree—it is apiculated. I have spoken of these bony projections as *bony denticles*; for if their development were traced, I imagine that the osseous matter of the præmaxillary would be found to run directly into the arrested dentary papillæ. Even in the Mergansers, amongst the horny-toothed birds, the dentary edge of the præmaxillary is very obscurely marked by denticulations.

In *Phytotoma* there are about fourteen marginal elevations, and about ten submarginal (fig. 8); there is a deep fossa between these, into which the toothed ridge (with one row) of the dentary fits; this latter is a swollen mass of bone united by a wide bony mass to its fellow of the opposite side. The bony union of the mandibles, however, is feeble and small as compared with what is seen in *Coccothraustes*, although equal to what may be found in the smaller Parrots. The maxillary (*mx*) runs feebly

[1] See also Prof. O. C. Marsh "On Odontornithes," Amer. Journ. of Sc. and Arts, vol. x. Nov. 1875, and vol. xiv. July 1877.

into the long jugal style (*j*), to which it is ankylosed; it is also completely confluent with the præmaxillary in front, running in as a splint-like wedge. But over the middle of the præpalatine bar a process of the maxillary grows; this is its maxillo-palatine process. This outgrowth is unusually massive, short, and non-pedunculated for a Passerine bird (compare fig. 1 with figs. 8, 9, *mx.p*). This maxillo-palatine is quite unique: it is spongy, has a large, oval, inferior pneumatic opening, and sends out postero-externally, behind its short neck, a sharp spur. On the whole, however, this part comes very near to the like process in *Pitta* and *Grallaria* (Part I. plate lvi.), and is very similar to that of the African Ostrich (Ostrich skull, plate viii. fig. 2). Altogether these parts speak of a generalized *Southern* bird, and yet, for one of its zoological rank, considerably specialized.

In this and other Southern types the palate owes much of its strength to the maxillo-palatines, which are like flying buttresses inverted; but in the stoutest of the Finches (*Coccothraustes*, see Plate LI. figs. 1 & 2, *mx.p*) these parts are reduced to the frailest and most delicate bony air-tubes, and the strength of the palate lies in the palatines themselves and the ox-faced massive vomer. This bone (figs. 8 & 9, *v*) is large and spongy: its "horns" have not distinct septo-maxillaries; but these have probably coalesced. The shoulders of the bone are broad, and in front are faceted obliquely, where they glide on the maxillo-palatine facet; the facets of the vomer are elevated, like basipterygoids; and there appears to be a small joint-cavity. In front the vomer is emarginate by a rounded notch; below subcarinate, and then fenestrate, and lastly slit, the flat crura on each side running to coalesce with the ethmo-palatines. As in the Southern types, *Pipra*, *Thamnophilus*, &c., the osseous matter of the vomerine horns stops short at the nasal wall, which is ossified independently and not by free extension of bony matter from the vomer, as in the Old-world Finches. Lastly, the whole nasal labyrinth is ossified, with the exception of the inferior turbinal; the septum (*s. n*) is but little alate in front; and the "recurrent cartilage" (*rc.c.*) is much arrested. The alinasal turbinal is hidden below (figs. 8 & 9) by the nasal wall and floor (*n. w*); but it is seen on the outside joining an oblong valve in the external nostril (fig. 10, *a. tb*, *e. n*). The whole alinasal wall (*al.n*) is thoroughly ossified, and is relatively larger than in the Tanagers. There is a truly Corvine lacrymal as in *Tanagra* (figs. 2 & 10, *l*); but it is hammer-shaped, and the "head" looks forwards and downwards. As in the Grosbeak and Parrot, but not to the same extent, the pars plana (*p. p*) runs into an elongated process, which is the "os uncinatum;" it has either coalesced with the pars plana or was from the beginning connate. As in the Grosbeak and Parrot, the septum of the orbits (fig. 10, *p.e*) is perfectly bony. A large open space in the antero-internal part of the orbit admits both the olfactory and orbito-nasal nerves (1, 5 *a*). In the Grosbeak the orbital bony ring is nearly as perfect as in the lesser Psittacidæ (e. g. *Psephotus multicolor*); it is much less so in *Phytotoma*. Here, however, we encounter a character not expected in a Passerine; for the upper

rim of the frontal (*n. gd*) is scooped, as in water-birds, for the long nasal gland. This Grallatorial character is as remarkable as the Passerine modifications seen in the skull of the Hemipods, whose skulls do not clearly show any bevelling of the orbit for the gland.

In another remarkable type, also from Chili, *Thinocorus rumicivorus* (Plate LIV. fig. 5), the orbital cave is scooped a little more than in *Phytotoma* for its long tongue-shaped nasal gland; and these birds agree, also, in the height of the rostrum and in the narrowness of the frontal region, above, between the eyes [1].

Altogether this type must be considered to be one of the very lowest of the Passerines (Coracomorphæ), on the whole on a level with the Cotingidæ, Formicariidæ, and Tanagridæ; but by its pluvialine nasal-gland groove, and its probably aborted *teeth*, it is marked off from its nearest known congeners—a species representing a genus, and even a family, quite unique.

Example 34. Skull of *Acanthorhynchus tenuirostris*. Family Meliphagidæ. Section Oscines.

Habitat. Australia.

This and the next type of skull (Plate XLVII. figs. 1–4) may be profitably compared with those of the Nectarinidæ (Plate LIII.).

Whatever the zoologist may find like or unlike in these two families, anatomically, they are widely apart—the Meliphagidæ of Australia being very aberrant as Passerines, and the Nectariniidæ of Celebes (and, I suppose, also of regions north of the equator) being merely delicate tenuirostral modifications of the soft-billed singing birds of the Old World.

In *Acanthorhynchus* there is nothing especially to be remarked upon in the pterygoids (Plate XLVII. fig. 1, *pg*), but that they diverge considerably to reach the quadrate bones. They are expanded where they join the palatines, and have given off the usual mesopterygoid plate to those bones. The epipterygoid process (*e.pg*) is well developed and rather broad. The postpalatine keels (*pt.pa*) are as well developed as in Southern birds generally; the interpalatine spike (*i.pa*) is arrested; and the ethmo-palatine half-coil has completely coalesced with the corresponding crus of the vomer (*e.pa*, *v*).

The transpalatine (*t.pa*) shows the retral, spike-shaped form of the *Notogæal* types; they diverge considerably in this species. The double isthmus running from the inner part of the bone to the ethmo- and interpalatine region is broad, and the præpalatine (*pr. pa*) is long, slender, and dilated in its anterior third; but in its *position* this bar is very remarkable. The relation of the præpalatine bar to the palatine process of the præ-

[1] *Thinocorus*, as I have elsewhere shown, comes nearest, on the whole, to the "Geramomorphæ," yet it has a palate compounded of the Dromæognathous, Ægithognathous, and Schizognathous types of structure. If the zoologist would find out this riddle, he must plough with the morphologist's heifer.

maxillary is very variable if the whole Class be considered; but in by far the majority of the Coracomorphæ the palatine runs on the *inner* side of that process. In this species and in the next, both of them belonging to the Meliphagidæ, the palatine runs on the *outer* side (Plate XLVII. figs. 1–4, *p*, *px*, *pr.pa*): these are the only instances found by me at present amongst the Passerines. This exceptional character in the Meliphagidæ is not so striking as the uniformity of the rest of the group as to a modification so slight; but altogether their close kinship is evident in all their structure, and their variations, from family to family, gentle in the extreme.

The following Table will show how mobile is the articulation of the splintery elements of the fore palate:—

1. Apex of præpalatine some distance behind palatine plate of præmaxillary.

   Examples. *Struthio camelus* (adult), *Rhea americana*, *Dromæus ater*, *Casuarius Bennettii*.

2. Apices of præpalatine bar and palatal process of præmaxillary united by suture.

   Examples. *Struthio camelus* (one third of incubatory period), *Gallus domesticus* (at time of hatching).

3. Præpalatine bar passing *over* the palatal process of præmaxillary, as well as to the inside.

   Examples. *Falco tinnunculus* (fledgeling), *Ardea cinerea* (fledgeling).

4. Præpalatine bar let into the *under* surface of the large palatal process of the præmaxillary.

   Example. *Platalea leucorodia*.

5. Præpalatine bar passing *outside* the palatal process of præmaxillary.

   Examples. *Tinamus variegatus*, *Gallus domesticus* (adult), Picidæ and Yungidæ, Meliphagidæ.

6. Præpalatine bar passing *inside* the palatal process of præmaxillary.

   Examples. *Dicholophus cristatus* and the Aëtomorphæ generally, the Coracomorphæ (with the above exception), *Cuculus canorus*, *Corythaix buffoni*, *Megalæma asiatica*, *Caprimulgus europæus*, *Trochilus* (*Patagona*) *gigas*, *Colymbus septentrionalis*.

As in those low types, the Rhea and the Tinamou ('Ostrich's Skull,' pls. iv., xv.), the palatine process of the præmaxillary (Plate XLVII. figs. 1 & 2, *p.px*) is very large, long, and lathy. Between the two, at their root, there is a short median process, which hides the recurrent horns of the trabeculæ, and ends the groove in which the prænasal cartilages lay. All the fore part of the long decurved rostrum is narrow, the dentary edge (*d.px*) sharp; the median line deeply scooped. The frail maxillary (*mx*) is entirely confluent with the rostrum in front and the jugal (*j*) behind; at its middle it is bowed somewhat outwards, and expanded inwards: this wide part has a large fenestra, and a long maxillo-palatine bar (*mx.p*); and nearly half the length of this is taken up by the filiform pedicle; the greater half is a free lanceolate leaf of bone. This process here is more retrally developed than usual; it is peculiarly ornithic. At

the inner side of the base of the bony leaf a spur is given off; this binds strongly on the shoulder of the vomer (*v*)—a *Southern* character. The bony lamina is too thin for an air-cell. As in *Petroica* (Part I. pl. lx. figs. 9 & 10, *v*), the vomer is evidently composed of two larger, inner, and two smaller, outer, tongues of bone: the inner are the proper vomers (*v*), the outer the septo-maxillaries (*s.mx*). As in the Struthionidæ, the vomerine crura are short; they are ankylosed to the ethmo-palatines. The nasal wall (*n.w*) sends inwards a thick spur of cartilage (*i.a.l*), on which each vomer and septo-maxillary is grafted. The septum nasi (*s. n*) is unusually long, rather deep, and is not alate. The alinasal wall is long; and it, with its turbinal, and the inferior turbinal, are all unossified—very unlike what we see in the Humming-bird (Trans. Linn. Soc. ser. 2, Zoology, vol. i. p. 119). In the lower view the alinasal turbinal is only slightly seen (figs. 1 & 2, *a. tb*); for the nasal labyrinth has the unusual bony floor formed by the palatal plates of the præmaxillaries. The ecto-ethmoid and its downward continuation, the pars plana (fig. 1, *e.eth*, *p.p*), together form a large spongy mass, on which I fail to find either lacrymal or os uncinatum; inside this mass, above, a large chink forms a common foramen for the olfactory and orbito-nasal nerves.

Above, the skull resembles that of a Humming-bird; but its true character is soon understood when carefully inspected. It is much further off from the Sylviidæ than the Nectariniidæ are, as I shall soon show.

Example 35. Skull of *Ptilotis*, sp.? Family Meliphagidæ. Section Oscines.

Habitat. Australia.

This is a stouter type, with a shorter beak; and yet it diverges still more than the last from the more accurate Sylviine form (as to its skull) of the Nectariniidæ. The hinges of its face are still more modified; for the pterygoids (fig. 3, *pg*) are quite unique in their divergence and their arcuate form; they are quite flat as they approach the palatines, being *depressed*; they are *compressed* behind; so that they have a twisted appearance. The anterior end is foot-shaped, and has lost a large triangle of bone—the mesopterygoid, which has coalesced with the palatine. Behind, the epipterygoid hook (*e.pg*) is well seen.

But the palatines are at once the most remarkable and elegant seen by me in any ornithic type, although the whole class is characterized by the consummate beauty of its cranio-facial architecture; and in that building, which looks as though it had been wrought by the hands of fairies, the palatines are always the parts that strike the eye. The solid part of the rostrum is short in *Ptilotis*, as compared with *Acanthorhynchus* (figs. 1 & 3); and the bar formed by coalescence of the palatal process of the præmaxillary with the præpalatine is very long, and reaches into the anterior third of the rostrum. This long widish plank of bone is gently bowed outwards in the nasal region, and again in its terminal, free, outer spur—the transpalatine (fig. 3. *p.px*, *pr.pa*, *t.pa*); so that it

is elegantly undulating in form. The large postpalatine keels terminate below, in front, in a blunt interpalatine process (*pt.pa*, *i.pa*); a strong ligament binds the retral maxillo-palatine (*mx.p*) to this spur. The ethmo-palatine, ankylosed to the vomer, does not reach further forward than the isthmus and interpalatine, and is out of view below. The parasphenoid (*pa.s*) is uncovered from the solid part of the vomer to near the end of the palatines; but these close in where they meet the pterygoids. The widest part of the maxillary is fenestrate, as in the last instance; but the maxillo-palatines have not so long a pedicle, have no spur where they underbind the vomer, and are thick enough to contain air-cells (figs. 3 & 4, *v*, *mx.p*); their whole form is strongly arched, the roundest part of the bow being at their root. As in the last, the vomer is but little emarginate, a strong contrast to that of the Nectariniidæ (Plate LIII.); and I strongly suspect that it was ossified from four centres, the two outer being the septo-maxillaries. The whole bone is oblong, smooth, and, in front, slightly carinate; its shoulders are grafted upon the inturned lamina of the nasal wall (*n. w*). The out-bowing of the bony bars exposes more of the nasal labyrinth below (*n. w*, *a.th*) than in the last instance; it is entirely unossified. The septum (*s. n*) is long, deep, and non-alate; and the recurrent lamina is hidden by the median part of the præmaxillary mass.

This skull, generally, is like the last, but has less resemblance to that of the Trochilidæ; its ethmoidal masses (*e.eth*, *p.p*) are, like those of *Acanthorhynchus*, very large and spongy, showing no os uncinatum or lacrymal; and over the pars plana the olfactory and orbito-nasal nerves pass through one common large space.

I found the syrinx very perfect in this bird.

Example 36. Skull of *Sericornis humilis* (?). Family Sylviidæ. Section Oscines [1].

Habitat. Australia.

This bird and the next are Australian; then I have to describe several from Panama and the Central-American district. All these, with two species of the Australian genus *Petroica*, described in the first Part (plate lx. figs. 9 & 10), come, as to their skull, under one category, however the zoologist may find it necessary to put them into various families.

Some of them have a "syrinx;" and in others it is not developed; but as to their skull, they have much in common, and they are evidently intermediate between the soft-billed Passerines with which we are familiar here, such as *Sylvia*, *Muscicapa*, *Motacilla*, *Anthus*, and those of South America, such as *Muscisaxicola*, *Synallaxis*, *Anæretes* (Part I. plate lix.), and also the Australian "Meliphagidæ," just described [2].

[1] This bird has, I find, a perfect *syrinx*.

[2] I must confess that the latter are much nearer to the Sylviines than the South-American Tyrannidæ and Dendrocolaptidæ; the most archaic Australian type is *Menura* (Part I. plate lvi.). The Whinchat (*Pratincola rubetra*) corresponds very closely with the Central-American types (see Plate XLVIII.).

In *Sericornis* the pterygoids (fig. 5, *pg*) are slender and arcuate, and the epipterygoid is short and broad (*e.pg*), whilst the palatine end is much dilated; it is separate from its own lanceolate segment, the mesopterygoid, now completely united to the postpalatine (*pt.pa*). The keels of the latter part are moderately developed; and the interpalatine spur (*i.pa*) is aborted; the ethmo-palatine is of moderate size, and the transpalatine (*t.pa*) broad and foliaceous; the whole præpalatine bar (*pr.pa*) is long and slender. The palatal processes of the præmaxillary are suppressed or absorbed; the palato-maxillaries do not appear; and the maxillary (*mx*) is quite ankylosed to the rostrum and to the jugum (*j*). The pedicle of the maxillo-palatine process (*mx.p*) curves backwards, and not forwards as in *Ptilotis* (figs. 3 & 4, *mx.p*); and the dilated end is pedate, with an anterior "keel," as in *Acanthorhynchus* (fig. 1). The vomer has its margins evidently composed of splints distinct from the two main vomerine moieties, as in *Petroica* (Part I. plate lx. figs. 9 & 10, *v*) and the types next to be described. The nasal capsule is not hard; and yet it is in some degree calcified, retaining its form well in the dry skull; it is very elegant and instructive in this lower view.

In front, the trabecular cornua have coalesced to form a triangular carinate recurrent cartilage (*rc. c*); behind this part the subseptal region of the trabecular bars had become foliaceous, the leafy flaps being sinuous; the hinder third of the bar forms merely a thickened selvage to the septum nasi (*tr, s. n*). The nasal wall contracts and grows inwards, behind, to form the inturned ala (*i. al*), on which the vomerine bones are grafted. The floor of the labyrinth is imperfect below, and especially in front, showing the large alinasal turbinals (*a. tb*).

The lateral ethmoids (*e.eth, p.p*) are like those of *Ptilotis*: they are one mass of spongy bone; to the fore face of this mass the inferior turbinals (*i. tb*) are attached.

Example 37. Skull of *Sittella*, sp.? Family Paridæ. Section Tracheophonæ.

Habitat. Australia.

In its skull (fig. 6) this form agrees with *Sericornis* more closely than it does with *Sitta* (Plate LI.). Its osteological characters are also like those of *Petroica*; and these small Australian Passerines, however much their other characters may demand that they be drafted off into various families, yet to the morphologist appear as one very natural group, having so much in common as to support the doctrine of unity of origin [1].

The description just given of the skull of *Sericornis* may serve for this also, save that it may be noticed that the transpalatines (*t.pa*) have a larger and less-notched leafy expansion, the interpalatine spurs (*i.pa*) are well developed, and the maxillo-palatine

[1] I must confess that I cannot account for the fact that *Pratincola rubetra* has the same type of skull (palate especially). A thorough examination and comparison of these Australian types with the Chats generally is very desirable.

hooks (*mx.p*) are simpler. The inferior submarginal sulcus of the vomer evidently here also marks off a distinct septo-maxillary (*s.mx*)[1].

Example 38. Skull of *Dendræca pennsylvanica*. Family Mniotiltidæ. Section Oscines.

Habitat. Panama.

These forms come very close to the last, but also somewhat nearer to the proper Notogæal types. The leafy part of the transpalatine (Plate XLVIII. fig. 1, *t.pa*) is very abortively developed; the postpalatine keels are well developed; the transverse isthmus is broad, the interpalatine spike (*i.pa*) large, the ethmo-palatine (*e.pa*) broad, and the præpalatine bar (*pr.pa*) very long and slender. The maxillary is completely united to the præmaxillary and jugal; and the maxillo-palatine (*mx.p*) is an elegant decurved spatula, with a small "keel" and a large external open air-cell. The vomer (*v*) runs into the ethmo-palatine below; it is large, subcarinate laterally, sulcate below; and the part beyond the sulcus is manifestly a long septo-maxillary (*s.mx*) pointed behind and bilobate in front. The bony mass formed by these two pairs of bones is freely grafted upon the inturned lamina (*i. a. l*) in the usual manner. The whole nasal capsule agrees very closely with what has been described in *Sericornis* and *Sittella*; but the recurrent cartilage (*rc.c*) is unusually large. Besides the lesser transpalatines, this type has another character distinguishing it from the Australian forms: it has a delicate palato-maxillary style (*p.mx*) on each side of the præpalatine bar. I have already shown that this bone exists in the Tanagridæ and Brachypodidæ, and shall soon describe it in other families. Outside the Coracomorphæ I have only seen it in the Celeomorphæ (Picidæ and Yungidæ); and in them it only occurs on the *left* side (Trans. Linn. Soc. 1875, ser. 2, Zool. vol. i. pls. i.–v.). In *Dendræca* I find neither lacrymal nor os uncinatum. The ecto-ethmoid is specialized further than it is in the Australian forms; for a bony bridge separates the passage for the olfactory from that of the orbito-nasal nerve.

Example 39. Skull of *Mniotilta varia*. Family Mniotiltidæ. Section Oscines.

Habitat. Panama.

The palate of this bird is almost precisely like that of *Dendræca*; even in the minutest details this is seen (Plate XLVIII. fig. 2). One description may serve for both.

[1] The rapid development and early ankylosis of bony centres in birds makes the study of their osteology very difficult; also the breaking-off of a projection of a primary centre to make a new bone, as in the mesopterygoid. I am in some doubt whether this lateral piece of the tetramerous vomer of the type now being described is not formed in this way. Perhaps, also, in some cases, the distinct "palato-maxillary" may be the palatine process of the præmaxillary detached; I have, however, no proof of this; and that process is very apt to become absorbed when no palato-maxillary appears. It would be sure to be removed if a new centre came behind it to take its place.

Example 40. Skull of *Geothlypis trichas*. Family Mniotiltidæ. Section Oscines.

Habitat. Barbadoes.

A third specimen, type of a third genus of this family, shows on the whole the same amount of specialization.

Its maxillo-palatine (Plate XLVIII. fig. 3, *mx.p*) is a very narrow, decurved scoop, with a curiously bulbous handle. It is worthy of notice that in these small forms the vomer is as large, relatively, as in the Struthionidæ.

Example 41. Skull of *Chlorophanes atricapilla*. Family Cœrebidæ. Section Oscines.

Habitat. Central America.

In this bird the transpalatine is much longer, and the interpalatine feebler (fig. 4, *t.pa*, *i.pa*), the palatine isthmus is narrower, the maxillo-palatines (*mx.p*) less pedate, the recurrent cartilage (*rc. c*) shorter, and the trabecular base of the septum nasi (*tr.*, *s. n*) has wider and shorter alæ. The palato-maxillaries (*p.mx*) are equally distinct, and the ecto-ethmoids (*e.eth.*, *p.p*) as large and as spongy. It is evident, then, that the Cœrebidæ and the Mniotiltidæ are near of kin.

Example 42. Skull of *Vireosylvia olivacea*. Family Vireonidæ. Section Oscines.

Habitat. Panama.

In this larger and more strongly built skull the pterygoids are arcuate forwards, and the epipterygoid hook is long (Plate XLVIII. fig. 5, *pg.*, *e.pg*). The pterygoid is separate from the palatine, and has yielded up the usual mesopterygoid segment to that bone. The postpalatine ridges are well developed, and end in a stout blunt interpalatine spur as in the last described type (*pt.pa.*, *i.pa*); but in this kind the præpalatine is broader, the transpalatine bilobate (*pr.pa.*, *t.pa*), and the palato-maxillary is not apparent. There is no evident pneumatic opening into the maxillo-palatines (figs. 5 & 6, *mx.p*), which are large, dentate, pedate, and possessed of a thickened inner margin. The large vomer is emarginate, clearly four-membered; and the points of the outer pieces (*s.mx*) project beyond the cleft between the posterior crura. Two more smaller ossicles appear upon the under surface of the inturned cartilage (*i. a.l*); and these, with the side piece, make three centres corresponding to the lacertian or ophidian septo-maxillary.

The nasal wall (*n. w*) only gains the palatine region behind; so that the large alinasal turbinal (*a.tb*) is freely unveiled below. The expanded subterminal region of the trabeculæ forms a long leafy base to the septum nasi, which is only thickened behind (*tr.*, *s. n*); this narrowed part projects below the alate tract. But the most instructive part is the recurrent cartilage (*rc. c*), which is very large and ends in two rods, which are the actual distal ends of the trabecular bars, normally turned backwards under

the subterminal part, and united at their folded part to form such a symphysis as is common in visceral arches.

The prænasal bar grew during incubation, and for some time afterwards, forwards from the recurrent part.

Example 43. Skull of Virginian Cardinal (*Cardinalis virginiana*). Family Cardinalidæ. Section Oscines.

Habitat. Virginia.

This type has been put here both for comparison and to show contrast; it is as massive as some of the more Southern American kinds are delicate. The pterygoids (not given in the figure) are, in this genus, straight, moderately strong, and furnished with a long epipterygoid. The palatines (Plate XLVIII. figs. 7 & 8) are very strong, and are well provided with postpalatine keels, each ending in an interpalatine spike (*pt.pa*, *i.pa*). The large backwardly growing transpalatine (*t.pa*) is foliaceous, and lies on a lower level than the rest of the bone; each grows obliquely inwards as an isthmus, the lower lamina of which is of moderate extent, whilst that which forms the ethmo-palatine (*e.pa*) is very broad and shell-like, where it passes into the crura of the short broad vomer (*v*).

Looking at the palatine apparatus from above (fig. 8, *pt.pa*) we see that the postpalatine groove is formed of two distinct parts until we reach the shell-like ethmo-palatines; there the vomerine crura and the palatines are all ankylosed together into a very elegant two-winged tract, from which the U-shaped vomer springs. In front, the præpalatine bars are flat planks of bone, that converge until they come nearly together—a key-stone process from the median palatal region of the præmaxillary (here a very solid rostrum) binding them into one mass. Into this mass the præpalatine bar can be traced for some distance in the old birds; here the rostrum is bent upon the skull with great abruptness, although it is much more than a right angle (135°). Yet here, and above, the cranio-facial hinge is formed by elastic splints, and not by any separation of the bony elements.

The maxillary (*mx*) is overlapped by the thick downturned angle of the præmaxillary (*d.px*); and to this the jugal is joined by a direct hinge without a joint-cavity. The front part of the maxillary is thick; but within it flattens and passes to the palatine. It joins the præmaxillary by ankylosis; and its jugal process (*j.mx*) is a flat-pointed plate lying on the inner edge of the jugal (*j*). At the point where the maxillary reaches the præpalatine bar, it sends inwards and backwards its inwardly bowed maxillo-palatine process (*mx.p*); this is a flat band of bone which runs over the palatine, is bound strongly, in its course, to the outer edge of the two-horned vomer, and has at its free extremity an elegant cup or ladle, the opening of which looks forwards, and is made at the expense of the inferior face.

The vomer is supported on these two arms of the maxillary; and much of its most

accurate form appears prone between these arcuate bars (fig. 7). The anterior emargination of the vomer is semicircular, the inferior edge of which has a rim like the rim of a cup; and in front it is somewhat carinate. But above (fig. 8) it becomes subtubular by the sudden inbend of its high sides; these inturned plates end sharply behind, diverge in front, and stop suddenly at the thick septo-maxillary region—a compound tract, formed by osseous substance affecting the "inturned alinasal lamina." Beyond these cornua the nasal wall is only feebly calcified; but the septum nasi (*s. n*), which is narrow, is largely ossified. Where the vomer reaches the "inturned lamina," a small separate ossicle can be seen above, and at the side, further forwards, another; these are septo-maxillary ossicles added to the endosteal deposit of that part of the nasal labyrinth.

But that which induces me to illustrate the Cardinal's skull at this point is the possession by it of the largest "palato-maxillary" bones seen in any bird (Plate XLVIII. figs. 7 & 8, *p.mx*). Here, by comparison of this palate with that of a large Finch, such as *Coccothraustes* (Plate L. fig. 1), it will be seen how thoroughly independent this bone is of the præmaxillary. It is pupiform, and takes up considerably more than the middle third of the contiguous palatine, to the flexuosity of which it is accurately adapted. This bone, thickest behind and blunt-pointed at both ends, is a thick slab, with diploë inside; but I can find in it no pneumatic passage.

Example 44. The skull of *Icterus*, sp.? Family Icteridæ. Group Oscines.

Habitat. South America?

In the Cow-Buntings we have a type from the hotter parts of America, which is very interesting in relation to the Virginian Cardinal and the others of its family, and also to the ordinary Buntings ("Emberizidæ") and that Chilian genus *Phrygilus*, which evidently represents them in another hemisphere.

Nor can they be considered to be unrelated to the Starlings (Sturnidæ); yet whilst these differ from the larger "Corvidæ" in having a small lacrymal, in the Icteridæ this is large and corvine, as in many South-American Passerines. The skull of the common Starling is altogether lighter and more springy, and has a peculiarity seldom seen outside the Duck family, namely a pair of distinct "interpalatine" bones (Trans. Linn. Soc. ser. 2, Zool. vol. i. pl. 20. fig. 12).

The skull of the species of the Icteridæ, Cardinalidæ, and Emberizidæ (including *Phrygilus*) shows a most close conformity; in these types it differs from that of the Starling in being (1) thick, stout, and *Fringilline*, (2) in possessing well developed palato-maxillary bones (which are not present in *Sturnus*), and (3) in not possessing distinct interpalatine bones as in that type. Moreover all these families are American, except the main part of the Emberizidæ; and these very birds are the most divided off, by special morphological characters, from the great Fringilline group. That remark-

able character, the possession of distinct palatine plates in the maxillary region, in addition to the maxillo-palatine processes, is most important; for these bones, in a descending survey, are not found until we reach the Batrachians and Ganoid fishes. I am speaking of forms still existent; they may turn up in fossil Reptilia.

Then we have just seen that in Central and South America certain tenuirostral and the feebler of the conirostral types have these bones (Mniotiltidæ and their allies on the one hand, and Tanagridæ on the other). However near or far off these types may lie in their relation to each other, the existence of any one marked character in the species of families belonging to a continuous geographical territory indicates a common root or cause. In an unnamed species of *Icterus* I find such a similarity of the whole skull and face to that of a Starling, on one hand, and of the Cardinal and the Buntings on the other, that I am at a loss to characterize it otherwise than by saying that it is an intermediate type. Yet on the whole, with a narrower face and a broader and a more capacious cranium, it has altogether a stronger structure than that of any of these birds.

The straight pterygoids are quite normal both in possessing a moderate epipterygoid hook and in giving off a mesopterygoid segment. The transpalatine is spongy and angular, and the whole of that region is steep. Stout to the fore end, the palatines lose themselves in the solid, decurved, high-backed rostrum (Plate XLIX. figs. 1 & 4, *pr.pa*). The interpalatine spurs (*i.pa*) are not large, nor are the ethmo-palatine coils much extended (*e.pa*). The palato-maxillaries (*p.mx*) are somewhat ankylosed to the præpalatal bars; but their middle is opposite the dentary angle of the præmaxillaries, so that they are thus excluded from that category, and seem to belong to the outworks of the palatine arch.

The vomer (*v*) is broad in front, and has very converging crura, which are ankylosed to the ethmo-palatines. Between each shoulder and the pedicle of the maxillo-palatine there is a solid subcentral septo-maxillary (*s.mx*); and also on the inturned part of the nasal floor (*n. f*) there are two more ossicles on each side, besides lesser bones. The septum nasi (*s. n*), which is alate, is ossified considerably; it is strongly ribbed. The alinasal and inferior turbinals are soft; the former are not seen from below, on account of the great development of the nasal floor. The delicately pedunculate maxillo-palatines end in a large, flat, cultrate blade, with sharply produced points, giving it a falcate character; the inner edge of this scythe is serrate. The lacrymal, like that of *Sturnella* (fig. 4, *l*), is long and pupiform, and has the form and position seen in *Pipra*, *Phytotoma*, *Tanagra*, and the larger Crows. At its base it has a large, distinct, ovoidal os uncinatum (*o. u*). The general ecto-ethmoidal mass projects outwards less than in the Passerine types generally. The alinasal region is soft.

Example 45. Skull of *Icterus vulgaris*. Family Icteridæ. Group Oscines.

Habitat. South America.

On the whole, this species agrees very closely with the last. In some things it differs; and, perhaps, being a younger specimen than the one studied, it is less ossified in its nasal labyrinth, the floor of which (Plate XLIX. fig. 2, *n. f*) does not show the bony centres seen in the last. The septum nasi (fig. 3, *s. n*, *tr*) is ossified; it is largely alate; and its recurrent process is floored by a tongue of bone proceeding from the præmaxillary (*p.mx*).

The vomer (*v*) has a wide head, in the horns of which a large septo-maxillary is seen, just where it is grafted on the inturned lamina (*s.mx.*, *i.a.l*). The maxillo-palatines (*mx.p*) are not knives, but *pouches*; they have a narrow pedicle, which has a pneumatic opening in it where it enlarges and bends; a larger mouth is seen outside the inflated end.

This, as compared with the last, shows how variable a thing the pneumaticity of the bones is, and that there must be considerable variation in the distribution of the lesser air-cells.

Example 46. Skull of *Sturnella militaris*. Family Icteridæ. Group Oscines.

Habitat. Chili.

My picture-gallery will be greatly enriched by a lateral view of the face of this species, illustrating, as it does, the peculiarities of this type.

The boss on the face-top (Plate XLIX. fig. 4, *n.px*), is seen dipping backwards to the skull, and descending steeply to the beak-point. Laterally, the nasal, lacrymal, and lateral ethmoidal mass (*n*, *l*, *e.eth*, *p.p*) are all seen to come flush with the face. Above, the lacrymal forms a spongy subtriangular wedge jammed in between the descending crus of the nasal and the ecto-ethmoid. Halfway down it becomes a narrow rod, suddenly bent inwards; it forms an arch, turning outwards below, and spreading its base over the elegant egg-like os uncinatum (*o. u*), which almost reaches the zygoma (*j*). The vomer (fig. 4, *v*, *s.mx*, and fig. 4 *a*, from above) corresponds very closely with that of the last, but has a median process in its front emargination. The thick ossified septum nasi (*s. n*) has three converging ridges, a fenestra in front, and a very large notch below it and the mesethmoid. The alæ and the alinasal and inferior turbinals are soft.

At the obtuse lateral facial angle the upper jaw is lifted at the side, like a dog's lips in snarling, to make room for the crested mandible; here the more median structures are seen, viz. the palatine, with its deep rib-edged transpalatine process, and the palato-maxillary bone nearer the outer margin (fig. 4, *t.pa*, *p.mx*). The pterygoids and mesopterygoids are like what I have described in the first species: here, however, these parts are nearly ankylosed.

Example 47. Skull of Corn-Bunting (*Emberiza miliaria*). Family Emberizidæ. Group Oscines.

Habitat. Great Britain.

The skull of the Bunting has the same breadth and fulness of form as that of the Icteridæ; its rostrum also is deflected in like manner; but the boss is not so raised, and the length is much less. The deflection of the bill is very similar in Cardinals, Cow-Buntings, and Buntings; and the latter seem to me to deserve to have their own little enclosure penned off from the great Fringilline territory. On the whole the skull is like that of the Finches; but, besides its greater breadth, it has its tympanic bullæ, formed by the exoccipital tympanic ala, much more dilated and large. The pterygoids are straight and quite normal, giving off a mesopterygoid segment in front, and having a free moderate epipterygoid behind. But the palatines are almost as feeble as in the Tanagers (Plate XLVI. figs. 1–4 and Plate XLIX. fig. 5).

The postpalatine keels are steep and emarginate behind; the transpalatine spurs are small, the interpalatines small, the ethmo-palatine large and coiled, and the præpalatine bars long, almost straight, and feeble (Plate XLIX. fig. 5, *pt.pa*, *t.pa*, *i.pa*, *e.pa*, *pr.pa*). In this species the maxillo-palatines (*mx.p*) are flattish trowels, scarcely pneumatic. In old birds the palato-maxillaries (fig. 5, *p.mx*) become ankylosed to the præmaxillary; but in young birds of the first winter I find them free; they are jammed in between the dentary angle and palatal process of the præmaxillary, and are thickish spatulæ with the blade behind, and but little dilated. These bones are longer and narrower than in the Cardinals; they are unusually large.

The vomer (*v*) is quite normal; it loses the distinctness of its septo-maxillary element early, and is grafted upon the nasal wall; this wall does not form so large a *floor* as in the Icteridæ. As in the Icteridæ, the septum nasi is largely alate; and these alæ, as well as the edges of the nasal floor, are elegantly dentate (*s. n*, *tr*, *n. f*).

The fore margin of the vomer has a small median process running into a slight keel; its edges are thick, and do not send down a ridge. The alinasal walls, septum nasi, and the alinasal and inferior turbinals do not ossify; the ecto-ethmoid projects considerably; the pars plana is large, and has a concave external margin, ending in a large foot; it is of great size, considerable thickness; and over it, as in Larks and Finches, the first and nasal nerves escape by one chink. I can find neither lacrymal nor os uncinatum; in this the Bunting agrees with by far the majority of the lesser Passerines, either thick- or soft-billed.

Example 48. Skull of Yellow-hammer (*Emberiza citrinella*). Family Emberizidæ. Group Oscines.

Habitat. Great Britain.

In the lesser species the palatines are still feebler than in the last, the transpalatine

spike (fig. 6, *t.pa*) being scarcely more developed than in the lower forms of the Coracomorphæ. The interpalatine spurs are large, and the ethmo-palatines about equal (*i.pa*, *e.pa*). The palato-maxillaries (*p.mx*) are much more acerose; and the maxillo-palatines are large pneumatic "ladles," with an inferior gaping aperture.

The vomer has a notch in front; and, above, it runs as a bony "horn" into the inturned lamina (*i. al*); it sends down a sharp ridge from each outer edge. In *E. miliaria* the rostrum is very naked or scooped below; in *E. citrinella* it is much less so. In this latter species the tympanic bullæ are extremely large and very elegant.

Example 49. Skull of the Snow-Bunting (*Plectrophanes nivalis*). Family Emberizidæ. Group Oscines.

Habitat. Great Britain.

In this species the concavity of the rostrum, below, is reduced to two submedian, widish, shallow channels, divided by a ridge which ends in a median spur (Plate XLIX. fig. 7). This spur is seen in the other species (figs. 5 & 6), and it forms an exact floor to the "recurrent lamina."

The palatine, on the whole, differs but little from that of *E. citrinella*; but it diverges more to the transpalatine spike, and is not so steep. The lower lamina of the isthmus is narrower, and runs into larger interpalatines; the ethmo-palatine coils are thin and dentate (fig. 7, *i.pa*, *e.pa*). The præpalatal bars converge more, and are broader and more lathy; they carry a palato-maxillary, which is intermediate in size between that of the last two instances; it is attached by a sort of "callus" of bone, by most of its anterior half (the point is free), to the præpalatine bar. The maxillary (*mx*) has an unusual breadth in front of its jugal process; and its maxillo-palatine process (*mx.p*) is flatter than in *E. citrinella*, broader than in *E. miliaria*, and is scarcely pneumatic.

The vomer (*v*) is almost oblong; its sides descend as a steep ridge, as in *E. citrinella*; its under face is gently convex, answering to the gently concave upperside; its crura are broad, and their interspace scarcely twice as long as the notch in front.

Where the septo-maxillary should appear (most probably it has been ankylosed), there is, on the side of each thick vomerine cornu, a large pneumatic opening. Just the "foot" of the inturned alinasal lamina (*i. al*) has received bony matter. The chink for the first and nasal nerves is continuous on the left side; but on the right a lobe from the pars plana has converted it into two separate foramina.

Example 50. Skull of *Phrygilus fruticeti*. Family Emberizidæ. Group Oscines.

Habitat. Chili.

I have provisionally placed this type amongst the Emberizidæ; it is equally distinct from the typical Finches, is not a member of the Cardinal family, and does not differ more from *Plectrophanes nivalis* than that species does from *Emberiza miliaria*.

In *Phrygilus* the large tympanic cavities, the straight stout pterygoids, the narrow palatine isthmus, ending in large interpalatine spikes, and the larger ethmo-palatines (Plate XLIX. fig. 8, *i.pa*, *e.pa*)—all these are almost the exact counterparts of those of the Snow-Bunting. The transpalatine (*t.pa*) is very similar to that of *E. miliaria* (fig. 5), but it is flatter; the first part of the præpalatine bar is narrow, and then widens as in *E. citrinella*. It differs from our native forms in having the palatines wider apart and not so steep.

The palato-maxillaries (*p.mx*) are exactly like those of *Plectrophanes*; the maxillo-palatine processes are pneumatic as in *E. citrinella*, but narrow as in *Plectrophanes*. Also, as in the latter, the maxillaries (*mx*) are flat bands in front of the jugum. There is more submarginal channelling on the palatal face of the rostrum than in *Plectrophanes*; but the two inner grooves, with their separating bulb ending in a triangular bony tongue, are very similar to this and the last.

The vomer (figs. 8 & 9, *v*) is large, oblong, and has on each side a descending ridge as in the last two, whilst its emargination is equal to that of *E. citrinella*. On the inturned lamina there is an ossicle near the vomer: this is the septo-maxillary (fig. 9, *s.mx*); it exactly corresponds to the ossicle which forms the ascending horn in the vomer of *E. citrinella*, which, however, in my specimen, had become ankylosed to the vomer. The nasal floor runs further inwards than in our Buntings, as in *Icterus* (figs. 1, 5, 8, *n.f*). These laminæ and the edges of the largely alate septum (*s. n*, *tr*) are not distinctly dentate, as in *E. miliaria*. There is some considerable amount of calcification in the septum nasi and inferior turbinals, about equal to what is seen in the Icteridæ, and beyond any thing I find in the Buntings.

The ecto-ethmoid is very similar to what is found in both these families. It differs from both the Icteridæ and *E. miliaria* in having a deeper notch on the outer edge of the spongy pars plana; but the notch is similar to that of *Plectrophanes*, and exactly like that of *E. citrinella*, where, as in this species, the "foot" of that plate has a sharp ascending process.

Neither in this kind nor in the Buntings do I find either lacrymal or os uncinatum; but when those bones are taken in outline, together with the pars plana, in *Icterus*, then the lateral notch is deep and rounded, as in *Emberiza citrinella* and *Phrygilus*.

The ethmo-præsphenoidal bony bar, that runs between the paired orbital and the single interorbital fenestræ, is about equal to what is seen in the Icteridæ and the Buntings. In the Cardinals the orbital fenestræ are much less, and the interorbital becomes a solid bony wall.

Altogether the cranio-facial characters of this bird, which is about equal in size to *E. miliaria*, come so close to those of our native Buntings that it may truly be said it differs no more in this respect from the Snow-Bunting than that bird does from the Corn-Bunting.

It is certainly related to the Cow-Buntings (Icteridæ), and perhaps is one of a

number of forms which would connect these families together. In nearly all that distinguishes a Bunting from a Finch this bird agrees with our native kinds; the most that can be said is that its rostrum is more Fringilline. But even here the Snow-Bunting comes in, whose rostrum has its special Emberizine characters much softened down from what we see in *E. miliaria*.

After the Cardinals and the Buntings have been culled out from among the typical families, there remain whole hosts of genera, certain groups of which, perchance, would be found to possess cranio-facial specializations as important as those I have just described.

Example 51. Skull of Grosbeak (*Coccothraustes vulgaris*). Family Fringillidæ. Group Oscines.

Habitat. Great Britain.

We come now to those lesser Conirostral Passerines in which that kind of specialization is required by which a bird of this order may become a fruit-breaker or a corn-husker. These results are arrived at in the skulls of these birds without any of that superadded desmognathism which is seen in certain southern types, such as *Gymnorhina*, *Artamus*, &c. (Part I. pls. lviii. & lx.). I shall select one of the largest, or northern, and one of the smallest, or southern, Fringilline forms, for the description of this kind of Ægithognathous skull, and then give a median type. Then the Lark's skull will connect these stout-faced forms with those of the soft-billed songsters.

There are certain secondary modifications of the skull of the Grosbeak which remind the observer of what is seen in that of a Parrot; but these are merely isomorphic, and no two skulls within the range of this Class can be found more entirely different in their morphology. All that ridgy strength seen in the skull of *Coccothraustes*, and the very useful although extremely rough hinges formed by the apposed bones when the rostrum and hinder face and skull meet—these modifications are required for mechanical purposes in this strong-headed bird, and have little morphological meaning. The quadrate is perfectly Fringilline; but the parasphenoid (Plate L. figs. 1 & 3, *pa.s*) is narrow, and has its lower surface smoothly rounded for the adapted superior surface of the pterygo-palatine arcade, by which it is most closely embraced (fig. 3). In Parrots that arcade embraces the parasphenoid very little, and the lower surface is carinate and not rounded. The strong, straight, ridgy pterygoids (*pg*) have a very perfect cup for the ball on the fore edge of the quadrate, and above this cup the most notable epipterygoid hook (*e.pg*) to be seen in the "Carinatæ." The anterior spatulate part of the bone is two fifths the length of the whole; and the raised margin of the spatula runs, below, as a ridge on the shaft; this part has a long ligamentous attachment to the palatine. The amount of modification undergone by the palatines may be seen if the primary form of the palatine bar of a Passerine bird be considered; and that is the same in all.

The young of the Redstart *Ruticilla*, shown in the former part (pl lv. fig. 13), and of the House-Martin and Golden Oriole, given in this present paper (Plate LII. figs. 4 & 6), show the primary form of the bone, which is a gently arched and pointed bar, broadening suddenly in its hinder third, where it sends inwards to the parasphenoid two laminæ, an upper and a lower. These, as we have seen, are the interpalatines below and the ethmo-palatines above; opposite these twin plates a triangular flap of cartilage, the transpalatine, grows backwards and outwards; it ossifies separately, and then ankyloses with the main bar. On the upper surface of the upper lamina the pointed end of the pterygoid is applied; this becomes distinct as the mesopterygoid (*ms.pg*), and soon ankyloses with the palatine.

In *Coccothraustes* the pointed end of the pterygoid has become the steep, ribbed, skull-embracing plate seen in front of the pterygoid spatula (Plate L. fig. 3, *ms.pg*). The long, pointed, slender præpalatine bar (figs. 1–3, *pr.pa*) has become præmorse, thick, and solid, and dilates from side to side as a huge buttress of bone. Behind and outside this great bony foot the bone soon widens again; for the transpalatine cartilage has ossified, become ankylosed, and by copious periosteal outgrowths has grown into another "foot," with thin digitiform processes. Of the hinder twin plates the lower is only one third the extent of the upper; and thus the interpalatine, becoming postpalatine, is pointed in front and behind, is coiled upon itself at its inner edge, so as to make three fifths of a tube. Here we find the palatine bones, above, tending to throw the inner narial opening far backwards, as in the mammal. The hollow roof of the nasal passage, which is so much enclosed behind, is of great extent; the large, hollow ethmo-palatine plates, thoroughly ankylosed to the vomer, are also completely confluent with one another. This hollow roof is two-ridged; and these ridges, formed, as we see, by the mesopterygoids (fig. 3, *ms.pg*), clasp the parasphenoid and the base of the orbital septum, along which, in every movement of the rostrum in front, the whole pterygo-palatine arcade glides.

The præpalatines articulate with the rostrum by coarse sutural teeth, which are intermingled with a strong fibrous tissue serving as a ligament. I can find no proper articular cartilage, nor any trace of a synovial cavity; the same may be said of the cranio-facial hinge, above, and of the junction of the stout jugal bar with the rostrum laterally. All these *five* junctions are anatomically like, and like in general purpose.

The magnificent rostrum (which, like its counterpart below, the dentary region of the mandible, has no fellow in the bird class) is composed mainly of the præmaxillaries, but is flanked in its hinder part, both above and below, by the maxillaries and nasals. As the palatines become eroded and short in front, so are the maxillaries behind; these lose their jugal process to articulate with the jugal bone (fig. 1, *j*), an unusually high and stout bar.

All traces of the composition of the rostrum are gone, even above, at the "hinge;" but the maxillaries, small and inwardly placed, as in most osseous fishes, can be detected

by their maxillo-palatine process. This *region* of the maxillary, which in Mammalia and Crocodiles forms so much of the great "hard palate," in the Grosbeak is the frailest of all bony structures (figs. 1 & 2, *mx.p*): their *use* in this bird is to contain a most minute globule of air from the naso-palatal labyrinth. Arising from the supero-internal face of the bone as a fine arcuate filament, they gradually widen; and in widening they become scooped below. They then become bowed backwards as well as inwards, nearly meet below the vomer, and have two fifths of their scooped part closed in so as to form a microscopic *test-tube*, which, however, is irregular in form and flattened from above downwards.

The vomer is Passerine in the highest degree (figs. 1, 2, *v*). It is ox-faced in shape; and the *horns* and *ears* are represented by processes of bone that have trespassed upon the nasal wall; the *forehead* also is seen on the lower face, in front—a triangular thickening ending behind in a keel, and in front forming the sinuous margin of the bone. The vomer is deeply grooved above, and lost in the palatine commissure behind.

A considerable amount of ossification has occurred in the nasal labyrinth—in the septum most of all, which is sharply segmented off from the mesethmoid, is sharp below, behind; but its alate part has ankylosed with the rostrum, and runs invisibly into the proximal ossified part of the alæ nasi. Both alinasal and inferior turbinals are three fourths bony. The great ethmoidal mass projects above in the same degree as in the Buntings. So also the spongy pars plana (*p.p*) is scooped towards the eye, and has a round notch on its outer margin; but here its "foot" is unusually prolonged, as in those Psittacidæ whose suborbital bar is imperfect. In these types, such as *Psephotis multicolor*, it is easily seen that a large os uncinatum has coalesced with the pars plana; so it is in *Coccothraustes* (fig. 1, *o.u*, *p.p*); for, although ankylosis has taken place, the remains of the suture can be traced.

Example 52. Skull of an Averdavat (*Estrelda astrild*). Family Ploceidæ. Group Oscines.

Habitat. South Africa.

Intensity of ossification, with equivalent ankylosis of independent parts, takes place in this, one of the smallest of the Finches, equally with the Grosbeak, one of the largest. My study of these small southern forms has been in the type given above, in the Crimson Finch (*Estrelda phaëton*) from Port Essington (Australia), and in the young (as Mr. Sharpe believes) of *Habropyga subflava*. In these types the broad strong rostrum is deflected as much as in the Buntings and the Corn-Buntings, and has a high back near the frontal region. For their size the skull is nearly as strong as in the Grosbeak; but they lack the rimmed orbit.

The pterygoids are similar, and have a good epipterygoid hook (Plate L. figs. 4 & 5, *e.pg*, *pg*); but in these forms the spatulate end ankyloses with the palatine. In the

young bird the palatine suture can be seen; but in the adults it is lost. The transpalatine (*t.pa*) is a flat spatula; and the interpalatines are well rolled over below as they pass into the postpalatine region (*pt.pa*). The ethmo-palatine shells are very large relatively; they pass insensibly into the vomer; and the main bar is, as it were, twisted upon itself as it runs forward, first steep and then lying horizontally, where it passes by ankylosis (not as a rough joint as in the last) into the rostrum. The upper and lower faces of the pterygo-palatine arcade seem to be much alike (figs. 4 & 5); for both have a round large channel. Above, this is caused by the ascending laminæ clasping the basis cranii, and below by the interpalatine laminæ forming a wall, and almost a floor, to the nasal passage. The maxillaries pass into the jugal behind, and into the rostrum in front, insensibly; and the maxillo-palatine processes are as frail as in the last, but end in a flat pedate plate.

The vomer, by trespassing far on the nasal territory, is enormous; it has lost its freedom behind; and in front it has lost the separateness of its septo-maxillary elements and has ossified a large tract of the nasal labyrinth (fig. 5). The upper part is very steep on each side of the septum (figs. 5 & 6, *s. n*, *v*), which is strongly ossified, and has two series on each side of sinuous bony ridges, the hinder parts being the nasal-nerve bridges; and the front ridges are where the alate part runs into the alæ nasi (fig. 6, *s. n*, *al. n*). These ridges are strongly folded and bent upon themselves, and so also is the great alinasal turbinal (figs. 5, 6); and being ossified, we see in the dry skull a curious modification of these parts.

Then, between the lateral dentate mass and that part of the alinasal region ossified by the vomer, there is a large, almost directly transverse synchondrosis. Hence we see that in the nasal labyrinth of *Estrelda*, besides the centres for the hinder olfactory region (the septum nasi and the anterior part of the alæ), the alinasal turbinals and the inferior turbinals are separately ossified from the hinder part, which has bony matter creeping far into it from the four vomerine bones.

The outer face of the alæ nasi, round the external nostril, is but little ossified. In *Coccothraustes* the olfactory and nasal nerve pass through the opposite ends of a shortish chink; and outside this the pars plana, above, is deficient, the nasal bone being visible through it. In these Waxbills, especially *E. phaëton*, that space is wide, and the nasal nerve passes separately through it. The top of the ecto-ethmoid projects normally; the pars plana is thick and spongy, with a round notch on its outer edge, a moderate foot, and no separate os uncinatum. I find no trace of a lacrymal in these types.

Example 53. Skull of Green Linnet (*Linaria chloris*). Family Fringillidæ. Group Oscines.

Habitat. Great Britain.

Careful study of the skulls of various kinds of Finches leads me to cull out, as the

best medium type, this species[1]. This strong skull corresponds with that of the types just described; and so also does the upper face specially: it is that of a feebler Grosbeak.

The straight strong pterygoid has a long epipterygoid hook; and, as in the Wax-bills, the spatulate fore end is ankylosed to the palatine and mesopterygoid. The sharp interpalatine spikes (Plate L. fig. 7, *i.pa*) run backwards into coiled postpalatine plates; the ethmo-palatines, ankylosed to the vomer (*e.pa*, *v*), are of great extent. The transpalatine (fig. 8, *t.pa*) is bilobate; the præpalatine (*pr.pa*) is intermediate between that of *Coccothraustes* and *Estrelda*, being articulated externally, and ankylosed inside.

The vomer (figs. 7, 8, *v*, *n. w*, *i. a. l*), grafting itself freely on the inturned lamina and upon that part of the nasal wall which runs into the alinasal turbinal, has two pairs of ear-like processes on each side. The fore edge of the vomer is deeply emarginate by a rounded notch; and the horns therefrom arising have a lesser horn on them—a falcate plate of bone, the septo-maxillary (*s.mx*).

The jugum is semiarticulated with the maxillary, the maxillo-palatine processes of which are bands of bone, flat and elbowed proximally, and then spreading into a flat foot with a ribbed "sole," lying near to and almost parallel with its fellow; each inner edge is gently arcuate. The septum nasi, whose alate part rests upon the mass of the scooped præmaxillary, is largely ossified in old age; and from it bony matter runs into the anterior alinasal floor. The rest of the labyrinth (turbinals and alæ nasi) is scarcely calcified. The two nerves pass through one short oblique chink, as in the Grosbeak. The ecto-ethmoid and pars plana are like those of *Estrelda*, save that the "foot" is more developed, but shows only a slight sign of the os uncinatum. Here, again, in *five* skulls, one of them of a fledgeling, I see no lacrymal.

I find, however, a small lacrymal in the Canary bird; it is a little prickle on the top of the hinder edge of the descending crus of the nasal.

Example 54. Skull of Skylark (*Alauda arvensis*). Family Alaudidæ. Group Oscines.

Habitat. Great Britain.

As in its digestive organs, so in its skull, the Lark is close to the Finches, and wide apart from the *Sylviæ*. My description is made with a dozen skulls of this kind before me, of various ages; and these have been examined and compared with related types of skulls many times, and during many years; yet, the twentieth time, this skull strikes the eye as very *Sylviine*.

The pterygoids are straight and slender, but stroug; they have scarcely any epi-pterygoid snag, but give off a flat process from the middle of their outer edge. The

[1] For the development of the palatal elements in the Fringillidæ, see Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 104, tab. 21.

fore part is a large plate; but it soon coalesces with the palatine, *one side* first, as first-winter birds show. The palatines are intermediate between those of *Sylvia* and *Fringilla*; for the postpalatine keels, running into the interpalatine spikes (Plate L. figs. 9, 10, *i.pa*), are curled over to make a partial floor to the nasal canal; and yet the transpalatine is like that of a soft-billed bird, being outspread, triangular, and apiculate. The ethmo-palatine (*e.pa*) is larger than the lower lamina, and sends a sharp spike outside the long vomerine crus, with which it eventually coalesces.

The præpalatine bar is long, slender, and Sylviine; it passes forwards mesiad of the long delicate palatal process of the præmaxillary (*p.px*). The rest of the præmaxillary and the maxillary are like those of a stout soft-billed bird. The maxillo-palatine processes (*mx. p*, indicated in outline in fig. 9) are large decurved spatulæ, with thick inner edges and round ends, and a concave but not tubular upper surface.

But the vomer and its relation to the nasal capsule claim most attention in this type; for here we have the Fringilline characters "without controversy." It is broadly *ox-faced* in shape, short, broad, with long outbowed legs and a strong median keel below. Above (fig. 10, *v*) it has a large groove for the fore end of the rostrum, the rims of which are turned inwards, exactly as the interpalatine laminæ are below. Opposite the middle third of the keel there is, on each side, a septo-maxillary, prickle-shaped, and having directly over it a pneumatic foramen; for the vomer is thick and spongy. At its fore edge the vomer passes insensibly into the nasal labyrinth for a good distance, nearly twice the extent of its own proper body. Below, on each side, in front of the aciculate septo-maxillaries, the vomerine bony substance runs into the inturned lamina (*i. a. l*), close above the maxillo-palatine pedicle. Then, looking below, we see two large oblique fossæ, divided by a bony ridge, and ending in a bony ridge; these are flat at the top (figs. 9 & 10, *i. a. l*, *a. tb*). These arise from arrest of this free ossification leaving the rest of the alinasal turbinal and nasal wall soft; so that here an *ox-faced* vomer becomes *cervicorn* by extension beyond its own region of bony substance. The septum nasi becomes largely bony with age, and the inferior turbinal somewhat calcified.

The ecto-ethmoid is more massive and spongy than in the "Fringillidæ;" but the two nerves pass out of one chink. The foot of the pars plana is large, but has no os uncinatum separate; its outer margin has a round notch; there is no lacrymal. The Lark in its song manifests the excellencies of its right- and left-hand relations, and altogether is a borderer on the "marches" of two families—the Motacillidæ, and the Fringillidæ.

Example 55. Skull of Coal Tit (*Parus ater*). Family Paridæ. Group Oscines.

Habitat. Great Britain.

If our native typical "Titmice" can be shown to have a very characteristic speciali-

zation of their skull, then it will not be hard to draw unto them such forms as show, more or less, a like state of that part of their build.

That which is suggested by the outer form and by the living bird is that this small type has large brain-power, and indubitable energy and courage, combined with great bodily strength for so small a creature. The skull is large and wide, and the face short, conical, and strong; these two regions are so hinged on each other that they admit of as much motion as in the highest Finches and even the Parrots. On the whole, the palatal framework is as strong as in the Finches; and some of the specializations are similar; but the Tits are further removed from them than from their soft-billed allies.

The pterygoids (Plate LI. fig. 1, *pg*, *e.pg*) are stout and straight, with a lobate epipterygoid. The dilated anterior end is of much less extent than in either the hard-billed or soft-billed songsters. So also the segment given off, the mesopterygoid, is much smaller; and, as in the Parrots, the pterygo-palatine arcade embraces the skull-base very little: this is a clear and good *Parine* character. This part is also still further differentiated from what is normally Passerine; for where the anterior spike of the pterygoid breaks off to form the mesopterygoid, the result is *two* new centres; the foremost of these (fig. 1 A, *ms.pg'*), corresponding to the normal segment, is a small triangular grain of bone, whilst the larger heart-shaped piece (fig. 1 A, *ms.pg''*) is *behind* the steep top of the pterygoid, which is thus wedged in between its own *filial* segments. Also it is to be noted that these parts continue separate for a long time, and do not behave like the very temporary segment of the ordinary Passerines.

The palatines are more like those of the thin- than of the thick-billed kinds; but they are as strong as in the latter. The transpalatine part (figs. 1 & 1 A, *t.pa*) is roughly triangular, and passes, by a broad isthmus, with a short ethmo-palatine plate, into interpalatine snags, which are blunt and pass into steep postpalatines (figs. 1, 1 A, *i.pa*, *e.pa*, *pt.pa*). From the broad part proceeds the long, sinuous, broad præpalatine (*pr.pa*); the breadth, with the length, of this bar is another safe *Parine* character. The setting-in of the fore end of this bar into the short rostrum is very definite; but it coalesces with the præmaxillary, and therefore falls short of the Grosbeak and Parrot in this part of the cranio-facial hinge. But the præmaxillary of this bird is, perhaps, the part least likely to be mistaken for that of any other bird; it forms its hinge at *quite another point* than in the Grosbeak and the Parrot: they *include* the maxillaries in the rostral mass; the Tit *excludes* them (Pl. LI. fig. 1, *d.px*, *mx*, *mx.p*). The form of the coalesced præmaxillaries is metamorphosed greatly; and by the absorption of their long processes a very characteristic bone is found in the adult [1].

In a three-fourths ripe embryo of a Tit (see my paper referred to in footnote) the præmaxillaries are fast ankylosing together: they are very Reptilian in their shortness; and their dentary and palatine processes (*op. cit.* fig. 4, *d.px*, *p.x*) are very small spurs,

[1] For the early stages of this Tit's skull, see the 'Monthly Microscopical Journal,' Jan. 1873, p. 6, pl. ii.

the outer a little the longer of the two. These processes continue long and sharp even in thoroughly fledged birds (Plate LI. fig. 2). In the adult the dentary part is a broadish band of bone, enlarged near its end by the coalescence with it of the descending crus of the nasal, but not by the maxillary, which lies behind it as in other Classes of the Vertebrata.

The palatine processes of the præmaxillaries (*p.px*) are now small processes *lying below* the præpalatal bar, at its end; between these there is an elegant triangular middle process. The angle of the dentary part is cut off transversely, and is notched in the middle; into this notch the fore end of the once styliform maxillary (*op. cit.* fig. 4, *mx*) fits: it is now a short knuckle of bone. The body of the maxillary is very short, and at once gives off and ends in two processes—one, the jugal (*j.mx*), originally very long and free (*op. cit.*), but now coalesced with the jugal; the other branch is the maxillo-palatine (*mx.p*), once (*op. cit.*) a large curved spatula, and now a large, decurved ladle, its end being wrought into a thin-walled air-cell. Above, the hinge is made by such adaptation of the rostrum with the frontals that the fibres of bone running into the ligament are extremely thin, and the bones are nearly applied by transversely squared ends. In the vomer also the Tits are contrary to their relations; for, whilst its shoulders are broad, its legs are feeble and drawn near together (Plate LI. fig. 1, *v*). In the embryo (*op. cit.*) the vomer is two threads of bone; in my figure these are shown as just united in front, and these threads converge backwards. In adults of the same species, through difference of age, the head of the bone varies: it has no emargination at first; but this appears and increases as the bony matter creeps into the contiguous nasal wall.

The vomer is subcarinate in front, below; and it neither shows parallel lateral division, nor have I found the smallest septo-maxillary at its angles. The septum nasi has a large posterior ossicle (fig. 1, *s. n*), which involves the wings, or bridges, that cover the nasal-nerve tract. The rest of the relatively large and deep septum is ossified considerably above, in conjunction with the floor of the alæ, in front; but the trabecular, or basal portion (*tr*), which is alate, remains soft, as do the turbinals and outer wall.

The ecto-ethmoid (fig. 1, *p.p*, *e.eth*) is typically Passerine: the upper part projects moderately; the pars plana is thick and spongy, and has a lateral rounded emargination, a large "foot," and no appended os uncinatum. The nerve-passages above the anteorbital are perfectly distinct. I find no distinct lacrymal in the adult.

Example 56. Skull of the Ox-eye Tit (*Parus major*).

Habitat. Great Britain.

In a young specimen of our native largest Tit the parts just described are intermediate between those of the embryo (*op. cit.*) and of the adult of the last species. The

maxillary (fig. 2, *mx*) wedges in between the long and pointed dentary and palatine processes of the præmaxillary (*d. px*, *p.px*); the mesopterygoid ossicles are not yet distinct. There is a small prickle of bone on the front of the ecto-ethmoid, looking like a recently separate, but very small, lacrymal; it most probably corresponds with the larger and quite distinct bone seen in the Wagtail (*Motacilla yarrelli*—Plate LII. fig. 8, *l*).

Example 57. Skull of *Suthora bulomachus*. Family Suthoridæ. Group Oscines.

Habitat. Amoy.

As this alert and quarrelsome bird[1] has a skull which comes nearer to that of the Tits than any I have yet examined, I bring it in here. The specimen was sent me from Amoy by Robert Swinhoe, Esq., in the autumn of 1866. This accomplished ornithologist, with the specimen, gave his views of its relations in his letter to me. I append that communication in a note below[2].

The skull of *Suthora* is smaller, but much stronger, than that of *Parus ater*; it has a *coarse* appearance as compared with the skull of our native Titmice. The pterygoids (Plate LI. figs. 3 & 4, *pg*) are stronger and more sinuous than in *Parus ater*;

[1] βουλόμαχος, *pugnax*.

[2] "British Consulate, Amoy,
22nd Sept., 1866.

"My Dear Sir,—As you are great in osteology, I make no apologies for sending you a specimen of my *Suthora bulomachus*. It is a Formosan grass- and reed-bird; and you will see a figure and description of it in the July 'Ibis' for this year. The sternum of this bird is worth examining, as it seems to me to present affinities to those of the *Garrulax* group. Mr. A. Newton observes that an examination of this bird might tend to throw light on the relations of *Calamophilus biarmicus* of Europe. This you will now have it in your power to determine. It appears to me that *Paradoxornis* and *Suthora* are to *Garrulax* what *Spizixos* is to *Ixos* and the Brachypodidæ.

"Besides seeds, I find *Suthora* is extremely partial to *grasshoppers*. It holds the insect down with its foot, while it tears it to pieces with its bill, beginning at the eyes and head of the insect in every case. In eating and tearing the insect the upper mandible seems to have an independent motion, working its tip into the inside groove of the lower, which has then the appearance of being projected. It will be worth while to examine the muscles of the bill, to note if they be in any way developed differently from those in cognate species.

"I had a *Suthora* alive some days since, and had then the pleasure of watching closely its habits. I have the specimen now in spirits. The one I send I had dried in the wind, in order the more easily to transmit it home to you by letter. I should like you to subject it to a close examination, and to make a report on it either in the 'Ibis' or the 'Proc. Zool. Soc.'

"If I can at any time advance your osteological labours with any special species that I have within reach, pray do not spare to command me.

"I am, my dear Sir,

"Yours very truly,

"ROBERT SWINHOE,

"*H.M. Consul.*"

"*W. K. Parker, Esq., London.*"

the epipterygoid process (*e.pg*) comes near that of the lower schizognathous types: the spatulate fore end of the bone has evidently given off a mesopterygoid segment to the palatine; but I see no further subdivision, as in *Parus*. In the latter the palatines are strong and broad; but in this bird they have a breadth and a strength quite unique in the Passerines. The postpalatine keels are deep, and run into a bevelled interpalatine angle (*pt.pa*, *i.pa*). The ethmo-palatine lamina above is of equal extent to that below; and together they form a broad isthmus, becoming the transpalatine (*e.pa*, *t.pa*), the outstanding angle of which is a short strong spike as in *Parus*; this part is steep, as in that species. Thence the base becomes gradually less oblique, but does not lessen in width until we come to its anterior half; the præpalatine is set in by a blunt end into the stout, high, V-shaped rostrum (*pr.pa*, *d.px*). So far all is *Parine*, but on a lower level. As in *Parus*, the rostrum is formed of the coalesced præmaxillaries and nasals, to the exclusion of the maxillaries. Moreover this mobile rostrum has a good hinge above with the frontal edge, and also on the side with the maxillary (figs. 3, 4). The upper hinge seems to be more perfect and *Psittacine*; and the lower hinges are less perfect than in *Parus*. The palatal process of the præmaxillary is more suppressed than in *Parus*, forming only the inner edge of the strong deep dentary plate (*p.px*, *d.px*). The median part of the rostral palate is very remarkable: instead of the triangular tongue of bone there are two rounded bosses, evidently formed by osseous matter from the præmaxillaries growing into the recurrent trabecular flaps; these are ankylosed to the strong bony septum nasi (*s. n*, *tr*), which does not seem to be so alate as in *Parus*, but has much larger nerve-bridges in the hinder part. These wings rival what is seen in Rapacious birds.

The fusion of the parts of the rostrum is very perfect, and the same part in *Parus ater* looks very feeble and *Sylviine* beside it (fig. 4); its hinges, grooves, median ridge, and steep dentary edges, all indicate a bird of unusual strength and "pluck" for its size—strong as the strongest Finch, but fierce withal. The broad body of the maxillary (*mx*) is twice as large as in *Parus*; like that type it has very large pedunculated maxillo-palatines (*mx.p*); but the stalk is coarser; it turns inwards somewhat, and the end is rounder and more clubbed; this part is pneumatic. The maxillary passes into a strong zygoma (*j*), which is high, just in front of its middle.

The vomer (*v*) is larger than in *Parus*; it is broadly emarginate in front. Its body has rounded sides, which draw in fore and aft; and this part is two fifths the length of the whole, the crura being long and gently converging; they are a long while distinct from the ethmo-palatines. A considerable amount of osseous deposit is seen in the alinasal, and some in the inferior turbinal, at least in the nasal wall close to it (fig. 4, *n. w*); the former appears in the dry skull as a bony coil inside the nostril, the curtain of which is soft (fig. 4, *a.tb*, *al.n*).

From the steepness of the head, the lateral ethmoid, with *its pars plana* (*e.eth*, *p. p*), is a large mass of bone: it does not project much externally; for the frontal fore edge

is as broad as in *Parus*: the outer margin is gently excavated; and the nerve-passage is simple, and not separated into two for the olfactory and the orbito-nasal as in *Parus*. There is no lacrymal bone.

Altogether this bird belongs to the Paridæ; it differs from them in precisely the same manner as Southern birds do differ from Northern, although it has come from 24° 30′ north of the equator. This will be conceded to me—that the distribution of types must, of necessity, be marked by an undulating line, Southern forms passing north, and Northern forms going south, to some considerable extent.

I am the more confident in calling this bird a Notogeal type of the Paridæ by what, in the most unexpected manner, I see in a Passerine bird from Bahia, in Brazil. The skull of that bird will now be described; and in it we shall see a bird the size of a Nuthatch, with the characters of *Suthora*, but still more generalized.

Example 58. Skull of *Cyclorhis*, sp.? Family Vireonidæ. Group Oscines.

Habitat. Bahia, Brazil.

It is not possible to see this bird, from 38° 59′ south of the equator, on the eastern coast of South America, and find in it, as it were, the large prototype of the little Chinese bird just described, without a sense of hopelessness with regard to the discovery of the laws of the geographical distribution of birds [1].

The skull of *Cyclorhis* is altogether lighter and more pneumatic than that of the little *Suthora*; this is a constant thing amongst even the highest families of birds, the pneumaticity agreeing with the size of the bird. Also, on the whole, it is less specialized as to the height, shortness, and strength of the rostrum (Plate LI. figs. 4 & 6); this agrees with the fact that the larger is the more generalized type. But their likeness, on the whole, is incontestable, and would be seen at once by the most inexperienced anatomist; the palatal and lateral views (figs. 5, 6) speak for themselves; and the greatest contrast between the two arises from their difference in relative length, or degree of prognathism.

This large archaic Tit shows the same want of typicalness in its pterygoids (*pg*) as does *Suthora*, only in a greater degree. The epipterygoid (*e.pg*) is not more pronounced than in a Fowl, being merely a low triangular crest strapped to the fore edge of the quadrate. This crest is the hinder part of a steep ridge which runs along the top of the bone, and ends in front in the usual "spatula." Great strength of the pterygoid muscles is here suggested. Altogether this is a strong-faced bird, but not specialized to such activity and power of movement as in *Suthora*. Whatever was the size of the mesopterygoid segment, it is lost now on the postpalatine plate (*pt.pa*): this latter part

[1] The skull here described was taken from a skin put into my hands by Osbert Salvin, Esq., F.R.S. I am writing in total ignorance of the views of zoologists with regard to this type; so that my thoughts are free whilst tracing its relationship.

is similar to that of *Suthora*; but the right and left keels come nearer together, leaving a narrow postnarial passage; they have not so steep a posterior edge, which is gently concave or emarginate: the difference here is very slight between the lesser and larger skulls. The transpalatine region (*t.pa*) is equally steep and strong; the snags themselves are more dilated and round at the end.

The ethmopalatal lamina (figs. 5 & 6, *e.pa*) is of greater extent than the interpalatine (*i.pa*), and not merely equal as in *Suthora* and *Parus*; it ascends very high, and is a large half-coil, as in many of the Passerines of South America. The interpalatine snags are thick and spongy. The præpalatine bar (*pr.pa*) is large and lathy, wider behind than it seems from below, because twisted on itself; at the middle, as in *Suthora*, it widens sensibly, and then narrows a little towards the fore end, so as to expose the alinasal turbinals (*a. tb*); it is completely ankylosed to the rostrum. Thus the palatines differ more in "letter" than in "spirit" from those of *Suthora*, and not otherwise than the rest of the skull differs.

The cranio-facial hinge exists here only in virtue of the elasticity of the bones; for the nasals and nasal processes of the præmaxillaries pass, by ankylosis, directly into the frontals; and the maxillaries, laterally, pass insensibly into the rostrum (*mx*, *d.px*). Thus we miss that parrot-like mobility of the face, and are, consequently, on the outer border of the Tit family. The fore part of the roof of the rostrum is deeply grooved in a rounded manner; and this groove ends in a triangular tongue of bone as in *Parus*; the "recurrent" processes are not distinct from this flap.

Whilst in *Parus* the palatal processes of the præmaxillaries are almost absorbed (fig. 1, *p.px*), in *Cyclorhis* as in *Suthora* they have lost all their distinctness, both from the dentary edge and from the præpalatine bar (fig. 5, *p.px*, *d.px*, *pr.pa*). The maxillary widens as it passes into the jugal bar (*j*), which is of moderate strength. The maxillopalatine processes (*mx.p*) have a short, straight, flat pedicle, which is as broad at its root as at the dilated end. That end is swollen, pneumatic, and just like that of a Tit.

The vomer (*v*) is large; but its crura converge, and are completely ankylosed to the shelly ethmo-palatines. The emargination in front is wider and straighter than in *Suthora*, and its crura somewhat shorter; but they are extremely alike. The "horns" of the vomer pass insensibly, by bony substance, into the large alinasal turbinals, which are well ossified and, as in *Suthora*, show through the short round nostril (figs. 5 & 6, *a. tb*). As in *Suthora*, the septomaxillaries do not keep distinct. The septum nasi (fig. 5, *s. n*) is a very remarkable mass of cavernous bone; it is completely ossified, not merely calcified; and the nerve-bridges are seen as the side-walls of a large air-cavity, which runs forwards along the mid line, above the lower face of the alinasal turbinals. Looking through the chink between these scrolls we can see that the whole septum is hollowed from below, the ossified trabecular flaps forming the shelving roof of the long air-chamber.

As in *Suthora*, the inferior turbinals appear to be but little ossified; and the alæ nasi are in both cases soft. The ecto-ethmoid projects moderately from the frontal edge (fig. 6, *e.eth*); and the pars plana (*p. p*) is a large spongy wall, greatly emarginate in a rounded manner externally; above, it has a wide common opening for the two nerve-trunks, as in South-American Passerines generally, and as in *Suthora*, where, however, the passage is relatively much smaller; and it terminates below by a rounded foot. There is no os uncinatum, and no lacrymal.

In all this detail, except in the deficient separation of the bones to form the cranio-facial hinge, there is scarcely any difference of consequence between the two skulls. It would be too much, perhaps, to say that they might belong to species of the same genus; but they are certainly representative genera, the small bird from Eastern Asia being, as one might expect, more specialized than that from Eastern America. Then, in the north the Titmice are typical forms, the culminating type of the group.

Example 59. Skull of Nuthatch (*Sitta europæa*). Family Paridæ.
Group Tracheophonæ[1].

Habitat. Great Britain.

The head of this bird is of the same length as the last; but in *Cyclorhis* the beak is shorter, and the cranium both longer and also much wider than in *Sitta europæa*, and appears large enough for one of the smaller Thrushes, the body being no larger than that of the Nuthatch.

In this latter bird the head is much like that of *Parus*; but its narrower cranium and longer rostrum, both being strong, remind the observer of the skull of one of the lesser Woodpeckers. So far as the skull of *Sitta* differs from that of an ordinary soft-billed songster, so much nearer does it come to a typical Tit. The pterygoids (Plate LI. fig. 7, *pg*, *e.pg*) are strong straight bones, with an unusually sharp and long epipterygoid process, very sharply bent forwards. The spatulate fore end of the bone is quite normal, and shows no additional mesopterygoid as in *Parus ater*. The postpalatine keels are moderately large and are emarginate in their hinder edge; the isthmus is broad, and runs into two nearly equal laminæ, as in *Parus* and *Suthora* (*pt.pa*, *i.pa*, *e.pa*). The transpalatine angle is less thrown backwards than in its congeners, and it is roughly dentate behind. The long præpalatine bar (*pr.pa*) is *Parine*, being a strong and rather wide sinuous plank; yet it falls off from the Tits as much as that of *Cyclorhis* by running insensibly into the rostrum. This latter part also has no more hinge above, nor are the maxillaries (*mx*) more hinged on the sides, than in that type. As in *Cyclorhis* and *Suthora*, the distinctness of the palatal portion of the præmaxillary from the dentary is quite lost (*p.px*, *d.px*). So also, as in *Cyclorhis*, the median line of the rostrum is

[1] I give this on the authority of Macgillivray (Brit. Birds, vol. iii. p. 49). He says that the "inferior laryngeal muscles form a small knob, and apparently single."

grooved and not carinate as in *Parus* and *Suthora*; this groove ends in a triangular rest for the recurrent lamina, as in *Parus* and *Cyclorhis*.

The pedicle of the maxillo-palatine is straightish and narrow; it is only slightly bent outwards, and terminates in a broad irregular spatula, which is scooped above and fenestrate; the air-cell lies rather *on* than *in* it; its inner edge is thick, and its whole form the almost precise counterpart of that of *Parus ater*.

The vomer is like that of its congeners; its fore edge is convex, and sends out an ear of bone on each side. Further back the bone broadens rapidly, not gently as in *Parus*, *Suthora*, and *Cyclorhis*. Then the strong crura lie near each other, but are parallel; they have coalesced with the sharp fore end of the ethmo-palatine on each side. In my specimen the nasal structures were all soft; it may, however, have been a bird of the first winter. The ecto-ethmoid projects moderately, and runs into a square pars plana, and has but a slight excavation laterally; the nerve-passage above is a common chink. The lower angle of the pars plana is almost acute; it shows no os uncinatum; nor does my specimen possess a lacrymal.

Example 60. Bearded Titmouse (*Panurus biarmicus*). Family "Panuridæ," Newton. Group Oscines.

Habitat. Great Britain.

The names given to this bird show how various have been the views of naturalists as to its zoological position. My opportunities of studying this type I owe to Professor Alfred Newton, F.R.S.[1], who first sent me incubated eggs and then three adult birds; from the latter I make my observations, as embryos only show general characters.

My first report to Mr. Newton was given in the autumn of 1873; and then I thought

"Magdalene College, Cambridge.
11th June, 1873.

[1] "My Dear Parker,—By this post I am sending you some incubated eggs of a bird about the affinities of which there has long been much uncertainty. I hope they may be of some use to you; but I have my doubts; for, though I only got them yesterday, I suspect they have been taken for some weeks, and I am sure they will require *immediate* attention. They belong to the bird known to naturalists as *Panurus biarmicus*, with which 'at large' I yesterday for the first time made acquaintance, though, of course, specimens and even live examples in cages have long been known to me. The Norfolk 'broadsmen' call it the Reed-Pheasant; Edwards figured it as the Least Butcher-bird; and most English and foreign writers call it a Titmouse; but there have been grave doubts expressed. Macgillivray showed that its digestive organs were those of a 'Deglubitor.' Tomes has touched upon its osteology. My own opinion I purposely refrain from giving you now.

"I am sure this is a case in which you might be of the greatest service to us taxonomists; and as you are fresh from the Titmouse and other small birds, you would be in particularly good trim to 'fix' us, provided only that these specimens are in trim and good.

"Yours very truly,

"ALFRED NEWTON."

that this bird was a genuine Titmouse, but subtypical. This was objected to by my correspondent, who, however, was satisfied of the truth of some of my remarks. "What you say [is his rejoinder] of a general resemblance which *Panurus* has to soft-billed Passeres is to me an indication that it is not so near *Parus*; but I think you dispose of the notion completely that it is nearer *Liothrix*. My own belief, I think, I have mentioned to you before—that *Panurus* has no very near allies; and I am prepared to make it the type of a new family, Panuridæ, to which possibly some other forms may subsequently be referred. I have grounded my faith on these characters among others (I omit those drawn from *external* characters, though they are many and strong):—

"1. The presence of a gizzard.

"2. The character of the plumage, quite unlike that of the Paridæ. The young having a style of plumage essentially peculiar to it, which becomes lost in the adult.

"3. The character of the egg, quite unlike that of any bird known to me, though Bartlett says that *Liothrix* lays the same kind of egg.

"4. The kind of nest it builds, which is quite unlike that of any of the Paridæ—no soft moss, fur, or feathers felted together, but a roughly woven ark of rushes, on which Moses's mother would have hardly hesitated to put her son, had it been big enough.

"5. The fact that the bird runs on the ground like a Wagtail or a Starling, instead of hopping like a Titmouse or a Finch.

"6. The difference between its vocal powers and those of *Parus*."

In the same letter Professor Newton says:—"In one way your conclusions are much to my taste; I never could reconcile to myself the Fringilline-affinity theory, in spite of Macgillivray[1] and Tomes. (N.B. The latter took osteological grounds.)"

So far my correspondent. The following account of this bird's palate (to which will succeed a description of that of *Liothrix*) will be seen to yield deductions in perfect conformity with the views of that accomplished ornithologist. How little this type resembles the Paridæ may be seen by comparing its palate with those of that family (Plate LI. figs. 1 & 7, and 8, 9). In the next Plate (LII. fig. 10) I have purposely put

[1] See Brit. Birds, vol. iii. pp. 694–698. The same author, speaking of its habits (p. 697), says:—"Their flight is quick and undulated; but they are seldom seen proceeding to a distance—the flocks, as observed by a writer in the 'Magazine of Natural History,' 'just topping the reeds in their flight, and uttering in full chorus their sweetly musical note. It may be compared to the music of very small cymbals, is clear and ringing, though soft, and corresponds well with the delicacy and beauty of the form and colour of the birds.'"

the figure of the palate of *Liothrix* side by side with those of several soft-billed Passerines.

The breadth and arcuation of the rostrum (figs. 8 & 9) have converted this part into a mask that hides its relationship to the soft-billed birds; it is such as is seen in *Pipra* (Cotingidæ, see Part I. pl. lvii. figs. 1–3). Yet this does not remove it far from the rostrum of a Wagtail (Plate LII. fig. 8); nor is it a greater modification of the fore face than we see in the Flycatcher (*Muscicapa grisola*). If the bill of that bird were slightly more decurved, and somewhat stouter, the two would be much alike; but these birds are far apart, and are here mentioned together for illustration merely. Compared with that of *Parus ater* the skull of *Panurus* is much more delicate; and in the palate all *Parine* stoutness is absent (compare figs. 1 & 8, Plate LI.).

The pterygoids (*pg*, *e.pg*) are very long and slender; and the epipterygoid hook is a flat crest, not a rounded hook as in *Parus*. The fore end of the bone has its usual spatulate form; but the laminated part is very large, and the triangular mesopterygoid segment, superadded to the palatine, is of medium size. The postpalatine keels (*pt. pa*) are normally passerine, being steep and having an almost vertical emarginate posterior edge. The broad part of the palatines is very similar to what is found in *Pratincola*, *Muscicapa*, and *Liothrix* (Plate LII. figs. 9–11). The transpalatine angle (Plate LI. fig. 8, *t.pa*) is a small, stunted, and somewhat outturned spur; this part is moderately steep. The interpalatine spurs are blunt, the ethmo-palatines sharp and triangular, reaching further forwards (*i.pa*, *e.pa*). The præpalatine bar (*pr.pa*) is a long narrow strap of bone, running into the rostrum by complete ankylosis; it slowly broadens in its fore half; and the right and left bars leave a large prævomerine space, in which are displayed the elegant coils of the olfactory vestibule. The inwedged maxillaries (*mx*, *d.px*) run in between the præpalatine bar and the retral part of the præmaxillaries quite normally.

The nasal, by its thick outer edge, hinges on to the skull (fig. 9, *n*, *e.eth*); but the inner part of the lamina and the nasal processes of the præmaxillaries are ankylosed by their thin fibrous ends to the skull. The median process of the præmaxillaries is suppressed; the palatal processes are ankylosed to the palatines and to their own dentary edge (*d.px*). The maxillo-palatines are, in stalk and blade, like those of the Paridæ; but the latter part, although thick and pneumatic, is smaller (fig. 8, *mx.p*).

The vomer (*v*) is like that of the Tits, in that its legs cling towards each other; and then the bone does not keep straight at its sides as in most soft-billed types: but this convergence is also seen in the Swift (*Cypselus*) (Plate LII. fig. 1, *v*). The fore edge of the bone is much more like that of an ordinary Passerine, having a thick low carina in place of an emargination. Its shoulders are broad where the graft is upon the inturned nasal wall (*i. n. w*); and although this part is, like the enclosed turbinal, calcified considerably, there is no separate septo-maxillary ossicle; nor is there in the Tits. The nasal labyrinth is not Parine, but Sylviine, with special modifications of its own (see

Part I. pl. lv.). Instead of the large nerve-bridges of the Tits (figs. 1, 3, 5, *s. n*), the septal base is suddenly narrowed there for a short tract in front of the great "notch," and then the trabeculæ (*tr*) reassert themselves as a large lanceolate leafy structure, which runs small in front. This front part is not calcified; the rest is quite hard; and the recurrent flaps are not to be found, as though the trabeculæ had run to fine straightened-out points. This leafy base of the septum has its median part grooved and its edges recurved; so that it is like the leaf of *Magnolia grandiflora* turned upside down. The large size of these alæ, and the coiling of their edges as though to convert them into a pair of median "turbinals," are peculiar to this type; I have not met with this modification so fully developed in any other. A crescentic portion of the nasal wall appears on each side of the præpalatine; and all the outside part to the external nostril (fig. 9, *e. n*, *al. n*) is soft.

The olfactory region (*e.eth*, *p.p*) does not differ sensibly from that of the Paridæ. The upper part projects moderately; the pars plana is a large mass with a round emargination outside, and a roundish foot; the nerve-passage is single; there is no os uncinatum, and no apparent lacrymal. Several of these latter characters correspond not only with what is seen in Titmice, but also in many of the *soft-bills*; they cannot be made to weigh much on the *Parine* side. Nor, indeed, can the clinging incurved legs of the vomer, seeing that this, although a good character, does not belong by absolute right to the Tits.

Looking right and left for relationships for *Panurus*, it seems evident that this bird, here at any rate, is "a stranger in a strange land;" we therefore look abroad for some cognate type near it, if not of the same precise family.

Example 61. *Liothrix*, sp.? Family "Liotrichidæ," Newton[1]. Group Oscines.

Habitat. Indian region.

The general form of the skull and face in this species is exceedingly like that of the last; it is, however, one third larger, and has a longer and less decurved rostrum, a character which gives it a more normally tenuirostral appearance.

The pterygoids (Plate LII. fig. 10, *pg*, *e.pg*) are less long and slender than in *Panurus*, and the epipterygoid hook is more developed. None of its spatulate end has been yielded to the palatine as a mesopterygoid. The palatines are very similar in both types; but the transpalatine angle (*t.pa*) is broader and has a more arcuate outer side. The ethmo-palatine spurs (*e.pa*) are longer; but the præpalatine (*pr.pa*) is quite alike in both.

The vomer (*v*) is quite like that of *Panurus*, but smaller; the ossification is feebler

[1] Professor Newton, in a letter to me, July 14, 1875, says:—"It seems to form a family of its own, 'Liotrichidæ;' how many more genera go with it, I do not know. They are all, I think, from the Indian region, but just creep into the Palæarctic (according to my view)—one species, I believe, occurring in Thibet."

in this specimen, from its being a captive. The maxillo-palatines have been injured; their pedicle is straight (*mx.p*); that contiguous part of the maxillary is broader than in *Panurus*, but runs on into the rostrum in a similar manner. The hinge, above, does not even show the notch in the outer edge of the nasal, as in *Panurus*. The præmaxillary has a better median process; but the palatine processes are indistinct. Altogether, we lack here the strong cultrate dentary edges to the præmaxillary, and the rostrum is very much like that of *Muscicapa grisola*, although neither so long nor so wide and gaping.

The whole nasal labyrinth, in front, is soft; and I miss the large *alæ* (*tr*, *s.n*) to the base of the septum; they are much less developed. Palate for palate, this is most like that of the Australian *Sittella* (Plate XLVII. fig. 6), a form in which I find the syrinx imperfect, and which zoologists class with the Paridæ. If *Sittella* belongs to the Paridæ, *Liothrix* must be related to them; it has at any rate a vomer in their style; whereas *Sittella* has a *four-banded* vomer, like that of the Mniotiltidæ and their allies in Central America, the *Muscicapine Petroicæ* of Australia, and our native Bushchat (*Pratincola*). The ecto-ethmoid of *Liothrix* differs from that of *Panurus* in that the outer emargination is shallower and the nerve-chink smaller; there is here also neither os uncinatum nor lacrymal.

My observations lead me to think that the position of *Sittella* is more doubtful than that of *Panurus* or *Liothrix*. It is easy to *exclude* these latter types from the Paridæ; but it is not so easy to *include* the former. *Cyclorhis* and, still more, *Suthora* have reason to hold with the Paridæ.

Example 62. Skull of Whinchat (*Pratincola rubetra*). Family Saxicolidæ. Group Oscines.

Habitat. Great Britain.

Amongst the modifications shown amongst our native soft-bills, this is one, to me, of the most interesting; for in no other is the vomer so manifestly "tetramerous"—an evident sulcus dividing off the sides, that are belved downwards gently from the ascending moieties of the subcarinate median part (Plate LII. fig. 11, *v*, *s.mx*). I have just mentioned this structure as occurring in the Central-American and Australian tenuirostral Passerines, and have already striven to show its great morphological importance. In all other things this bird approves itself to be typical, its palate and skull showing no important modification of what is seen in numbers of native soft-bills.

Example 63. Skull of Pied Wagtail (*Motacilla yarrelli*). Family Motacillidæ. Group Oscines.

Habitat. Great Britain.

The extremely delicate and elegant skull of this little bird well deserves a lengthened description; but its facial region is introduced here because of certain exceptionally

distinct osseous elements which it displays. The skull and face, as a whole, are perfectly typical, or like those of a true *Sylvia*; and the vomer, whilst quite normal, is relatively as large as in the Ratitæ. The nasal capsule is soft, all but the top of the septum (Plate LII. fig. 8, *s. n*). In the angle between the nasal and ecto-ethmoid there is, for a bird of this kind, a large lacrymal; it is broad above, and runs into a sharp point below.

But the point of greatest interest is the occurrence in the Wagtail of a very distinct os uncinatum, the ornithic counterpart of the ethmo-palatine pedicle of the Batrachia. Here this bone is perfectly distinct from, although strongly attached to, the antero-inferior aspect of the large spongy pars plana (Plate LII. figs. 8, 8 A, *p. p*, *o. u*); it is W-shaped, or rather is like what the human *incus* would be if it were a flat bone. In the Yellow Wagtail (*Motacilla flava*, Mont., Jen., & Selb., *Budytes rayi*, Macg.) the lacrymal is less developed, and the os uncinatum is a long, sinuous, arcuate thread of bone applied to the convex fore face of the thick spongy pars plana below (Plate LII. fig. 8 B, *l*, *p. p*, *o. u*).

In the absence of any marked osteological specializations, giving variety to the skull and palate of so many soft-billed types, these are, without controversy, of great value. But their *zoological* importance is much less than their *morphological*, seeing that by the sudden and unlooked-for breaking-out of these elements we are ever being brought face to face with the clearest evidence of the *derived* nature, from low and ancient types, of the most inexplicable parts of the organization of these high and perfect creatures.

No special-purpose doctrine is of any service here: from another standpoint these things must be seen.

Example 64. Skull of Golden Oriole, nestling (*Oriolus galbula*). Family Oriolidæ. Group Oscines.

Habitat. North America.

The palate of this type, in the young bird, is a sort of rough model of the Passerine structure; it also presents certain peculiarities deserving of notice. The pterygoids (Plate LII. fig. 6, *pg*, *e.pg*) are short and stout, with an imperfect epipterygoid process. The two laminæ of the palate are about equal (*i.pa*, *e.pa*), the isthmus broad, and the rest of the bone the ordinary ornithic scythe-shaped bar, having, as yet, on its hinder outbend an irregular lozenge of hyaline cartilage (*t.pa*). The fore end is a sharp point of bone passing, normally, on the inside of the palatal process of the V-shaped præmaxillary (*p.px*, *pr.pa*). The maxillo-palatine process is, as yet, thick-rooted, thick-stemmed, and having a backwardly-turned clubbed end.

In front the maxillary (*mx*) runs into the sharp reentering angle between the dentary and palatal spikes of the præmaxillary; and behind it sends a long jugal process almost to the quadrate, *as in the Frog*. The ox-faced vomer (*v*) has its right and left halves

well conjoined, all but the short crura. Whilst at the mid line, in front, there is a slight carination, towards the side there is some evidence of such a process of absorption as would cut off a lateral falciform septo-maxillary. Seen from above (fig. 7, *v*, *i. al*) these sides are thick, and form the walls of the scooped bone; *they* are grafted upon the inturned alinasal cartilage. This part of the nasal vestibule is forked, as in the Wren (Trans. Linn. Soc. ser. 2, Zool. vol. i. pl. 21. fig. 6), the larger process being above and outside, and the lesser below and more mesiad.

This lower and inner process sends inwards to the septum a crescentic tongue of floor-cartilage (*n.f*); it has a sinuous front and a convex hinder edge. Then the main part of the floor, on each side of the septum, is membranous; the septum itself (figs. 6 & 7, *s. n*) is not alate. At its extremity the prænasal region has a small rod of cartilage (fig. 6, *p.n*); and the recurrent cartilages appear as the triangular median part of a fore belt, which strengthens the floor at this part in a manner similar to what is seen behind. Submesially this fore belt sends backwards two ears of cartilage, then narrows a little as it passes, on its outer side, into the alinasal valve.

This is unlike any thing I have found in the other Passerines, and well worthy of being recorded in figures and in words. The septum nasi (*s. n*) is thickened where the nasal nerves burrow it postero-inferiorly; but in this kind we lose the trabecular wings, and, correlated with this deficiency, we find the alinasal cartilages closing in below both in front and behind; the fascia which unites these fore and hind belts effectually hides the alinasal turbinal from view.

In my former paper on this subject (pls. liv. & lxii.) I showed the very remarkable conditions of the nasal vestibule in *Turnix* and *Chasmorhynchus* as compared with what is the typical condition of these parts in the Coracomorphæ (*e. g.* in *Corvus* and *Ruticilla*); here, in *Oriolus*, we have a third modification for comparison with that which is the Passerine exemplar.

Example 65. Skull of Grey Flycatcher (*Muscicapa grisola*), 1st summer.
Family Muscicapidæ. Group Oscines.

Habitat. Great Britain.

In this type also I have been able to show the skull of a young bird (a fledgeling[1]); and I am able to note a very important morphological fact, namely that, whilst in the typical Fringillidæ (e. g. *Passer domesticus*, *Linota cannabina*) the moieties of the vomer are well coalesced by the middle of incubation, here, in this species, they are thoroughly distinct in young birds capable of flight. And this is of the greater consequence inasmuch as the Muscicapidæ, like the Chats (Plate LII. fig. 11) and many

[1] This specimen is one, among many, for which I am indebted to Prof. Rupert Jones, F.R.S.

of the Australian and Central-American soft-bills, show an evidently lower ornithic condition of the face, retaining as they do evident conformity to that of the Ophidians and the Lacertilians.

There is very little appreciable difference between the skull of a Whinchat (*Pratincola rubetra*) and this species; that which is evident is the greater *length* and *breadth* of the rostrum; for here begin the "fissirostral" types, that run into the Swallow, and pass over to the Swifts. The pterygoids have their epipterygoid processes a little smaller than in *Pratincola*. In the young (Plate LII. fig. 9) the transpalatine (*t.pa*) shows more angularity; but in the adult it is scarcely distinguishable from that of *Panurus* (Plate LI. fig. 8).

The vomer of the adult is exactly like that of the Whinchat (fig. 11, *v*); but in the fledgeling (fig. 9, *v*, *s.mx*) this bone consists of two perfectly distinct bars, which do not yet meet under the parasphenoid, and which are themselves also double. The halves of each lateral piece are joined at a right angle, each plate turning downwards. In front, each half has its own head, which is flattened and thick; and the main part is twisted on the head of the inner piece. Each head is grafted upon its own part of the inturned lamina (*i. al*). These two halves, the inner of which is the vomer (*v*) and the outer the septo-maxillary (*s.mx*) are not clearly distinct, save in front. Looking from below, holes are seen in the deep fossa; but the suture is far less evident than in the adult *Mniotilta* and *Dendræca* (Plate XLVIII.)[1]. The vomer, at the junction of the outer and inner pieces, sends upwards a crest.

But these long outer sickles of bone do not correspond to the whole of the Ophidian or Lacertian septo-maxillary, the fore part of which is clearly represented in the young Flycatcher by a triangle of bone (fig. 9, *s.mx'*), which is applied to the hinder face of the alinasal wall (*n. w*) some little distance outside the outer vomerine sickle. The large broad rostrum is confluent with the maxillaries and jugals. The maxillo-palatines are bony pneumatic ladles, as in *Pratincola*. The ecto-ethmoid has two distinct nerve-passages above it; its lower lateral part, or pars plana, is very large and spongy; its side is emarginate, and its foot rounded, without any distinct os uncinatum.

I find in the young a small lacrymal on the right side—a falcate spicule, attached to the descending crus of the nasal; this bone is ever ready to crop up in the Passerines, and doubtless often exists, but is soon ankylosed to the nasal, and then has its outline blurred by absorption of its angles.

[1] When bone is forming in the fibrous tissues of a bird's palate, it is not uncommon for a *temporary suture* to appear, which corresponds to the persistent suture of some lower type. The osteoblasts, which at first spread fairly through the tissue, become laid out in free morphological territories; these, however, are generally soon obliterated again. This state of things in birds is due to "the hot condition of their blood;" their metamorphosis hastes to its end. In the figure, Plate LII. fig. 11, the maxillo-palatine of one side has been dislocated, and part of the palatine cut away.

In this species, as in the Muscicapidæ of Celebes and Australia (*Lalage* and *Petroica*, see Part I. pls. lx. & lxii.), and also as in the Whinchat, there are no additional palatine bones (palato-maxillaries), such as we find in the Mniotiltidæ and their allies (Plate XLVIII.): here we seem to be feeling our way to morphological groupings that cannot be disregarded by the zoologist in his taxonomy.

These broad-faced birds lead to those which have the face still more gaping, and which yet depart but little from the normal Passerine type.

Example 66. Skull of House-Martin (*Chelidon urbica*), 1st summer.
Family Hirundinidæ. Group Oscines.

Habitat. Great Britain.

In this remarkable group of tender-billed gaping Passerines, there is not, as far as I am aware, a single aberrant character of importance. The skull, the skeleton generally, the digestive and the vocal organs—all these might belong to species of the genus *Sylvia*. And yet, in minor adaptive modifications (I say *minor* in reference to what is of importance in morphology) these birds are full of modifications, and to the unscientific eye they appear to belong to the kind of the Swifts, and not to the kind of the ordinary Warblers. The Swifts, however, lie on the extreme margin of the Coracomorphæ, and form another group, which leads to the Goatsuckers; but the Swallows have retained (or gained) that perfect *syrinx* which is the sign and the seal of their right to the title "Oscines."

My observations have been made on several stages; but, for the sake of morphology, I here give the skull of a *half-ripe* nestling (Plate LII. fig. 4), as this can be most easily compared with the skull of the young of the Crow and Warbler (Part I. pl. lv.), as well as with the skull of the young Oriole and Flycatcher just described (figs. 6 & 9).

The cranial cavity in the adult *Chelidon urbica* and *C. rustica* is large and broad; it is entirely *Sylviine* in all essentials. The eye-sockets are very large and well rimmed. In the adult the pterygoids are very long, slender, and arched outwards; in the young (fig. 4, *pg*, *e.pg*) they are straighter and stouter. The epipterygoid process is a mere snag at first; but in the adult it becomes an ear-shaped "trochanter." The spatulate fore end (fig. 5, *pg*, *ms.pg*) is seen to be giving off its lanceolate mesopterygoid for union with the palatine; afterwards its fore end is a spatula, concave to the parasphenoid (*pa.s*). The palatines, under the power of the *fissirostral* specialization, have lost no normal characters. The postpalatine keels (*pt.pa*) are smallish and incurved; and they are cut away, as it were, behind, and have their free edge excavated. The flat main bar, gently narrowing to its præpalatine point, has a large ear-shaped transpalatine cartilage, rapidly ossifying, independently, by endostosis. In harmony with the wide

gape, the isthmus is also broad; and the lower or interpalatine lamina is of less extent than the upper or ethmo-palatine (*i.pa*, *e.pa*); this latter is notched as it passes to the crus of the vomer (*v*). In the adult the interpalatine plate becomes convex below, and fenestrate, and ends in a large, free, triangular spike. The long, lathy præpalatines are wide apart, exposing a large nasal area; they run on the insides of the pointed palatal processes of the præmaxillary (*p.px*).

The solid part of the rostrum is short; and so, relatively, for a bird, are the dentary and palatal processes (*d.px*, *p.px*). Here, as compared with carinate birds generally, the face differs, as does that of a Salmon from that of a Carp or Perch; for the maxillary (*d.mx*) is no longer an inwardly placed "os mystaceum," but comes boldly to the outside, with a large *dentary* edge. It runs into the lateral part of the præmaxillary by two long splinters, and backwards almost to the quadrate, as in the *fissirostral* Batrachia. From the broad main part the maxillo-palatine process is given (*mx.p*); and there the bone is excavated into a fenestra. The pedicle of this process is curved backwards; and its end is a hammer of bone, thick on its inner edge, but not hollow. The maxillary forms a considerable angle before passing into the jugal process (*j*, *mx*) The long slender jugal reaches to the inner face of this part.

The rostrum of the House-Martin is not at all feeble; it is arched about half as much as in *Podargus*, of which it is a pretty accurate miniature and *isomorph*. The dentary part of the præmaxillary ends some distance in front of the angle of the maxillary (*d.px*, *d.mx*), and is better seen above than below; the palatal process is only half its length.

The vomer (*v*) is like that of a Lark (Plate L. fig. 9, *v*)—its outline being ox-face-shaped,—subcarinate, with a double horn on each side running into the nasal wall (*n. w*) and long bowed legs. In the adult the notch between the crura becomes sharper, the body longer, and the nasal "horns," especially the inner or lower, much longer; the whole bone, indeed, becomes more typical and elegant. Yet even in the adult, but more in the young, there is a very strong appearance of that *tetramerous* composition which is seen in the less-fissirostral Flycatcher (Plate LII. fig. 9).

The cranio-facial hinge is extremely mobile, the overlapping facial bones being reduced to the thinnest laths, and the septum nasi quite cut off from the perpendicular ethmoid. The lateral ethmoid is like that of the Flycatcher, projecting moderately, and has a pars plana with an excavated edge, a round foot, and no evident os uncinatum.

The nerves pass out of the orbit by thoroughly distinct foramina; and the outer face shows (in my specimens) no lacrymal. The nasal capsule, up to the ecto-ethmoid, shows scarcely any calcification.

Example 67. Skull of Swift (*Cypselus apus*), 1st summer. Family Cypselidæ. Group Tracheophonæ [1].

Habitat. Great Britain.

We saw that this particular form of palate was present in birds lying at a great depth below the Passerine level; *there* it was seen to be imperfect, although those birds possess every element; it is arrested in the metamorphosis in those birds, the Hemipods (*Turnix*, Part I. pl. liv. Here, in the uppermost territory, in a small group, equal in genera and species only to one of the smaller Passerine families, we have a most distinct kind of bird with a perfectly Ægithognathous palate. Therefore, if the morphology of the face is to count for much in the classification of birds, I do not see how Professor Huxley's "Cypselomorphæ" (P. Z. S. April 11, 1867, p. 468) can be retained. I have shown (Trans. Linn. Soc. ser. 2, Zool. vol. i. pp. 113–120) that two of the families placed by him in that group are schizognathous, this simple reptilian condition of the palate being retained by such high types as the Trochilidæ and the Caprimulgidæ. Feeling, as I do, that classification may be left to take care of itself, if the facts of the organization of the groups be made sure, I am not troubled to see that convenient little group break itself up into three lesser groups, each of equal value.

Although the border of the Swifts falls to them close on that "top-land" of the Passerines where the Swallows congregate, yet are these conterminous groups only "second cousins," and more alike in their habits and mode of dress than in their real nature. I mentioned that those *Swift-shaped Flycatchers*, the Swallows, come up to the true Sylviines in all that is normally Sylviine. Now a Swift, as to his skull and face, is merely an exaggerated Swallow, an *ultra-hirundine* bird—a caricature, as it were, of the true Passerine gaping birds. In the skeleton he comes close to the Humming-birds; in the huge disproportion in length of the *arm* to the *hand*, even the Swallow begins to be very *Cypseline*; but the Swift and the Humming-bird are here at one. So, also, are they in the sternum and shoulder-girdle; the Swift also has lost the "cæca coli," and has not developed any intrinsic muscles to the syrinx ('Shoulder-girdle and Sternum,' plate xiii. p. 176; Macgillivray, Brit. Birds, vol. iii. pp. 606–626, pl. xxii. fig. 5). These and many other characters that might be mentioned show that the Swift, although claiming to have arisen from the same essential stock and root as its Passerine relations, has, while failing to gain several of their most exquisite modifications, brought that kind of framework for which even the Swallow is remarkable to its uttermost degree of perfection [2].

[1] The term "Tracheophonæ" is applicable not only to those Coracomorphæ which have the syrinx imperfect, but also to the remainder of the Carinate birds. The title of these communications, "On the Ægithognathæ," gives me great liberty; I am not bound to the Coracomorphæ, although they yield me nearly all my materials; but I search everywhere for this particular form of facial modification.

[2] I think it is far from improbable that we owe that most exquisite creation, "Ariel," to the poet's familiarity

Passing on to details, I may observe that my study of this skull has been from a nearly ripe nestling (see Plate LII. figs. 1–3), from well-fledged young, and from the adult. The youngest of these suits my purpose best; it was twice as much developed as the young Martin whose palate has just been described [1].

The skull is short and broad; the basitemporal (*b.t*) a very narrow band; and this part of the basis cranii is very flat, and carinate forwards, as in *Caprimulgus*. Here also, ready to break out, are the basipterygoids (*b.pg*); here they are mere angulations of the upper wings of the basisphenoid, and they even get rounded off in the adult. The rostral region of the basis cranii (parasphenoid, *pa.s*) is much more thick and spongy than in the Swallows, but much less than in the Goatsucker, and is exactly intermediate.

The pterygoids (*pg*, *e.pg*) are more Hirundine; they are long, slender, gently arcuate, and with a fuller epipterygoid, as in *Caprimulgus*. Their anterior spatula and mesopterygoid segment are normally Passerine (fig. 2, *pg*, *ms.pg*). The palatines are peculiar, but they are Passerine. The transpalatine bone (*t.pa*) is scarcely invested by ectosteal layers, and is distinct; it is a flat hook. The main palatine bone is peculiar. The postpalatine region is bevelled off; it was lessening in the Swallow; but the edges that run into the interpalatine spike are well incurved round the postnarial channel. The isthmus is of great extent; but the interpalatine spikes run a distance in front of it equal to its breadth (*i.pa*); they overlap the maxillo-palatines largely, whereas it is the rule for the contiguous parts of these processes to be tied together by a considerable ligament; in this the Swift is peculiar. A new and *Cypseline* character is seen in the angulation of the main palatine bar in front of the distinct transpalatine, making the bar bidentate as it flattens out towards the jugum. In front of this second projecting angle the bar is a sinuous plank, convex below, concave above, and moderately strong; its fine point overlaps most of the delicate palatal process of the præmaxillary, on its *inner* side, as in the Passerines.

The broad part of the ethmopalatine plate (*e.pa*) is only two thirds the extent of the lower plate; but its spurs are of extreme length, and, contrary to the Passerine *norma*, they lie not only *above*, but on the *inside* also, of the long crura of the narrow-waisted ox-faced vomer. As in the Swallow and Goatsucker, the præmaxillary nasal processes and the nasal bones become extremely thin where they are let into the frontals. The relative size of the præmaxillary is here reduced to the utmost degree for a bird, and

---

with the Swift, a miracle of flying-power, which, in deeds, if not in words, says:—

> "I drink the air before me, and return
> Or ere your pulse twice beat."

[1] With these figures compare those of the larger "Fissirostres," e. g. *Caprimulgus* and *Podargus* (Trans. Linn. Soc. ser. 2, Zool. pl. 21. fig. 8, and pl. 23. figs. 6, 7).

the maxillary has its largest development. It is noticeable here that in this respect a Sauropsidan type which is the furthest removed from the lower cold-blooded forms by intense metamorphosis, yet has, for prehensile purposes, its fore face brought back into greater harmony with them than is seen in birds generally. Here the dentary edge of the præmaxillary (*d.px*) reaches halfway to the gape-angle of the maxillary (*mx*), and this latter bone forms a large and sinuously vaulted roof to the outer third of the fore palate. At the widest part of this plate it sends inwards and backwards the maxillo-palatine sickles (*mx.p*); and these also are peculiar. These delicate, crescentic, flat spurs come nearest to those of certain South-American Coracomorphæ, *e. g.* the "tracheophonous" *Synallaxis* (Part I. pl. lix. figs. 6 & 7, *mx.p*); and this is a reasonable thing, that a harsh-voiced outlier of the Passerines should approach some less-modified type of the group itself. In *Caprimulgus* they have the same form, are much like those of the "Dendrocolaptidæ" and "Formicariidæ," but are short and spongy.

The vomer (figs. 1 & 3, *v*) is an extraordinary bone, although absolutely Passerine. In the adult the "body" is only one fourth the length of the bone: it is more like the face of a *fox* than of an *ox*; and its sharp outstretched ears are formed by the extension of bony matter into the inturned alinasal lamina (*i. al*); they are not evidently separate as septomaxillaries (*s.mx*). The fore margin of the vomer is rounded, and not scooped; and the inferior surface is gently convex. The bone narrows in rapidly; and the crura are very near at first, but open out, like callipers, behind, exposing the overlapping ethmo-palatine spurs on their inner face (figs. 1 & 3, *v*, *e.pa*).

In old birds the septum nasi, which is well notched off from the far-projecting ethmoid, becomes bony above, the alinasal and inferior turbinals become largely calcified, but the alæ outside remain soft. Clinging to the upper two thirds of the descending crus of the nasal is a spongy pupiform lacrymal, which is smaller in the older birds than in those of the first summer.

With one exception in these examples, namely *Menura*, the Coracomorphæ expose their ecto-ethmoid after the manner of an ordinary Fish, a Monitor, or a Crocodile. So do the Swallows, quite normally; but in the Swift the fore part of the frontal forms an overhanging eave to that bone—the first step thus to that hiding away and abortive development of this part seen in *Podargus* and its desmognathous relations. The Goatsucker lies midway between the Swift and those types. In the Swift, as in the Goatsucker, the pars plana runs into the skull above, and the foramen for the olfactory crus is neat and distinct; but the orbito-nasal nerve grooves the outside of the over-roofed ecto-ethmoid, and does not perforate its mass: this is a *non-Passerine* character, a delicate test of the distance we have gained from that group. The whole of the outer ethmoid is spongy and thick, and of a squarish form—the outer margin, however, being convex, and the lower sinuous. In *Caprimulgus* (*op. cit.* pl. 21. fig. 8) the pars plana,

which is a huge spongy ear of bone, never ossifies at its free infero-external angle, but leaves a semi-oval tract of cartilage, a soft "pars uncinata." In the Swift the whole is completely ossified; and here we meet with a curious correspondence with the Passerines of Australia and Celebes (*Pacycephala* and *Hyloterpe*, Part I. pl. lxi. fig. 7, *o. u*, and pl. lviii. figs. 3 & 4, *o. u*). In the Swift, as in those birds, the "os uncinatum" (fig. 3, *o. u*) is a well-marked large lower lobe of the swollen pars plana; this part is like a bagpipe, and the short curved neck is turned inwards. These details, if they prove any thing, show how sharp is the angle intervening between the *Hirundine* branches of the Passerine stock and this distinct "leader," the *Cypseline* branch. Could we go lower down, and see the *common trunk*, we should most likely find *Cypselus* growing out only one "internode" lower than *Hirundo*. The latter form runs through all the metamorphosis, and attains to all the excellencies of the most perfect of the "winged fowl." The Swift outdoes its Passerine relations in some, and stops far short of them in other, characters. Like the Bell-bird (*Chasmorhynchus*, Part I. pl. lxii. figs. 5–8), the Swift is formed, as it were, by a commingling of Passerine and Caprimulgine characters; but in it the latter preponderate sufficiently to exclude it from the territory of the Coracomorphæ.

In the next group, the Nectariniidæ, the members resemble the Humming-birds, much as the Swallows resemble the Swifts. But these Old-world forms are not near relatives of those American forms; they are rather to be regarded as *isomorphs* than allies. The Swifts contain much of the Passerine nature, and come near the Swallows; Humming-birds are a greater distance from the Passerines; and the Nectariniidæ are but little modified from the "norma" of the ordinary Warblers.

Example 68. Skull of *Nectarophila grayi*. Family Nectariniidæ. Group Oscines.

Habitat. Celebes.

In this type we have the smallest, as in the Raven we have the largest, of the highest or typical Coracomorphæ; in both there is the perfect syrinx, albeit in the latter it is too large an instrument for the production of "sweet sounds." Notwithstanding the "isomorphism" of these birds, the Nectariniidæ, with the Humming-birds, they are very wide apart in their structure. In the skull, as in the rest of their organization (compare Plate LIII. with the figures of the skull of *Patagona gigas*, Trans. Linn. Soc. ser. 2, Zool. vol. i. pl. 22), they also conform far less to the structure of the Passerine Meliphagidæ (Plate XLVII. figs. 1–4) than might have been supposed. The base of the cranium (Plate LIII. fig. 1, *b.t*, *oc.c*) is quite similar to that of a *Sylvia*.

The pterygoids (*pg*) are gently arcuate, and are flattened from above downwards; they interdigitate with the postpalatine laminæ and the mesopterygoid plates in front; and

behind they send upwards and inwards a long epipterygoid hook (*e.pg*). The palatines are extremely delicate, and, for the length of the head, not long; for their frail præpalatal bar (*pr.pa*) is soon lost in the base of the large rostrum. Passing backwards, we see how wide they become in the middle to form the transpalatine lozenge (*t.pa*) which is relatively about the largest ever seen. If the zygomata had kept parallel, instead of diverging to articulate with the large quadrate bones, they would have passed close to the edge of the transpalatine process on each side, as in those Reptilia which possess an "os transversum"[1].

The broad part of these palatines (figs. 1 & 2) is formed of very fine, papyraceous, wavy plates, whose strength is increased by a selvage or ribbed edge on the outer margin of the transpalatine, the other free edges being irregularly toothed. The oblique and somewhat steep transpalatines send backwards and inwards a narrow but widening isthmus, which grows into two plates—the lower, or interpalatine, being small and but little spiked, whilst the upper, or ethmo-palatine, is broad, half coiled, and united to the vomer (figs. 1, 2, *v*, *i.pa*, *e.pa*). The postpalatine laminæ (*pt.pa*) are deep and steep, and end suddenly, with a high emarginate edge: between these parts the parasphenoid is bare. The rostrum, as seen from below, is deeply sulcate; laterally there is a small submarginal sulcus behind; the whole structure is solid and gently arched. The palatal part of the præmaxillary sends a median tongue of bone beneath the front part of the nasal floor; the sublateral processes are united to the præpalatine bar; and the dentary edge ends in a free angular process, which overlaps the descending crus of the nasal and the wide part of the præmaxillary; but all these bones are soldered together. The jugal (*j*) is continuous with the maxillary (*mx*); and the maxillo-palatine processes (*mx.p*) have a long inbent stalk, and a pedate blade, which is two-toed, behind. These processes are the frail homologues of the dense bony fore palate of the Mammal.

The two bacilliform vomers are united by a commissural plate, whose hinder margin reaches but little beyond the middle of the bars; and the free gently diverging "horns" are of greater extent than the uniting plate. That plate is a little convex below and concave above; and the whole bone is such as appears to belong only to the Nectariniidæ. No septo-maxillary appears on it; but the anterior bones are grafted on the inturned alinasal lamina as usual (*v*, *i. al*). The whole alinasal part of the labyrinth (indicated by faint drawing) is unossified, as well as the inferior turbinals. It corresponds very closely with what is seen in *Ruticilla* (Part I. pl. lv. fig. 13); but I have not been able to find *alæ* to the septum, either in this type or the next. On the whole, the huge spongy ecto-ethmoidal mass (*p. p*, *e.eth*) is like what is seen in the noblest

[1] The setting free of the complex palate, the attenuation of the zygoma into a fine "spring," the mobility of the quadrate, the gliding of the palate on the basicranial axis, and the formation of a cranio-facial hinge—all these things are ornithic specializations of equal interest to the student of fitness and the student of form.

Passerines; and the passage for the orbito-nasal nerve is some distance from that for the olfactory, as in *Anthreptes* (Plate LIII. fig. 6, 1, 5).

Example 69. Skull of *Anthreptes malaccensis*. Family Nectariniidæ. Group Oscines.

Habitat. Celebes.

This bird is more Sylviine, and is very useful to bridge over the space between *Nectarophila* and *Sylvia*; it has, however, characters of its own, and also shows a likeness to the Muscicapidæ (see *Lalage*, Part I. pl. lxii. fig. 1, and *Muscicapa*, Plate LII. fig. 9). The whole skull, although very delicate, is much less so than in the last, and approaches that of the Warblers in general and the Flycatchers in particular. The free anterior margin of the basitemporal (Plate LIII. figs. 3, 4, *b.t*) is tridentate; but, what is of more importance, the basipterygoids break out again as small spines on the base of the parasphenoid (*pa.s*, *b.pg*).

The pterygoids (*pg*) are shortish, rather stout, and carinate on the bowed outer margin; they are confluent by their laminar anterior "foot" with the palatine and mesopterygoid (*pt.pa*, *ms.pg*). The latter parts agree with the same in *Nectarophila*, but are stouter; and the whole interpalatine angle is bevelled off, showing the ethmo-palatine shell, to which the vomerine crus, which is short, is *articulated*. The transverse isthmus of the palatine is wider than in the last instance, and the transpalatine (*t.pa*) is intermediate between that of *Nectarophila* and *Lalage*; the præpalatine bar (*pr.pa*) is thicker than in the last instance, and more outbowed. Between these bars there is a triangular tongue of bone proceeding from the præmaxillary, the palatal processes of which are not distinct from the præpalatines.

The maxillary and maxillo-palatine processes (*mx*, *mx.p*) are like those of *Nectarophila*; and so also is the vomer, save that it has shorter crura both behind and in front, these latter being broader also. Here also things are reversed; for the vomerine crura are not ankylosed to the ethmo-palatal coil, whilst the pterygoids are to the postpalatal plate. The small, soft, and not deep septum nasi and the turbinals agree with the last; so also does the swollen ecto-ethmoidal mass on the whole; but in *Anthreptes* there is a small conical lacrymal, sticking like a limpet to part of the massive ecto-ethmoid (fig. 6, *l*, *e.eth*).

Below, on the foot-like base of the pars plana, there is an elegant oval mass of bone semidistinct from its root; this is the "os uncinatum" (fig. 6, *p. p*, *o. u*). The septum of the orbits is largely membranous; the perpendicular ethmoid (*p. e*) sends a frail bar back into the præsphenoid, which has no wings and only a small descending process; in this these two Nectariniidæ agree closely.

The rest of the skull in both these types is but little different from that of any ordinary soft-billed songster; to know one is to know all; and I have carefully chosen the parts for description in which the specialization is most marked.

In my former part (pl. liv. figs. 1–13) I gave two instances (in one family) of a type in which we were able to see Ægithognathism begin. It was acknowledged candidly that the space between that type (*Turnix*) and the lowest of the Passerines was very great; yet these birds, so few steps above the Ratitæ, were found to have several most marked and unmistakable points of agreement with the Passerines.

The same friend to whom I owe the adult Hemipod, viz. Osbert Salvin, Esq., F.R.S., has kindly supplied me with three entire skeletons of that remarkable Chilian bird, *Thinocorus rumicivorus*.

As to its skeleton generally, this bird is, broadly speaking, a Plover; but its skull forbids it being placed with the true "Charadriomorphæ." I rather incline to add it and some others to the "Geranomorphæ;" that can be done without calling it a Crane, which would be absurd if the term were applied strictly in a zoological sense.

Example 70. Skull of *Thinocorus rumicivorus*[1]. Family Thinocoridæ. Suborder Geranomorphæ.

Habitat. Chili.

This bird, no larger than a Dottrel Plover, has combined in its face several of the characters of other groups, viz. the Dromæognathæ, Schizognathæ, and Ægithognathæ; it is therefore not surprising that in seeking for its place in nature some difficulty was felt. In its body there is little difficulty: it is a Pluvialine bird, clearly; the whole form, texture, and condition of the bones put this into light at once; and, although it has only one pair of emarginations on the hinder part of the sternum, it is not alone in having that character; for it agrees thus with the Parridæ and with the common Snipe (*Scolopax gallinago*).

Professor Huxley's description of the Dromæognathous palate of the Tinamou is as follows. "It has," says he, "a completely Struthious palate. In fact, the vomer is very broad, and in front unites with the broad maxillo-palatine plates, as in *Dromæus*, while behind it receives the posterior extremities of the palatines and the anterior end of the pterygoid bones, which are thus prevented, as in the Ratitæ, from entering into any extensive articulation with the basisphenoidal rostrum" (P. Z. S. 1867, pp. 425, 426).

This matter will be best understood by reference to the morphology of the palate. It is characteristic of the Carinatæ, in which the original parts are metamorphosed to their uttermost, that those palatine productions of the mandibular arch, the pterygo-palatine bars, should approximate beneath the great trabecular beam. In most cases they meet and unite by strong ligaments gliding beneath the fused elements of the trabeculæ: in some, as Storks, Pelicans, &c., they coalesce extensively beneath that beam; and in others a key-stone piece or commissural element is formed. This latter condition may be due to the fusion of a pair of ossifications (mesopterygoids), as in the Barn Owl; or it may be a primarily azygous bone, as in Woodpeckers, or there may be a fore and

[1] See Garrod on *Attagis*, P. Z. S. 1877, pp. 413–418.

hinder median piece, as in *Podargus* and *Caprimulgus*: when truly azygous it is called here the *medio-palatine*.

Now this difference does not depend upon the narrowness or breadth of the face. The frog-like face of *Podargus* yields the most perfect typical instance of the Carinate type of palate, whilst the delicate attenuated skull of the Sun-Bittern (*Eurypyga helias*) has its parasphenoid exposed along almost the whole extent of the palate.

To one who is familiar with the structure of the skull and its development in the lower types—Fishes, Amphibia, Reptiles—this is full of meaning. The skull of the Ratitæ is rich in even *Batrachian* characters; and the one under consideration, that of *Thinocorus*, is being read off by me, whilst writing, in the light of that of *Testudo græca*.

I look upon Professor Huxley's Geranomorphæ (Cranes and Rails, P. Z. S. 1867, p. 457) as a great side branch of the Pluvialine stock, and not arising at any great height above the Tinamidæ; one of them (*Psophia*) retains the bony superorbitals of the Tinamou.

I have hunted up every type of skull, available, in this family. The one most to my purpose to compare with the small skull of *Thinocorus* was found to be that of the Stanley Crane (*Anthropoides stanleyanus*)[1]—a bird of stature, and of the seed of the giants.

This type, next to *Thinocorus*, has the palatines widest apart; next to it comes *Eurypyga*, and next to that the Weka Rail (*Ocydromus australis*). In the gigantic extinct Rail (*Aptornis defossor*, Owen) the parasphenoid is very narrow, and the palatines as much approximated as in the living Rallidæ generally. (See Trans. Zool. Soc. vol. iii. pl. lii. fig. 3, a paper read on January 11th, 1848, where this bird is described as *Dinornis casuarinus*, Ow.; and ibid. vol. vii., Jan. 1871, pl. xl. fig. 3, where this bird is termed *Aptornis defossor*, Ow.).

There are two characteristics in the adult *Thinocorus* which separate it from the ordinary Pluvialine types (Charadriomorphæ), namely:—the arrest of the basipterygoids[2]; and the absence of the lateral occipital fontanelles—vacuities shared by the Plover with the Goose tribe, but absent even in the young of the Rails, and very variable in the Gruidæ. The small azygous occipital fontanelle of the Pigeon, which is variably closed-in in the Sand-Grouse and Hemipods, is in *Thinocorus* wholly unenclosed, as in the feebler forms of Plover—the foramen magnum being pear-shaped, and the narrow upper part being due to deficient chondrification in the embryo.

In conformity with this divergence from the true Plovers, there is also the abortion of the inner notches on the posterior margin of the sternum. In *Eurypyga* they are almost suppressed, in the Rallidæ quite; whilst in the Cranes, in *Psophia*, and in the Kagu there are no distinct notches whatever, external or internal.

In some things, as I shall show, *Thinocorus* approaches the Hemipods; with Quails

[1] The gift of Dr. Murie.

[2] These are also aborted in *Œdicnemus* and *Otis*.

it has the remotest relationship; it eliminates itself from the typical Pluvialines or Charadriomorphæ; and there is no place for it, save within the bounds of Professor Huxley's group the "Geranomorphæ," wisely made sufficiently elastic to embrace the Cranes and the Rails. If the characters given of that group do not wholly correspond to, or are not general enough to embrace this type, they must be modified so as to be fit to receive this new subfamily; for this is a type quite distinct and special as compared with the other Geranomorphs, and as worthy of family leadership as the Rail, which has so many living congeners, and does not stand alone (or nearly alone)[1] like *Thinocorus*.

The occipital condyle (Plate LIV. fig. 1, *oc. c*) is somewhat ovoidal, the antero-posterior diameter being slightly longer than the transverse, unlike that of the Crane (fig. 6, *oc. c*), which is transversely bilobate, as in Fowls and Geese; *Thinocorus* here agrees with the Tinamou, the Hemipod, and the Plover. The broad two-lipped basitemporal plate (*b.t*) sends an ear-shaped process round each "internal carotid" (*i. c*); these processes extend a little further outwards than the tympanic wings of the basisphenoid above, which wings form the trumpet-shaped anterior tympanic recesses (*a. t. r*). At the mid line the basisphenoid is scooped for the opening of the Eustachian tubes; and between this fossa and the outer wing the bone sends out a slightly winged ridge, the only remnant of the basipterygoid processes (*b.pg*), the absence of which, in the adult, suggests that this bird belongs to the Gruines and not to the Pluvialines proper; this is in strong and sharp contrast with those characters in it which, without controversy, are essentially Struthious. These marginal wings and the submarginal ridges were, at first, modelled on the apices of the trabeculæ, which run backwards, embracing the whole lateral pituitary region (see 'Fowl's Skull,' pl. lxxxii. figs. 1–3, *lg*). The massive beam which the parasphenoid and coalesced trabeculæ together form beneath the interorbital septum in *Struthio camelus* (see 'Ostrich's Skull,' pls. viii. & ix. figs. 2 & 10, but still better seen in the adult skull, see Huxley, P. Z. S. 1867, p. 420, fig. 1) is here (figs. 1 & 2, *pa.s*) outrivalled; and the foremost undersetter, the vomer (*v*), has the same relative expansion and size. The parasphenoid is truly azygous (with symmetrical detached "basitemporal" wings behind); but the vomer was two broadish splints at first. I have drawn it from *three* individuals (figs. 1–3, *v*); and as the parasphenoid is a spongy pneumatic mass, so also does the vomer become a collection of bony air-cells.

In fig. 2, evidently the oldest individual, and having the largest vomer, this bone has a quaint but real resemblance to four chambers of a flat Polyzoon (*Lepralia* or *Membranipora*), having two pairs of air-passages beneath—a pair on each side of the obtuse median keel. Behind, the bone displays its primary symmetry by sending backwards a pair of thin bluntly triangular flaps, the outer margin being notched, where they begin,

[1] I have not yet had an opportunity of studying the osteology of *Attagis*, which, Mr. Salvin informs me, is its nearest congener; see, however, Prof. Garrod's paper on this type, above referred to.

for the setting-on of those small blunt hooks, the ethmo-palatines (*e.pa*). In front the vomer gradually, by steps as it were, being somewhat notched, narrows in; and the actual fore end may be rounded (fig. 2, *v*) or slightly emarginate (fig. 3, *v*). On each side of the fore end there is an oblique shoulder, thickened like the keel and the margins; to this shoulder is fastened the inturned alinasal lamina (*i. al*), the extremity of the alinasal floor (*n. f*); it is attached like a *splint* to the under surface of the cartilage, but is not *grafted* upon it.

Here the broad *double* vomer lies, at its fore end, like a floor beneath the contiguous part of the nasal labyrinth. The least overgrowth of this bone would have produced that remarkable character which is seen in the Passerines. The process is arrested; but the elements are in immediate contact.

Thinocorus, however, fails in one point, viz. that it has no additional "septo-maxillaries" at this part, which are seen in the Turnicidæ and commonly in the Passerinæ; but in the higher forms of that topmost group they are frequently suppressed. The vomerine cartilages, or *labials*, are not seen in the adult; they may have existed in an early stage. The nasal labyrinth approaches that of the Turnicidæ; the parts are totally unossified (walls, coils, and septum). The inferior turbinal (fig. 4, *i. tb*) is coiled once and a half; it is thus inferior to that of the Gallinaceæ and of Carinate birds generally, but comes nearer to the state of those parts in the Turnicidæ. As in those birds, there is a nasal floor of cartilage; but *here* it is continuous, and not a long severed band. The præmaxillary mass (fig. 5, *px*) is very unlike what obtains in the birds that come nearest to this; it is short, high, triangular, and very strong, quite unlike that of a Plover, a Crane, or a Rail, stronger and higher than in the Gallinaceæ, and wholly unlike their bony beak in the intense ankylosis by which maxillaries, præmaxillaries, and palatines are all welded together into one strong mass, the seams of which are all lost. Indeed the beak in this bird is intermediate between that of the conirostral Finch and the *curvirostral* Fowl. Here I will enumerate the points of harmony between this *almost undeclared* type and the Coracomorphæ:—

1. It is Ægithognathous (*imperfectly*).
2. The bill is nearly conirostral.
3. The basipterygoids are more thoroughly suppressed than in any birds except the Coracomorphæ.
4. The lacrymal is abortively developed; it is very small.
5. The ecto-ethmoidal wall projects beyond the frontal roof, is flush with the rest of the face, and is highly ossified (fig. 5, *eth*, *p. p*).
6. The space between the forks of the nasal, instead of being a clear slit as in the

great Pluvialine group, or a rounded notch as in the Passerines and Gallinaceæ proper, is exactly intermediate, being lanceolate. It agrees very closely in this respect with the small *Hemipodius* already described by me (Trans. Zool. Soc. vol. v. pl. xxxiv. fig. 3).

7. The bevelled shoulders of the vomer articulate with the maxillo-palatines, as in the Cotingidæ and Formicariidæ.

8. It agrees with *Hyloterpe*, *Pachycephala*, and *Cypselus* in its "os uncinatum." It also agrees with the Hemipods in showing part of the bony ethmoidal plate (fig. 5, *e.eth*) between the forks of the nasal, but not to the same extent—not as a swollen mass, but as a thin lamina, as in those birds generally that have the nasal notch sharp.

Pigeons, birds that stand immediately above Sand-Grouse and Plovers, and, although of a higher type, are almost equally related to both those groups, have the same structure [1].

The narrow frontal region between the eyes is deeply sulcate above; but the Gallinaceous value of this character is immediately annulled by the presence of very distinct super- and postorbital fossæ for the nasal glands: in this thing it is contrary to the Fowl tribe. The structure of the interorbital space, præsphenoid, orbitosphenoid, and pars perpendicularis (*p.s*, *o.s*, *pe*) is in perfect harmony with the Gruinæ and Pluvialine types of skull.

But there is one thing in the relation of the lateral ethmoid to the palatine which corresponds with that of both the Cuculinæ and of certain *Notogæal* Passerines: a "pars uncinata," like a small nipple, projects forwards and outwards close in front of the feeble ascending ethmo-palatine spur (fig. 5, *o.u*, *e.pa*). This, to one familiar with the development of the Batrachian skull, is most interesting; and the two converging points are the elements of the primordial commissure between the trabeculæ and the pterygo-palatine portion of the mandibular arch. This is the more noteworthy as being in unison with the huge dilated vomerine and parasphenoidal bars, and the distance between the pterygo-palatines.

The relative feebleness of these bars is remarkable (fig. 1, *pa*, *pg*); but they are truly ornithic and quite Gruine (see also fig. 6). The extreme shortness of the pterygoids as compared with the palatines is almost an exaggeration of that which is normal in Carinate birds. But the pterygoid of *Thinocorus* has become less than half its original length by metamorphosis; it originally reached the vomer; and the new segment (mesopterygoid, *ms.pg*) has coalesced with the palatine.

[1] I mention this to remind the reader how near some of the "Altrices" are to certain "Præcoces," and as an apology for any attempt to trace the Passerine *rhizome*.

The epipterygoid process (*e.pg*) is a mere auriform projection, as in the Crane (fig. 6); the shaft of the bone is carinate, and the palatine end bilobate.

The palatines (figs. 2 & 5, *pa*) are higher, where they ascend to the pars plana, than broad; they are elegantly bowed out behind, and, indeed, have altogether an undulating outline. Every curve and ridge and process corresponds with what is seen in *Anthropoïdes* (fig. 6): in each case these bones diverge to join the pterygoids, arch outwards external to the interpalatine and ethmo-palatine spurs (*i.pa*, *e.pa*), converge where they form a floor to the maxillo-palatine plates (*mx.p*), and are again gently arched outwards where they carry the alinasal cartilages (*al. n*); in front they have been affected by the intense ossification of the entire beak.

The solid dentary angle of the præmaxillary (*d.px*) has become completely fused with the outer part of the maxillary (*mx*); and its jugal process has coalesced largely with the jugal and quadrato-jugals (*j*, *q.j*); their line of junction can, however, be seen. The maxillo-palatine plates (*mx.p*) are short, broad, and ear-shaped—quite normal for a Pluvialine bird in general, or for a Gruine bird in particular; their distance from each other, as compared with those of the Crane (fig. 6), depends upon the size of the intervening vomer, with the bevelled shoulders of which they articulate, as in many of the lower types of South-American Passerinæ.

The quadrate is that of a Crane; the upper and lower otic processes are divergent and very distinct, wholly unlike those of a Fowl, in which the *prootic facet* (lower head) is a mere patch of articular cartilage inside the single rounded head or upper process.

The free fore-turned "pedicle," or orbital process, is true to the Gruine type, being broad-ended and ear-shaped.

The mandible has some Gallinaceous characters, which might beguile a hasty observer: the ramus is high and has a large double fenestra; the symphysis is short and strong; and the posterior and internal angular processes are longer than is normal in a Pluvialine bird; they thus approach those of a Fowl.

APPENDIX TO THE DESCRIPTION OF THE ÆGITHOGNATHÆ.

1. The Skull of Anthropoïdes stanleyanus.

I have already described the palate of this species with that of *Thinocorus*, and need now only refer the reader again to the figures of these two types, so diverse in outward form, so distinct from each other in mere detail, and yet on the whole so incontestably related and alike in all essentials.

The mere size and the breadth or narrowness of the various bones are things of but little importance in the presence of so much that is harmonious.

As a stand-point for comparison, this typical Crane's palate is of the utmost importance if the form next to be described is to be truly interpreted.

2. On the Skull of the Sun-Bittern (Eurypyga helias).

The familiar term for this bird might serve as a text to show how completely the outward observation of a bird fails, in many cases, to give a clear insight into its nature. And yet this is, as it were, a Bittern-Crane; a thin partition divides it from the Bitterns, although it is not a desmognathous Pelargomorph, but a schizognathous Geranomorph.

A thorough analysis of the trunk, and, indeed, of all the rest of its body, would be found to harmonize with what we see in the head.

This bird is one of those very teaching forms which, while ascending in certain things above its own family, also descends in others, and shows its close affinity to simpler types; it is at once higher and lower than a typical Crane. In the abortion of the præsphenoidal bar it comes close to *Himantopus*; but that character also occurs in *Phalacrocorax* amongst the Pelecanine types. This is a rare thing in the class; for, as a rule, if even the orbito-sphenoids are suppressed, the præsphenoid runs back from the upper process of the perpendicular ethmoid, partly dividing the great postorbital fenestra of the skull where the hemispheres and olfactory crura are tilted up and lie on a shelving floor, most of which is mere membrane.

The Pluvialine birds are very apt to have this deficiency of bone, through the abortion of the orbito-sphenoids and arrest of the orbital plates of the frontals. Also, beneath, the large optic foramina are only divided from each other by a membranous band; and, altogether, the huge size of the eyes, and their close packing towards the mid line, seem to have caused this arrest of bony growth.

In the adult *Eurypyga* there is no appearance of lateral occipital fontanelles; and they seem to have been a mere chink in the embryo: this is at once a sign of something either Ralline or Ardeine. The occipital condyle (Plate LIV. fig. 7, *oc. c*) is also largest transversely and notched as in both Gruinæ and Ardeinæ. The elegantly small basitemporal plate (*b.t*) shows also its affinity to the Bitterns; yet it agrees in form with that of the Crane. As is the rule in the Geranomorphæ, the basipterygoids are merely represented in the adult by a small ridge. The parasphenoid is rather bulky for so delicate a skull; and the palatines do not meet beneath it: its fore end runs forwards like a prow beneath the cranio-facial notch; and this projection is lodged in the bottom of the vomerine groove. The vomer itself (figs. 7–9, *v*) is perhaps the most elegant and attenuated of any in the entire class, although it is a double bone. It is much more delicate than that of the Humming-bird (Trans. Linn. Soc. ser. 2, Zool. vol. i. pl. 22. fig. 3), and, strange to say, agrees with its Trochilian counterpart

in having a septo-maxillary on each side above the edge of the bone at its middle (fig. 9, *s.mx*)[1].

The forks of the Sun-Bittern's vomer are large and divergent; they combine in front to form a rounded keel, which dies out where the bone suddenly narrows; it broadens in a lanceolate manner again, and then ends in a long bony needle in front. The whole fore beak is quite like that of *Anthropoides*, and very much unlike the very bony and solid beak of a Pelargomorph, even of the frailest kinds, viz. *Botaurus viridis*, *Ardea garzetta*. Indeed the wall between the Charadriomorphæ and the Geranomorphæ is very thin; and if the latter are not *special*, yet they are *general* Pluvialines (see Huxley "on the Classification of Birds," Proc. Zool. Soc. 1867, p. 457).

The palatines, like those of the Kagu (Trans. Zool. Soc. vol. vi. pl. xcii. fig. 2), are truly Ardeine; in the Stilt-Plover (*Himantopus*) the transpalatine angle is considerably produced; but it is in the true Ardeines, and in *Eurypyga* and the Kagu, that this is most intense. Here the *trans*- and *post*palatines end opposite each other; in Passerines the external process is a good distance in front of the postpalatine end.

Another point of structure is seen in this type: there is a "palatal fenestra" (*pa. f*). It is a membranous space tending to divide the proper palatine bar from the "os transversum," or transpalatine, which it does imperfectly. This structure has its highest development in the Tiger Bittern, *Tigrisoma leucolophum*, a very *Mycterian* Bittern. But this structure also occurs *down below* in a simple Pluvialine, namely the Whimbrel (*Numenius phæopus*).

The interpalatine ridges, the external sharp edge, and the intermediate deep muscular space are well shown here, as in the Kagu and the Ardeines; the præpalatine bar (*pr.pa*) is very long and slender.

Above, where the slender maxillary is giving off its elegant crested maxillo-palatines, there is an ear-shaped process looking inwards from the bone, as in *Rhinochetus* and *Psophia*, which process I took erroneously for a "septo-maxillary" snag. The maxillo-palatines show but little mesiad of the palatine bars; but above they are each developed into a most elegant flask-shaped air-pouch, which opens in front.

The sutures of the jugal bar (fig. 7) are nearly filled in; the base of the nasal crus and the angle of the præmaxillary both grow backwards as needle-like styles.

The upper part of the head is Ardeine. In *Anthropoides* and the Rails the superorbital edge is bevelled for the nasal gland; in *Eurypyga*, as in the Kagu and Heron, not at all, the edges of the orbit being well produced upwards and outwards, especially in the huge-eyed Kagu.

The septum nasi is ossified, and has a large fenestra in front; it is, however, Ardeine,

[1] In my paper on the Kagu (Trans. Zool. Soc. vol. vi. p. 502) I have spoken of the septo-maxillary as a *region* of the maxillary, a mere process: this is a mistake. For many years I searched in vain for any distinct rudiment of those reptilian bones; but although they are absent in many birds, they are common amongst the Passerines, as I have lately shown, and turn up in other groups.

and a little more bony development would have made both this bird and the Kagu "indirectly desmognathous." The mandible of the Sun-Bittern is a mere miniature of that of *Anthropoides* and *Rhinochetus* (Trans. Zool. Soc. vol. vi. pl. xci. fig. 1, & pl. xcii. figs. 1*a* & 3*a*).

I would suggest that here be facts helpful towards a fuller conception of the "Geranomorphæ," an enlargement of the borders of that very natural group, and at the same time a breaking down of every thing save most frail palings between that group and the more highly specialized Pelargomorphs, above, and the more simple and general Charadriomorphs, below.

Also let it be considered that I have but dug a little about the roots of the group, not doing any *final* work, but rather showing to a coming generation where the spade is to be applied.

If it were permitted me to lend a helping hand to those before whose eyes and for whose inspection the endless forms of birds have been marshalled, I would suggest such a scheme as the following for the Geranomorphæ:—

1*a*. Typical Cranes, or those with the fullest degree of specialization.

Example. *Grus anthropoides*.

1*b*. Subtypical Cranes, less modified.

Example. *Balearica*.

2. Ralline Cranes with a Tinamine character, *e.g.* the bony superorbitals.

Example. *Psophia*.

3. Ardeine Cranes with an almost Struthious sternum and a skull approaching *Nycticorax*.

Example. *Rhinochetus*.

4. Ardeine Cranes with same Pluvialine characters, but leaning most to *Botaurus*.

Example. *Eurypyga*.

5. Pluvialine birds with *Gruine* characters, mixed with what is seen in the Dromæognathæ and Ægithognathæ.

Examples. *Thinocorus*, *Attagis*.

6. The Rails.

There would be, in short, subdivisions of the Geranomorphæ under the following names:—

1. Gruidæ.
   - 1*a*. Gruinæ.
   - 1*b*. Balearicinæ.
2. Psophiidæ.

3. Rhinochetidæ.
4. Eurypygidæ.
5. Thinocoridæ.
6. Rallidæ.

The four groups from 2 to 5, inclusive, are truly *Notogæan*, the territory of ancient types, and for the most part only exist as a single genus or even species.

Concluding Remarks.

Believing, as I do, that all safe and true classification of organic types must be based upon a knowledge of their development, I have availed myself of every opportunity for research of this kind, in this class above all other.

Confessedly imperfect, and dealing with but a tract of the skeletal structures, I yet hope to find that these papers may be of *immediate* use to the ornithologist.

Labouring not at ornithology proper, and often painfully ignorant of the labours of the great leaders in that branch of science, I unconsciously use their terms, at times, in a sense different from that which they intend these terms to have.

Thus the Plover (*Pluvialis*) yields me the adjective *Pluvialine*; but whilst I use it often in a very *general* sense as giving expression to a form having a very wide distribution in the class, the ornithologist is thinking of the Plovers proper, only of a restricted group; he fits it accurately to his *Charadrian* norma.

I find that, already, the term *Ægithognathæ* is received as the equivalent of *Coracomorphæ*; and so, because I assert that Nature has given *Turnix* and *Thinocorus* an imperfectly Ægithognathous palate, I am accused of placing these birds with the Passerines. What is stated is this—namely, that these *low generalized* birds have taken on the earlier metamorphic changes by which in much more specialized types, by further metamorphosis, we obtain the true Passerine palate.

Exposing myself still further to criticism, I also show that the *raw material* for the Ægithognathous face, in the highest types, exists in a much lower bird, namely the *Rhea*, and that, still lower down, Reptiles, Amphibia, and various orders of Fishes possess the "homologues" of those morphological elements that become "as clay in the hands of the potter" when a singing-bird's face has to be developed.

Nevertheless, supposing that the framework of modern ornithology is made to shake when we find those explosive materials, *generalized types*, lying below our neat and snug "families," shall we on that account surcease from such research? I think not.

Index to Species referred to in this and former Memoir [1].

Name.	Vol.	Page.	Plate.	Figure.	Habitat.	Family.
Turnix rostrata	IX.	294.	LIV.	1–8.	Formosa.	Turnicidæ.
Hemipodius varius	„	294.	„	9–13.	Australia.	„
Corvus frugilegus	„	300.	LV.	1–6.	Great Britain.	Corvidæ.
„ corone	„	303.	„	7–9*a*.	„	„
Fregilus graculus	„	304.	„	10–12.	„	„
Ruticilla phœnicurus	„	304.	„	13.	„	Sylviidæ.
Menura superba	„	306.	LVI.	1–5.	Australia.	Menuridæ.
Pitta melanocephala	„	314.	„	6, 7.	Borneo.	Pittidæ.
Grallaria squamigera	„	315.	„	8–10.	Andes of Columbia.	Formicariidæ.
Pipra auricapilla	„	309.	LVII.	1–3.	Guiana.	Cotingidæ.
Pachyrhamphus, sp.?	„	310.	„	4–7.	„	„
Thamnophilus doliatus	„	312.	„	8–10.	„	Formicariidæ.
Artamus leucorhinus	„	317.	LVIII.	1, 2.	Celebes.	Artamidæ.
Hyloterpe sulfuriventer	„	328.	„	3, 4.	„	Sylviidæ.
Dicrurus leucops	„	333.	„	5, 6.	„	„
Enodes erythrophrys	„	334.	„	7, 8.	„	Sturnidæ.
Trichastoma celebense	„	335.	„	9.	„	Sylviidæ.
Dendrocolaptes albicollis	„	319.	LIX.	1–3.	Brazil.	Dendrocolaptidæ.
Anæretes parulus	„	320.	„	4, 5.	Chili.	Tyrannidæ.
Synallaxis flavigularis	„	321.	„	6–8.	„	Dendrocolaptidæ.
Muscisaxicola mentalis	„	323.	„	9, 10.	„	Tyrannidæ.
Homorus unicolor	„	323.	LX.	1–4.	Mendoza, La Plata.	Dendrocolaptidæ.
Gymnorhina tibicen	„	325.	„	5–8.	Australia.	Gymnorhinidæ.
Petroica monticola	„	337.	„	9.	„	Muscicapidæ.
„ bicolor	„	337.	„	10.	„	„
Elainea, sp.?	„	330.	LXI.	1, 2.	Barbadoes.	Tyrannidæ.
Lanius collurio	„	331.	„	3–6.	Great Britain.	Laniidæ.
Pachycephala fusca (?)	„	338.	„	7, 8.	Australia.	„
Lalage leucopygialis	„	335.	LXII.	1, 1*a*.	Celebes.	Muscicapidæ.
Paradisea papuana	„	339.	„	2–4.	New Guinea.	Paradiseidæ.
Chasmorhynchus nudicollis	„	341.	„	5–8.	Brazil.	Cotingidæ.
Tanagra cyanoptera	X.	252.	XLVI.	1, 2.	South America.	Tanagridæ.
Euphonia violacea	„	253.	„	3.	„	„
Stephanophorus leucocephalus	„	253.	„	4.	Brazil.	„
Pyranga rubra	„	254.	„	5.	South America.	„
Prionocheilus aureolimbatus	„	254.	„	6, 7.	Celebes.	Nectariniidæ.
Phytotoma rara	„	255.	„	8–10.	Chili.	Phytotomidæ.
Acanthorhynchus tenuirostris	„	258.	XLVII.	1, 2.	Australia.	Meliphagidæ.
Ptilotis, sp.?	„	260.	„	3, 4.	„	„
Sericornis humilis	„	261.	„	5.	„	Sylviidæ.
Sittella, sp.?	„	262.	„	6.	„	Paridæ.
Dendrœca pennsylvanica	„	263.	XLVIII.	1.	Panama.	Mniotiltidæ.
Mniotilta varia	„	263.	„	2.	„	„
Geothlypis trichas	„	264.	„	3.	Central America.	„
Chlorophanes atricapilla	„	264.	„	4.	Barbadoes.	Cœrebidæ.
Vireosylvia olivacea	„	264.	„	5, 6.	Panama.	Vireonidæ.
Cardinalis virginianus	„	265.	„	7, 8.	Virginia.	Emberizidæ.
Icterus, sp.?	„	266.	XLIX.	1.	South America.	Icteridæ.
„ vulgaris	„	268.	„	2, 3.	„	„
Sturnella militaris	„	268.	„	4.	Chili.	„
Emberiza miliaria	„	269.	„	5.	Great Britain.	Emberizidæ.
Plectrophanes nivalis	„	270.	„	6.	„	„
Emberiza citrinella	„	269.	„	7.	„	„
Phrygilus fruticeti	„	270.	„	8, 9.	Chili.	„
Coccothraustes vulgaris	„	272.	L.	1–3.	Great Britain.	Fringillidæ.

[1] See Trans. Zool. Soc. vol. ix. pt. 5, pp. 289–352, pls. liv.–lxii.

INDEX TO SPECIES REFERRED TO IN THIS AND FORMER MEMOIR—(*continued*).

Name.	Vol.	Page.	Plate.	Figure.	Habitat.	Family.
Estrelda astrild	X.	274.	L.	4–6.	South Africa.	Ploceidæ.
Linaria chloris	,,	275.	,,	7, 8.	Great Britain.	Fringillidæ.
Alauda arvensis	,,	276.	,,	9, 10.	,,	Alaudidæ.
Parus ater	,,	277.	LI.	1.	,,	Paridæ.
,, major	,,	279.	,,	2.	,,	,,
Suthora bulomachus	,,	280.	,,	3, 4.	Amoy, 24° 30′ N. lat.	Suthoridæ.
Cyclorhis, sp.?	,,	282.	,,	5, 6.	Bahia, Brazil.	Vireonidæ.
Sitta europæa	,,	284.	,,	7.	Great Britain.	Paridæ.
Panurus biarmicus	,,	285.	,,	8, 9.	,,	Panuridæ.
Cypselus apus	,,	295.	LII.	1–3.	,,	Cypselidæ.
Chelidon urbica	,,	293.	,,	4, 5.	,,	Hirundinidæ.
Oriolus galbula	,,	290.	,,	6, 7.	North America.	Oriolidæ.
Motacilla yarrelli	,,	289.	,,	8, 8 A.	Great Britain.	Motacillidæ.
Budytes rayi	,,	290.	,,	8 B.	,,	,,
Muscicapa grisola	,,	291.	,,	9.	,,	Muscicapidæ.
Liothrix, sp.?	,,	288.	,,	10.	Indian region.	Liotrichidæ.
Pratincola rubetra	,,	289.	,,	11.	Great Britain.	Saxicolidæ.
Nectarophila grayi	,,	298.	LIII.	1, 2.	Celebes.	Nectariniidæ.
Anthreptes malaccensis	,,	300.	,,	3–6.	,,	,,
Thinocorus rumicivorus	,,	301.	LIV.	1–5.	Chili.	Thinocoridæ.

DESCRIPTION OF THE PLATES.

PLATE XLVI.

Fig. 1. Palate of *Tanagra cyanoptera*, × $3\frac{1}{3}$ diameters.
Fig. 2. Side view of part of face of ditto, × $3\frac{1}{2}$ diam.
Fig. 3. Palate (part) of *Euphonia violacea*, × 10 diam.
Fig. 4. Palate (part) of *Stephanophorus leucocephalus*, × 7 diam.
Fig. 5. Palate (part) of *Pyranga rubra*, × 7 diam.
Fig. 6. Palate (part) of *Prionochilus aureolimbatus*, × 12 diam.
Fig. 7. Side view of part of face of ditto, × 12 diam.
Fig. 8. Palate of *Phytotoma rara*, × $3\frac{1}{3}$ diam.
Fig. 9. Part of same view, × 10 diam.
Fig. 10. Side view of face of ditto, × 5 diam.

PLATE XLVII.

Fig. 1. Palate of *Acanthorhynchus tenuirostris*, × $4\frac{2}{3}$ diam.
Fig. 2. Part of same view, × 10 diam.
Fig. 3. Palate of *Ptilotis*, × $4\frac{2}{3}$ diam.
Fig. 4. Part of same view, × 10 diam.
Fig. 5. Palate of *Sericornis humilis* (?), × $5\frac{1}{3}$ diam.
Fig. 6. Palate (part) of *Sittella*, × 8 diam.

PLATE XLVIII.

Fig. 1. Palate (part) of *Dendræca pennsylvanica*, × 8 diam.
Fig. 2. Palate (part) of *Mniotilta varia*, × 8 diam.
Fig. 3. Palate (part) of *Geothlypis trichas*, × 8 diam.
Fig. 4. Palate (part) of *Chlorophanes atricapilla*, × 10 diam.
Fig. 5. Palate of *Vireosylvia olivacea*, × 6 diam.
Fig. 6. Part of same view, × 8 diam.
Fig. 7. Palate (part) of *Cardinalis virginiana*, × 5⅓ diam.
Fig. 8. The same, seen from above, × 5⅓ diam.

PLATE XLIX.

Fig. 1. Palate (part) of *Icterus* sp. ?, × 8 diam.
Figs. 2, 3. Palate (part) of *Icterus vulgaris*, × 6 diam.
Fig. 4. Face (part of side view) of *Sturnella militaris*, × 5 diam.
Fig. 4 A. Vomer of ditto, × 5 diam.
Fig. 5. Palate (part) of *Emberiza miliaria*, × 7 diam.
Fig. 6. Palate (part) of *Emberiza citrinella*, × 8 diam.
Fig. 7. Palate (part) of *Plectrophanes nivalis*, × 7 diam.
Fig. 8 Palate (part) of *Phrygilus fruticeti*, × 6 diam.
Fig. 9. Vomer of the same, × 12 diam.

PLATE L.

Fig. 1. Palate of *Coccothraustes vulgaris*, × 3 diam.
Fig. 2. Part of same view, × 6 diam.
Fig. 3. Part of side view of same, × 6 diam.
Fig. 4. Palate of *Estrelda astrild*, × 7½ diam.
Fig. 5. The same, from above, × 7½ diam.
Fig. 6. Side view of rostrum of ditto, × 10 diam.
Fig. 7. Palate (part) of *Linaria chloris*, × 8 diam.
Fig. 8. The same, from above, × 8 diam.
Fig. 9. Palate (part) of *Alauda arvensis*, × 7½ diam.
Fig. 10. The same, from above, × 7½ diam.

PLATE LI.

Fig. 1. Palate of *Parus ater*, × 7 diam.
Fig. 1 A. Part of same, side view, × 7 diam.
Fig. 2. Palate (part) of *Parus major*, young, × 7 diam.
Fig. 3. Palate of *Suthora bulomachus*, × 7 diam.

Fig. 4. Side view of face of same, × 4 diam.
Fig. 5. Palate of *Cyclorhis*, × 4 diam.
Fig. 6. Side view of face of same, × 4 diam.
Fig. 7. Palate of *Sitta europæa*, × 5½ diam.
Fig. 8. Palate of *Panurus biarmicus*, × 6¾ diam.
Fig. 9. Side view of face of same, × 6¾ diam.

PLATE LII.

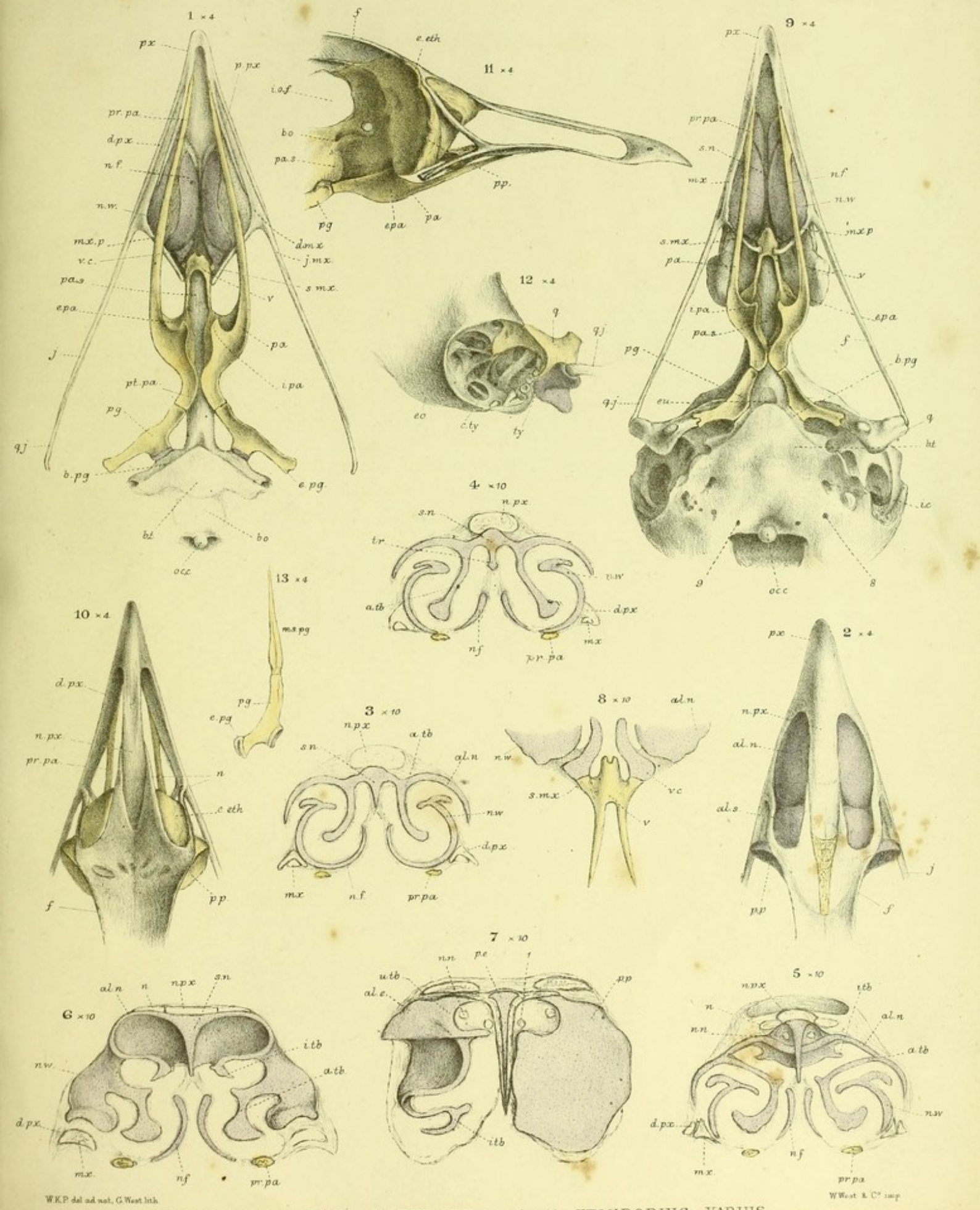
Fig. 1. Palate of *Cypselus apus*, × 4 diam.
Fig. 2. Part of palate of *C. apus*, side view, × 4 diam.
Fig. 3. Part of same as fig. 1, × 5⅓ diam.
Fig. 4. Palate of *Chelidon urbica*, × 5 diam.
Fig. 5. Pterygoid of same, inner view, × 10 diam.
Fig. 6. Palate of *Oriolus galbula*, × 4 diam.
Fig. 7. Part of same, from above, × 6 diam.
Fig. 8. Face (fore part, side view) of *Motacilla yarrelli*, × 5 diam.
Fig. 8 A. Part of same view, × 10 diam.
Fig. 8 B. A similar figure of *Budytes rayi*, × 6⅔ diam.
Fig. 9. Palate (part) of *Muscicapa grisola*, × 7 diam.
Fig. 10. Palate (part) of *Liothrix*, × 4 diam.
Fig. 11. Palate (part) of *Pratincola rubetra*, × 7½ diam.

PLATE LIII.

Fig. 1. Palate of *Nectarophila grayi*, × 6 diam.
Fig. 2. Part of same view, × 12 diam.
Fig. 3. Palate of *Anthreptes malaccensis*, × 5 diam.
Fig. 4. Part of basis cranii of same, × 10 diam.
Fig. 5. Part of palate of same, × 10 diam.
Fig. 6. Side view of face of same, × 5 diam.

PLATE LIV.

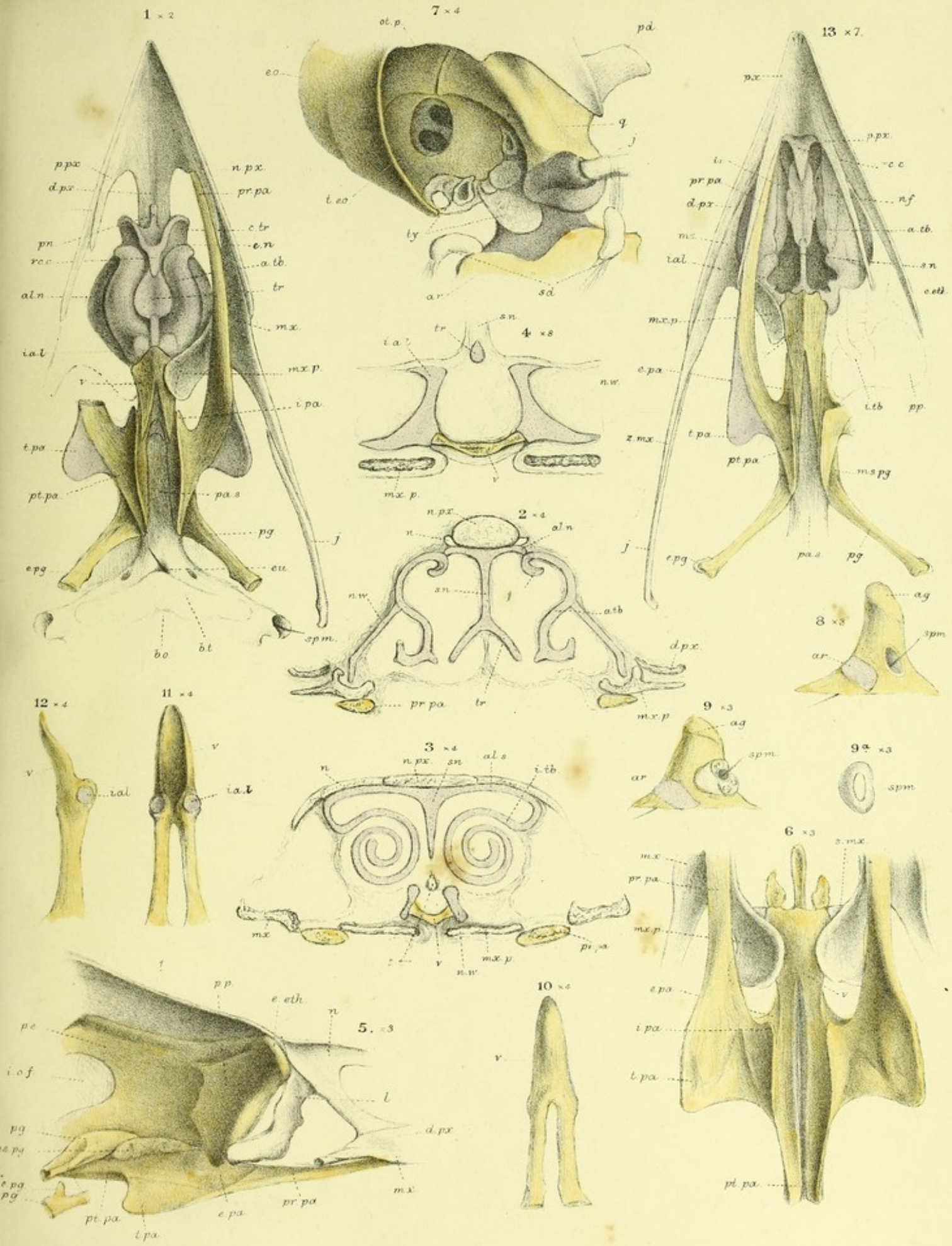
Figs. 1, 2, 3. Palate of *Thinocorus rumicivorus*, × 4 & 6 diam.
Fig. 4. Inner view of "turbinal" of same, × 6 diam.
Fig. 5. Side view of face of same, × 6 diam.
Fig. 6. Palate of *Anthropoides stanleyanus*, nat. size.
Fig. 7. Palate of *Eurypyga helias*, × 2 diam.
Fig. 8. Vomer of same, lower view, × 6 diam.
Fig. 9. The same, side view, × 6 diam.



W.K.P. del ad nat. G.West lith.

W.West & Co.° imp.

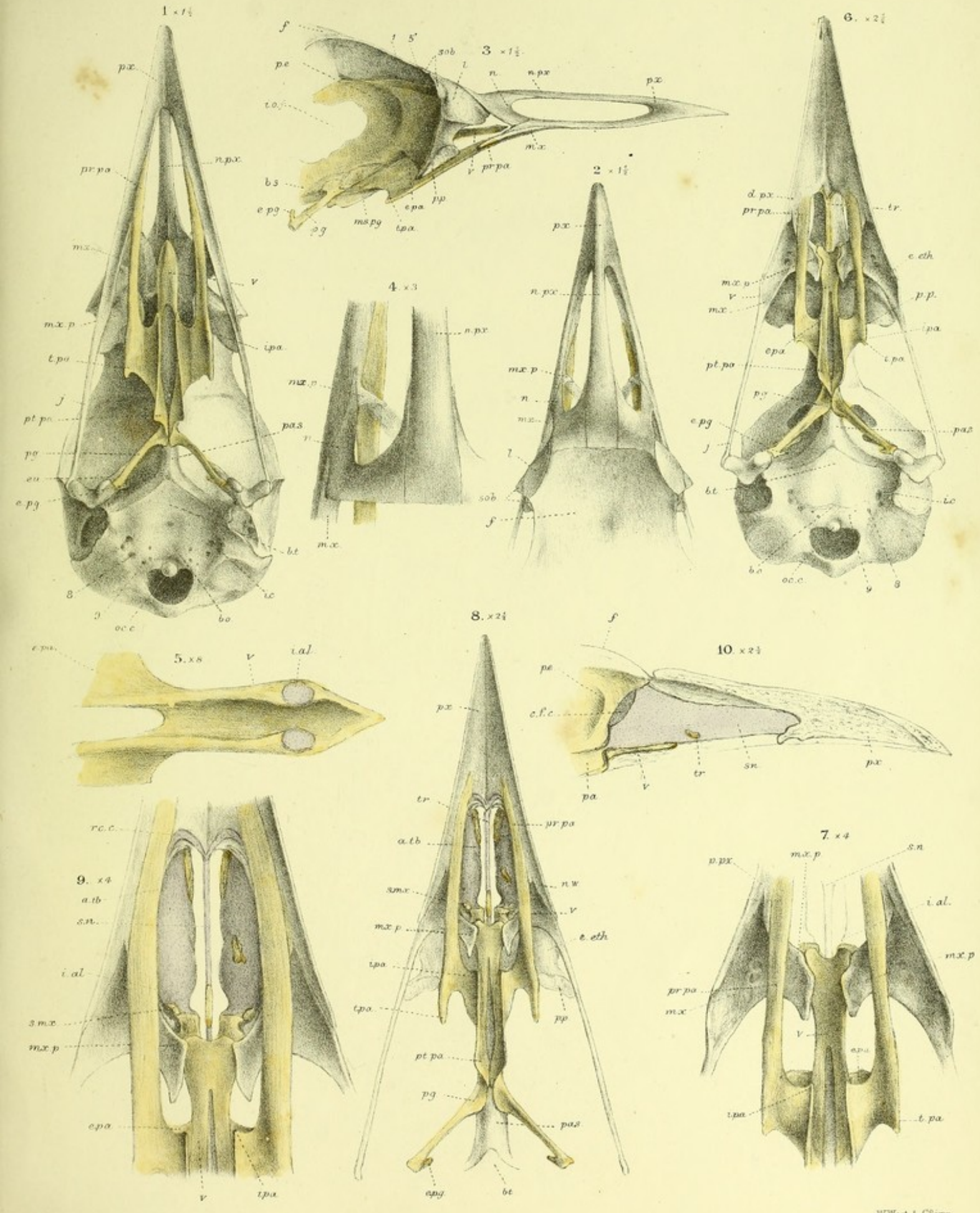
FIGS 1–8. TURNIX ROSTRATUS, 9–13. HEMIPODIUS VARIUS.



W.K.P. del. ad nat. C. West lith.

W. West & Co. imp.

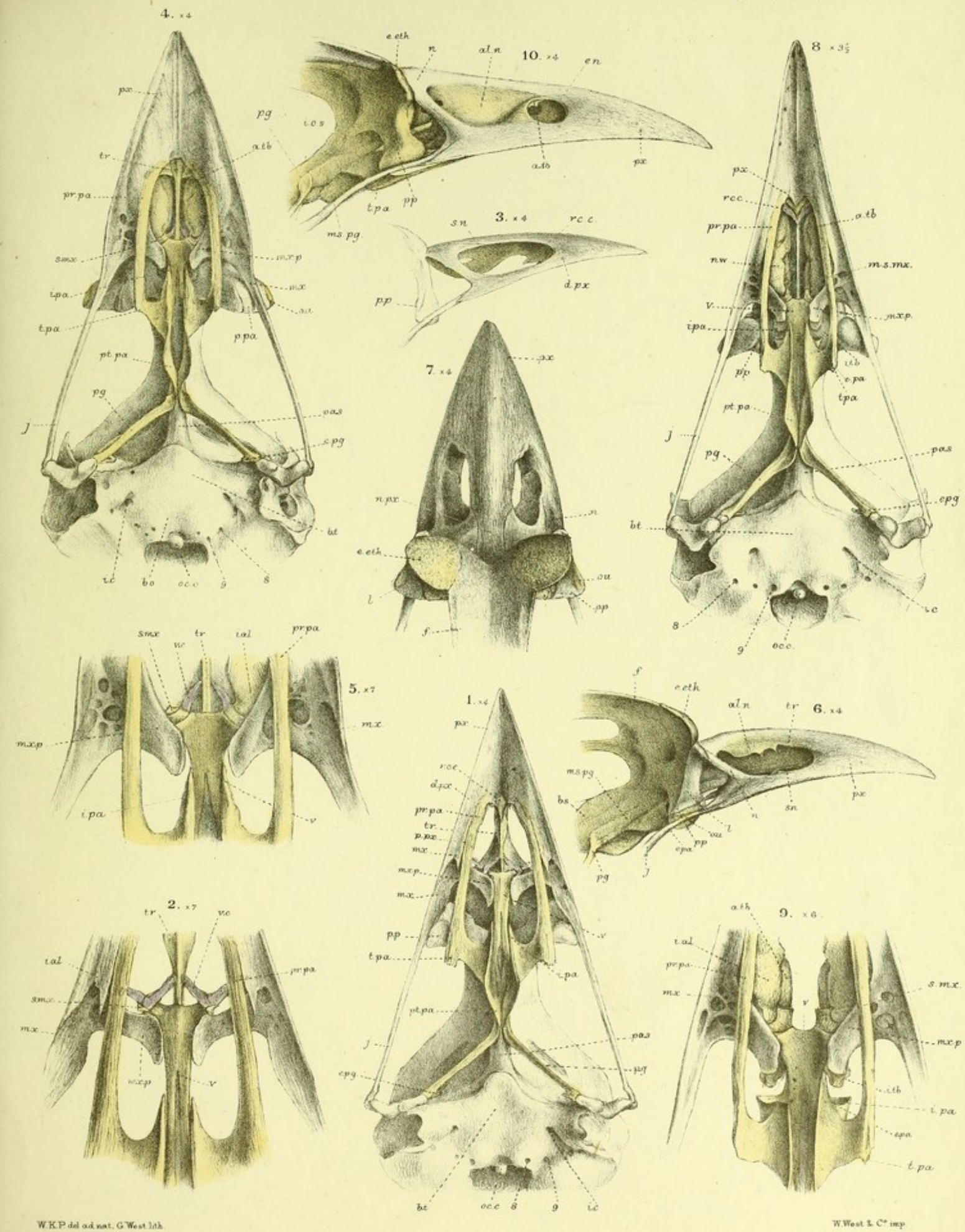
FIGS 1–9a CORVUS, 10–12 FREGILUS 13. RUTICILLA.



W.K.P. del. ad nat. G.West lith.

W.West & Co. imp.

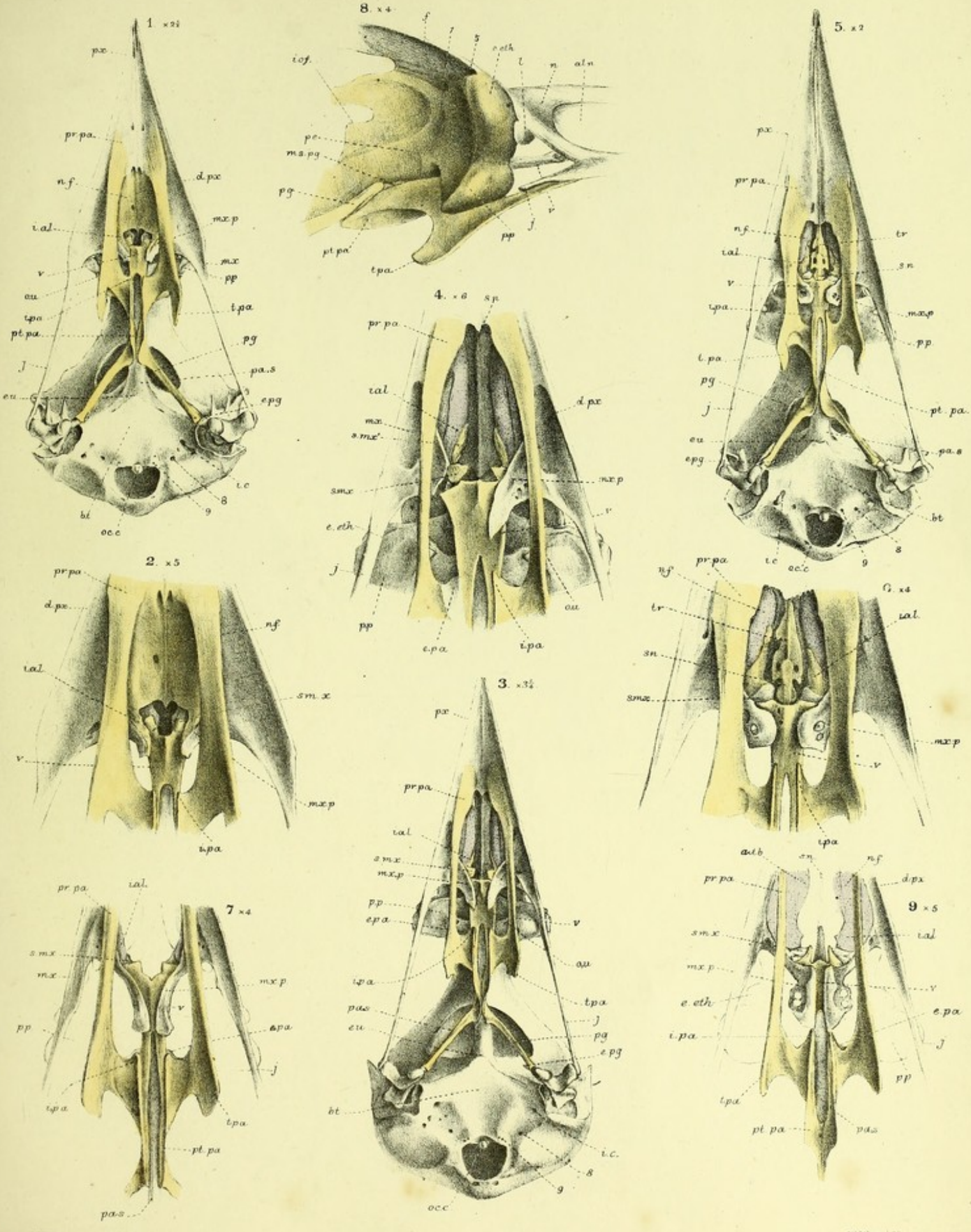
FIGS 1–5 MENURA, 6, 7 PITTA, 8–10. GRALLARIA.



W.K.P. del. ad nat. G.West lith.

W.West & Co.ª imp.

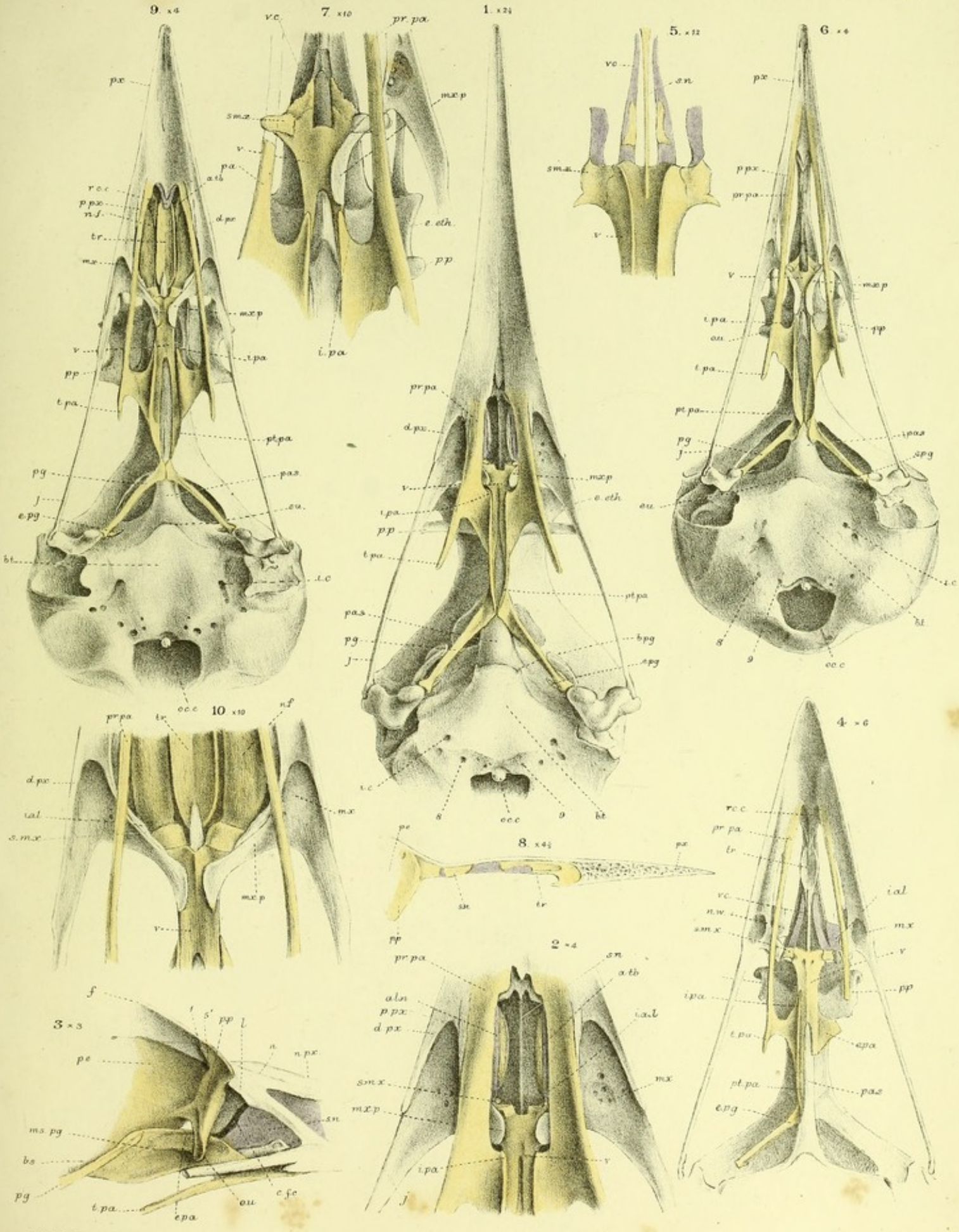
FIG.ˢ 1–3. PIPRA, 4–7. PACHYRAMPHUS, 8–10. THAMNOPHILUS.



W.K.P. del. ad nat. G.West lith.

W.West & Co. imp.

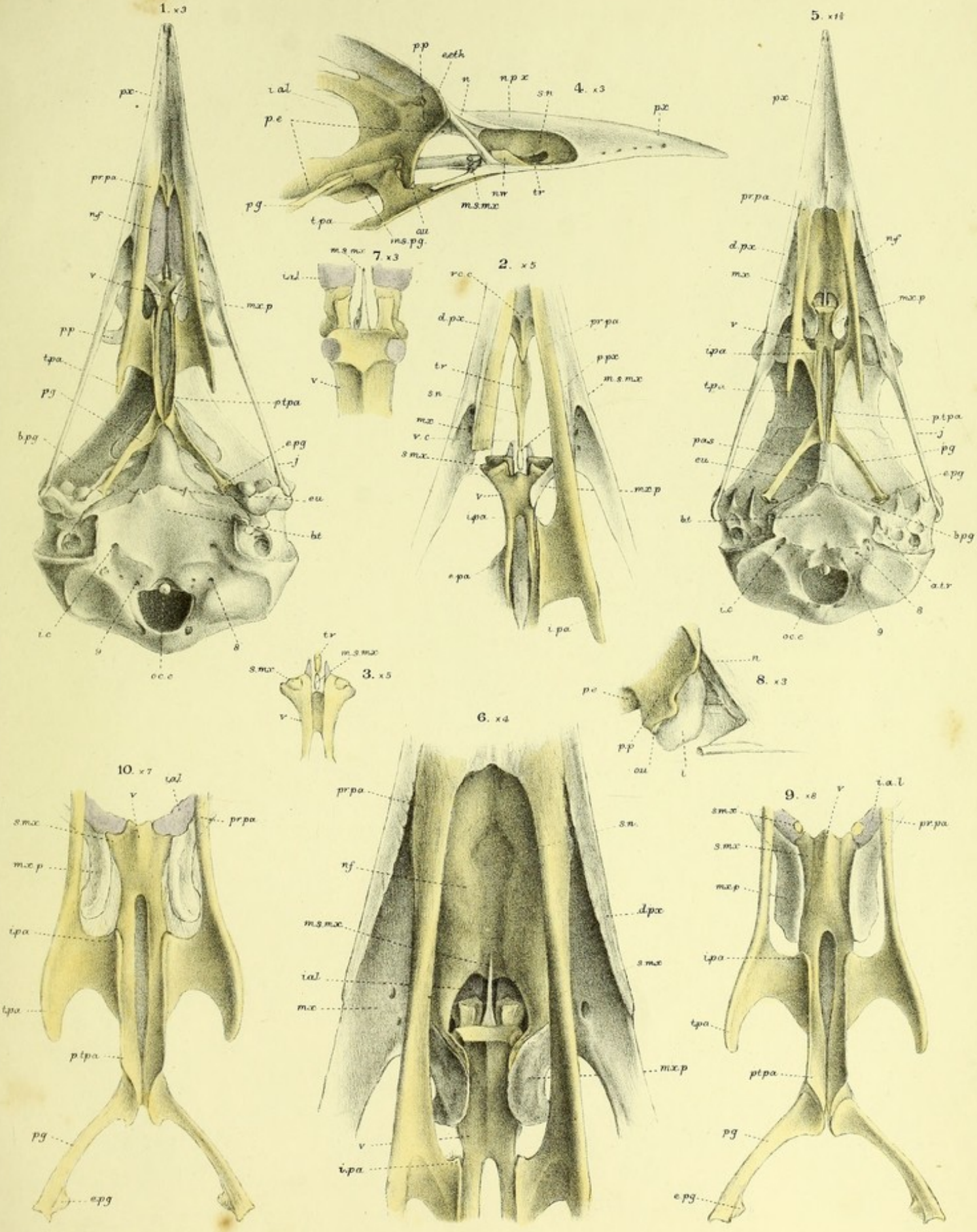
FIG^S 1, 2. ARTAMUS, 3, 4. HYLOTERPE, 5, 6. DICRURUS, 7, 8. ENODES, 9 TRICHASTOMA.



WKP del. ad nat. G West lith.

W West & Cº imp.

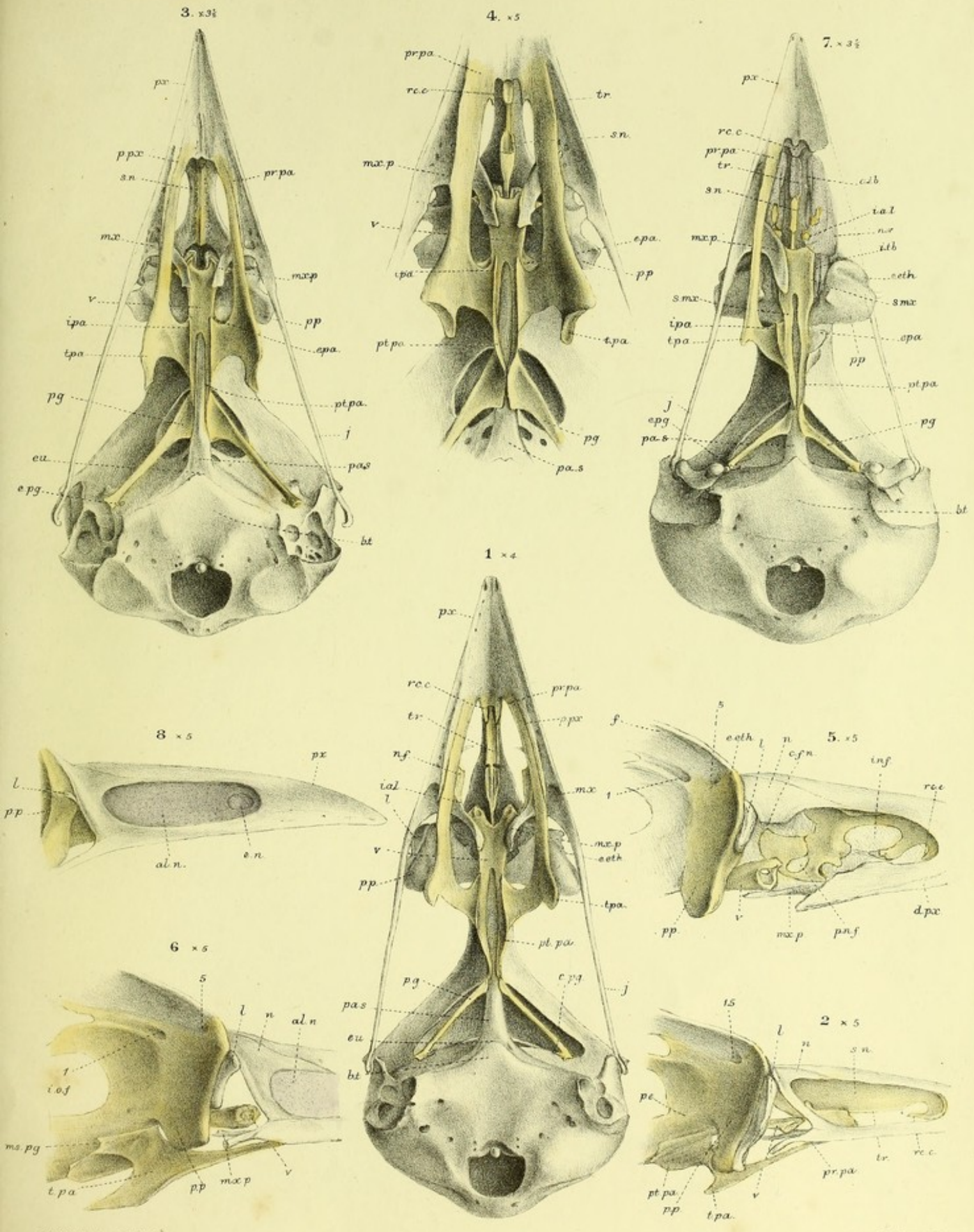
FIGS 1–3. DENDROCOLAPTES, 4, 5. ANÆRETES, 6–8. SYNALLAXIS, 9, 10. MUSCISAXICOLA.



W.K.P. del. ad nat. G.West lith.

W.West & C°. imp.

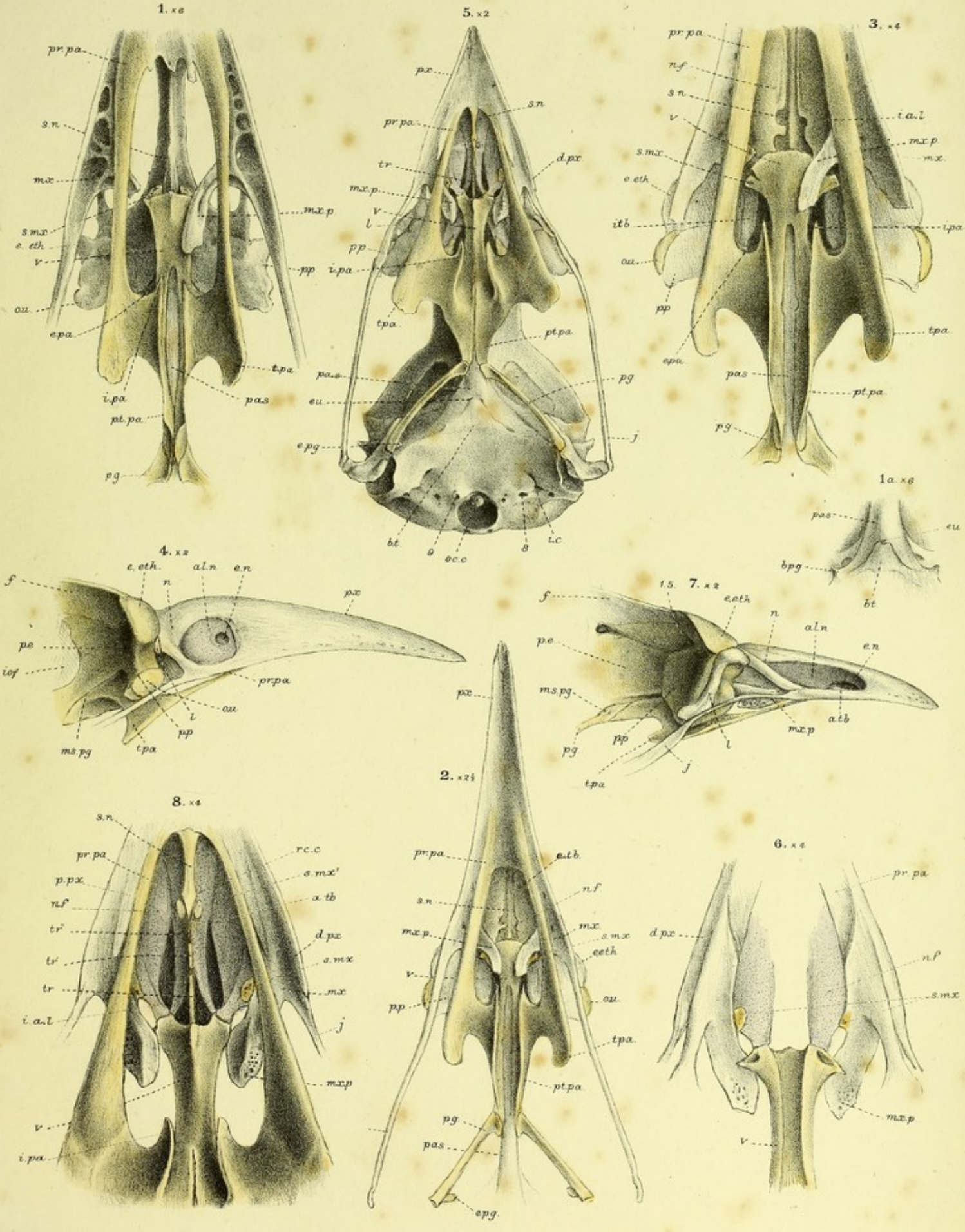
FIG.s 1–4. HOMORUS, 5–8. GYMNORHINA, 9, 10. PETROICA.



W.K.P. del. ad. nat. & West lith.

W. West & Co. imp.

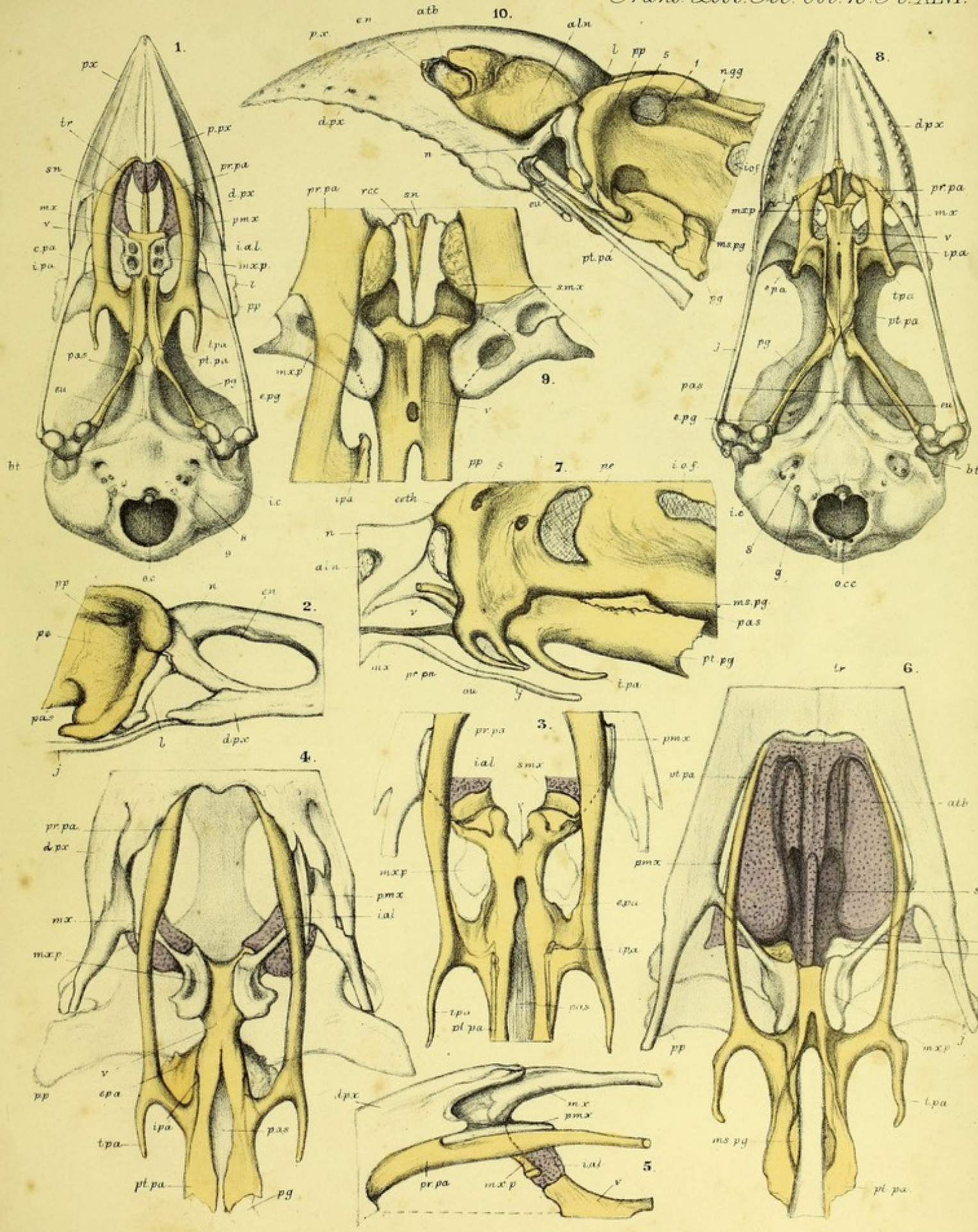
FIGS 1, 2. ELAINEA, 3–6. LANIUS, 7, 8. PACHYCEPHALA.



W.K.P. del. ad nat. G.West lith.

W.West & Co. imp.

FIGS 1, 1a. LALAGE, 2–4. PARADISÆA. 5–8. CHASMORHYNCHUS.

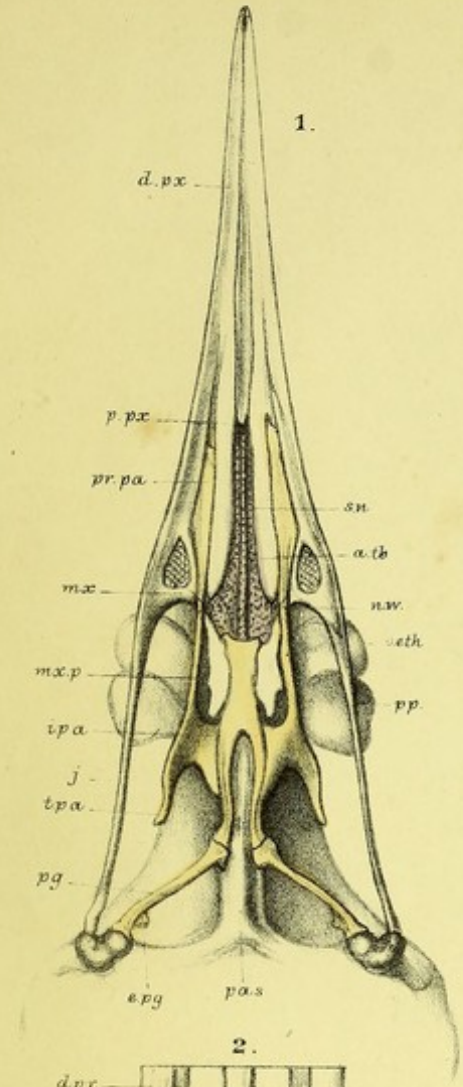


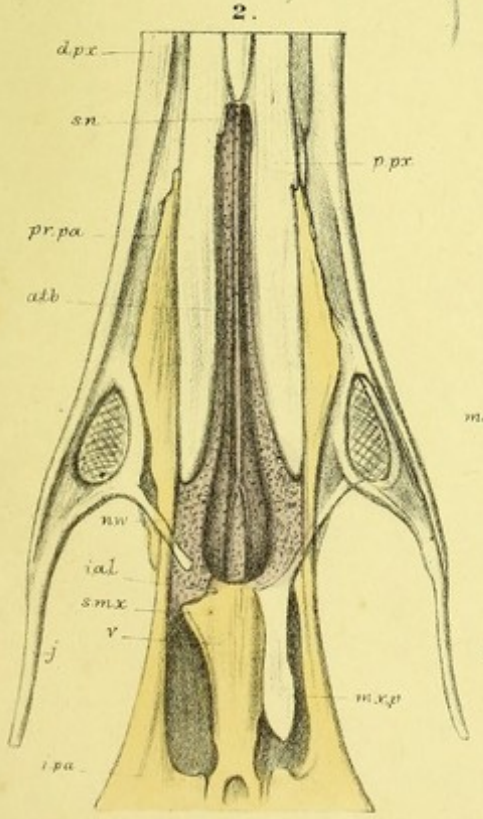
W.K.P. del. ad nat.

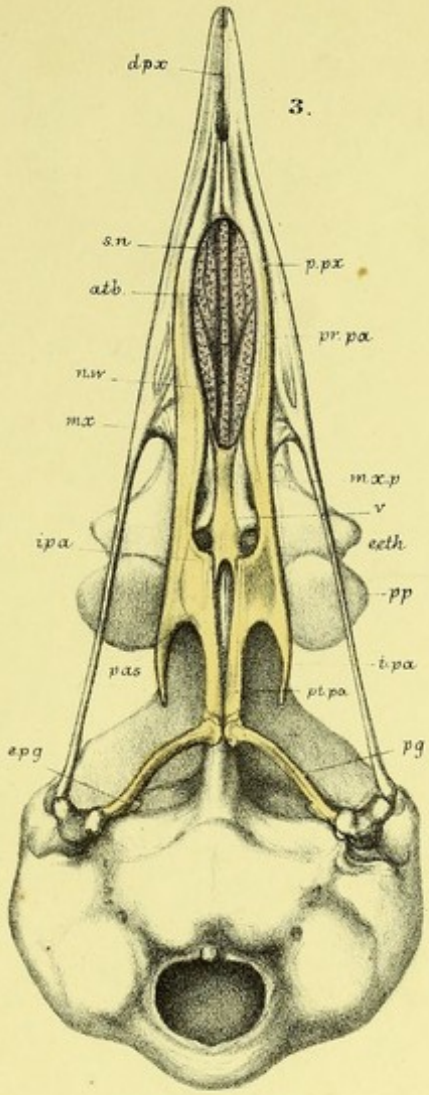
C. Berjeau lith.

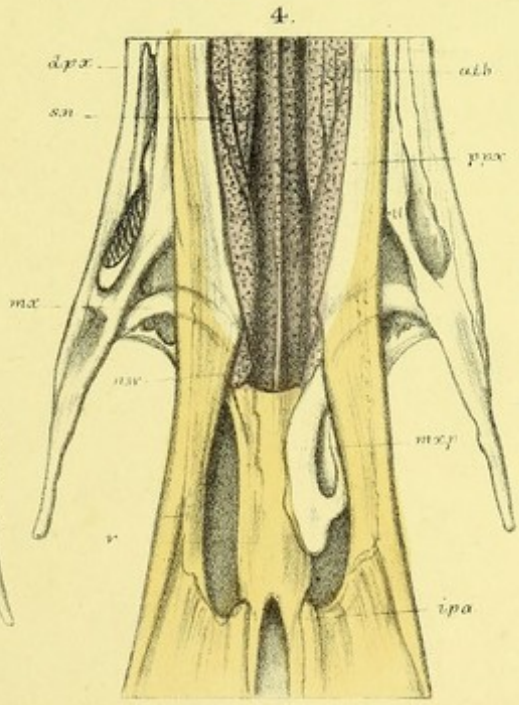
W. West & Co. imp.

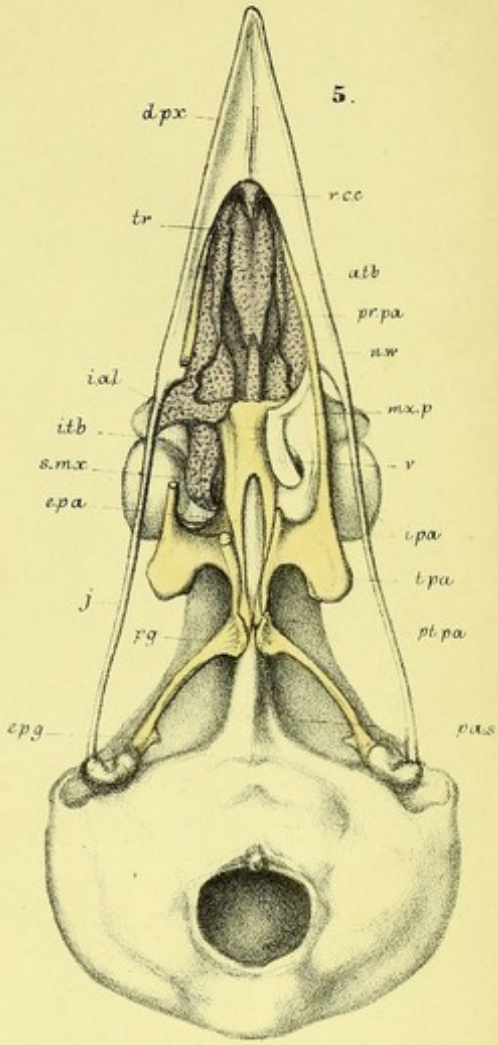
ÆGITHOGNATHÆ.

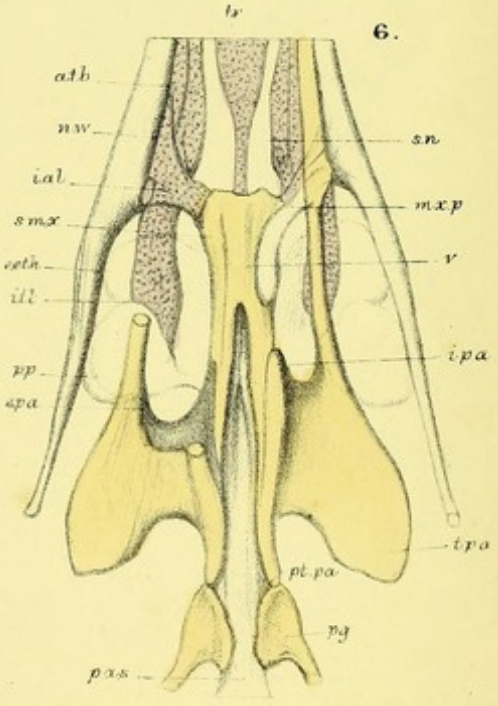










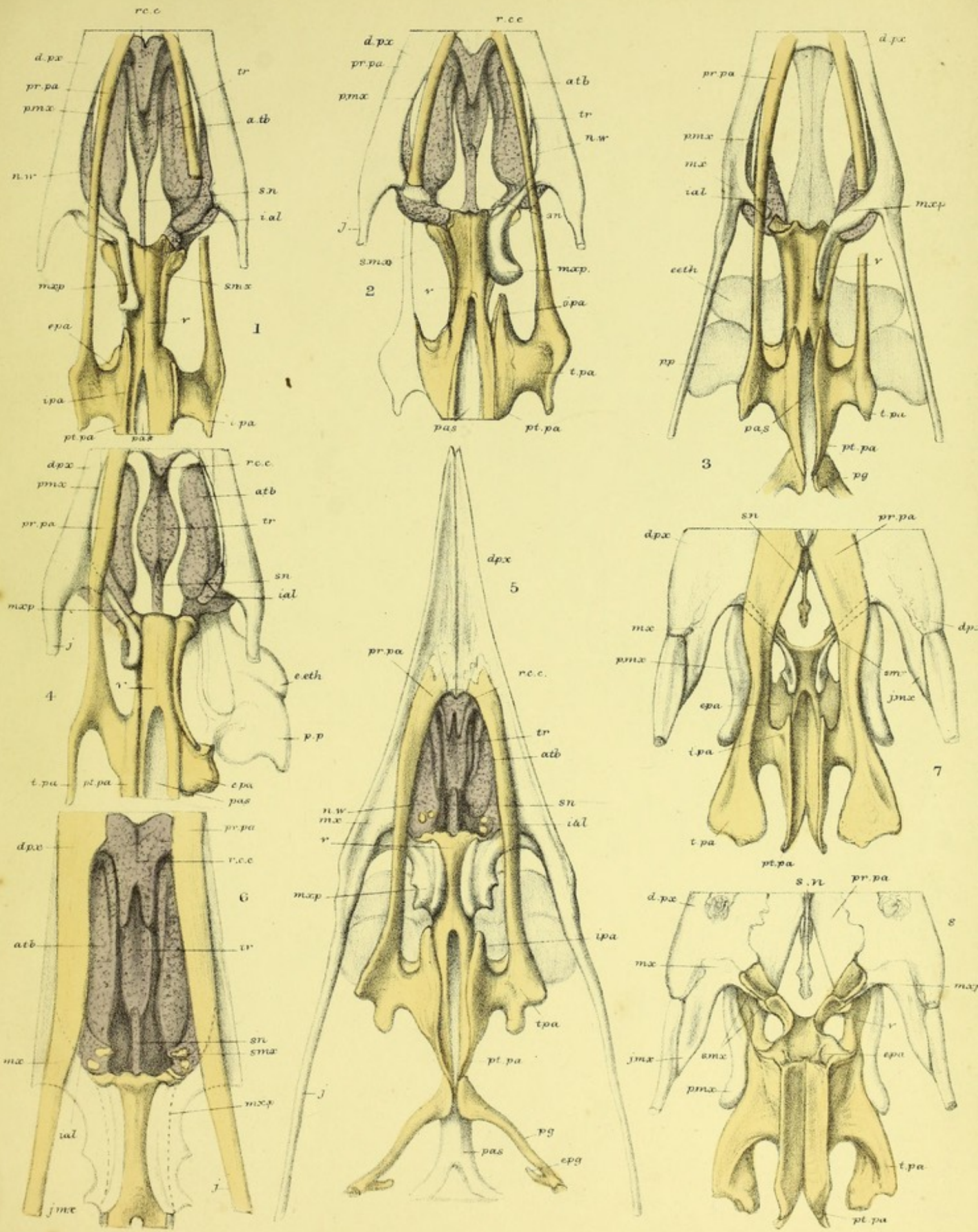


W.K.P. del. ad nat.

C. Berjeau lith.

W. West & Co. imp.

ÆGITHOGNATHÆ.

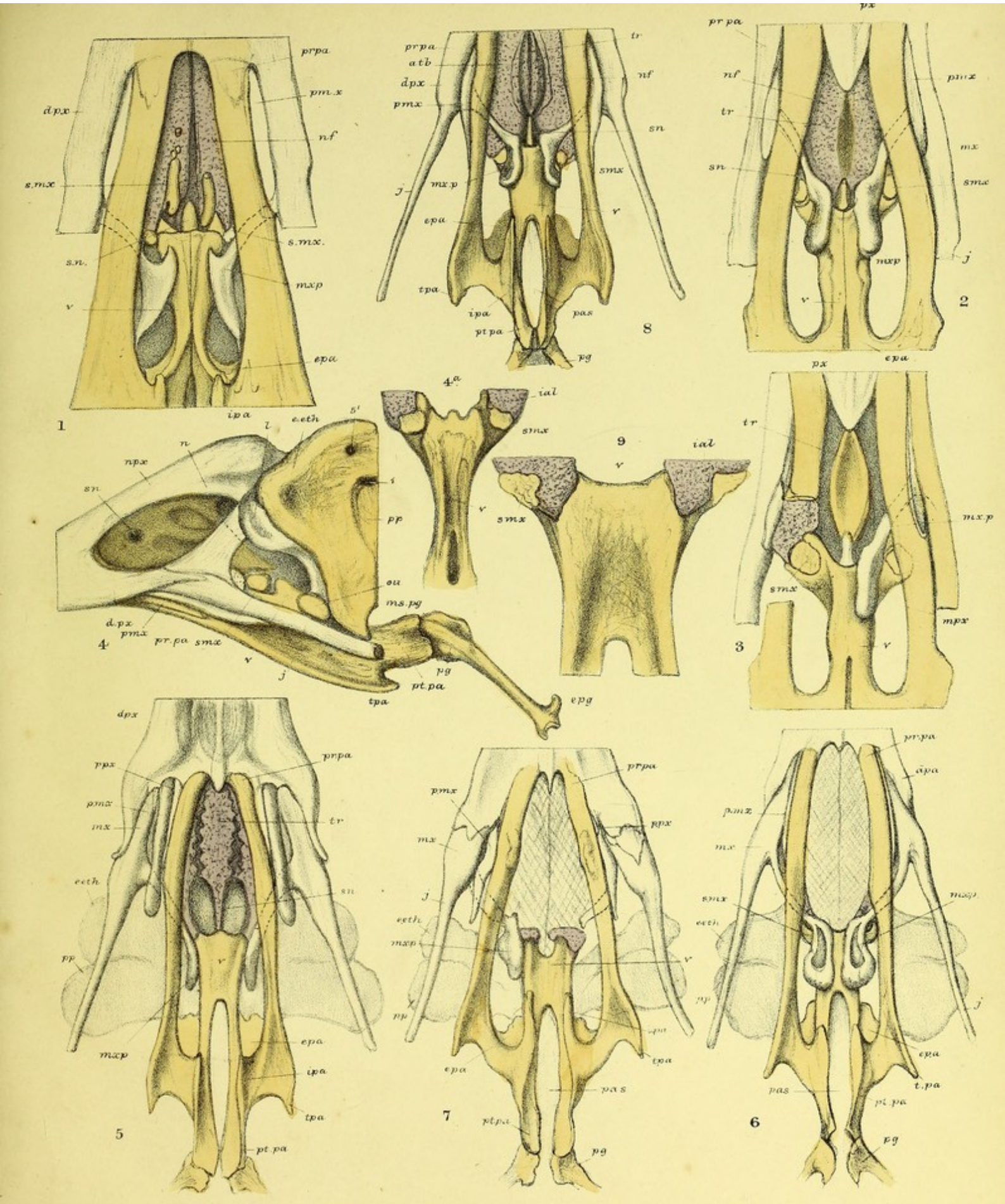


W.K.Pdel. ad nat.

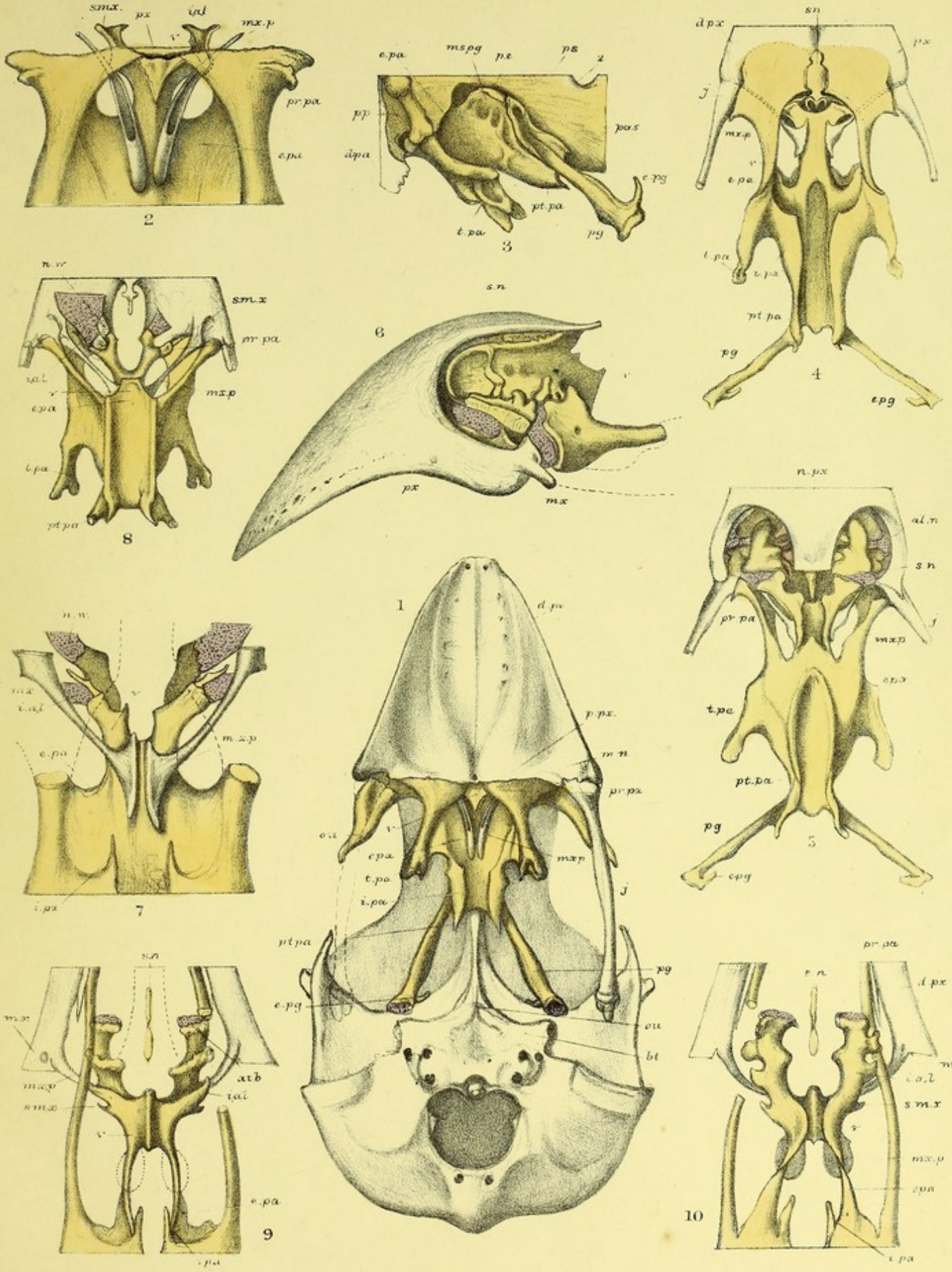
C.Berjeau lith.

W.West & Co. imp.

ÆGITHOGNATHÆ.



ÆGITHOGNATHÆ.

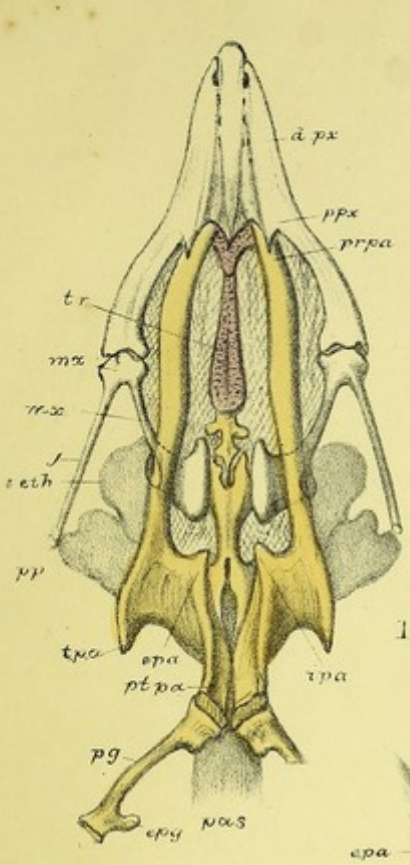


C.F. Land. ad. nat.

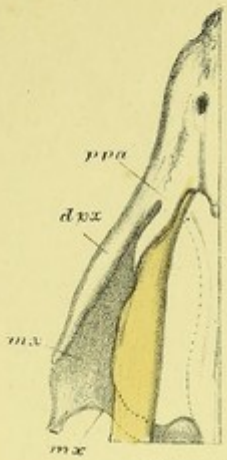
C.Berjeau lith.

W. West & Co. imp.

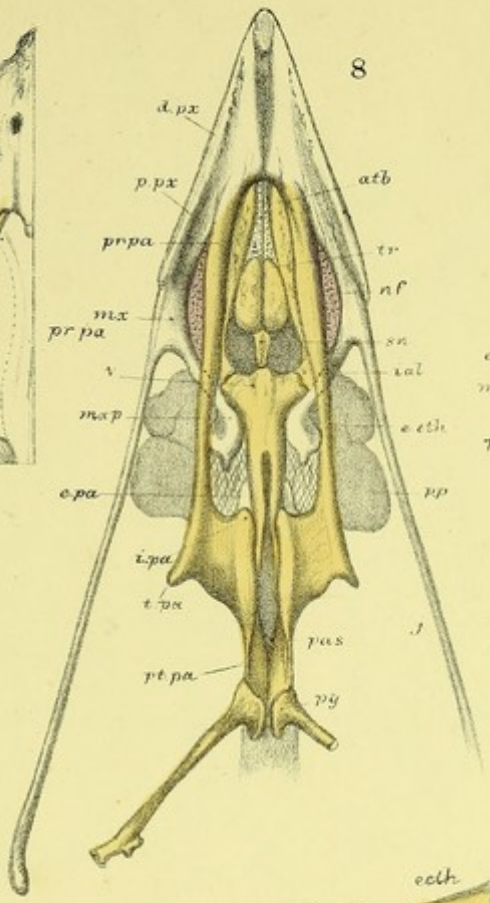
ÆGITHOGNATHÆ.

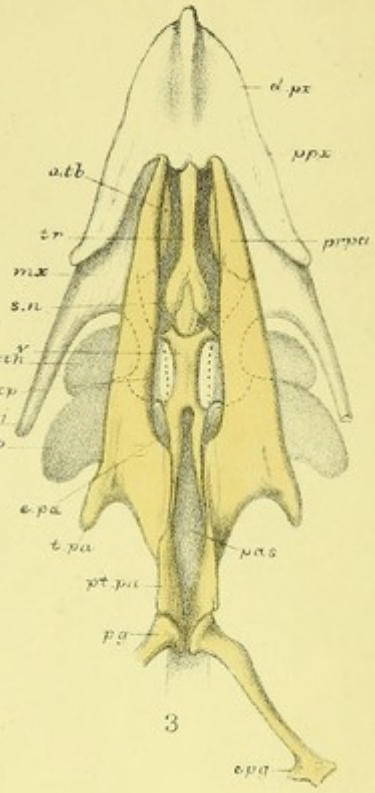

d.px
ppx
prpa
tr
mx
mx
mx
f
eeth
pp
tpa
epa
ptpa
ipa
pg
epg
pas

1

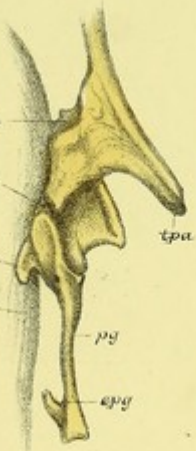

ppa
dpx
mx
mx

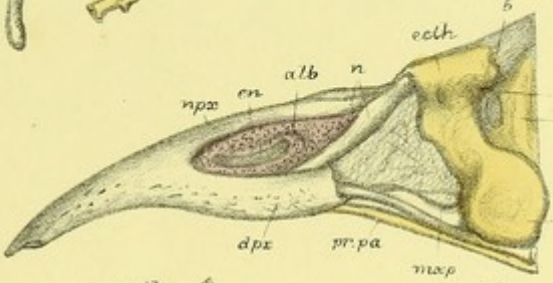
2


8
d.px
p.px
prpa
mx
pr.pa
tr
nf
sn
ial
v
mxp
eeth
pp
epa
ipa
tpa
pas
ptpa
pg
f

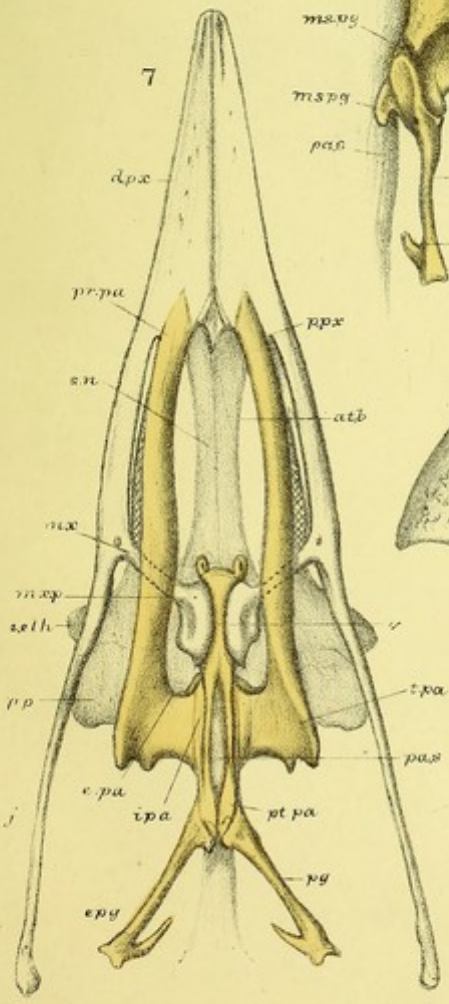

d.px
ppx
atb
tr
prpa
mx
s.n
v
eeth
mxp
f
pp
epa
tpa
pas
pt.pa
pg
epg

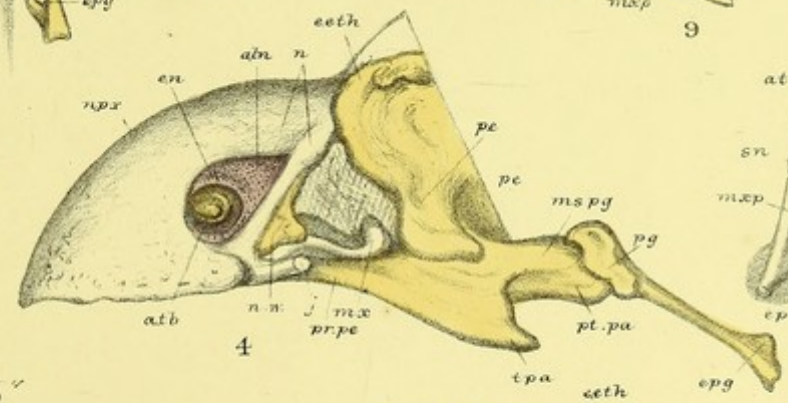
3


epa
mxpg
tpa
mspg
pas
pg
epg

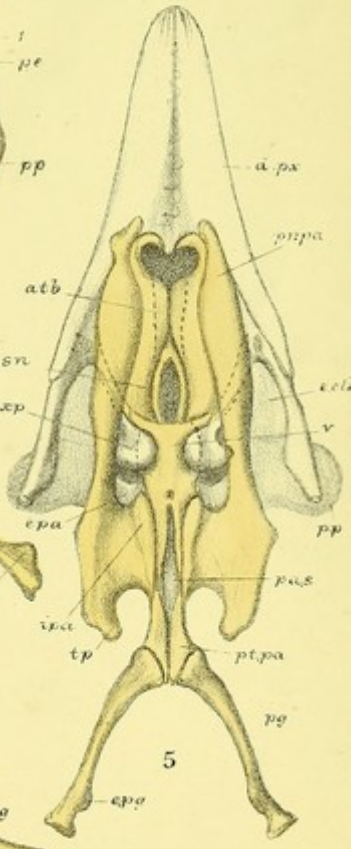

b
eeth
alb
n
npx
en
f
pe
pp
dpx
pr.pa
mxp

9

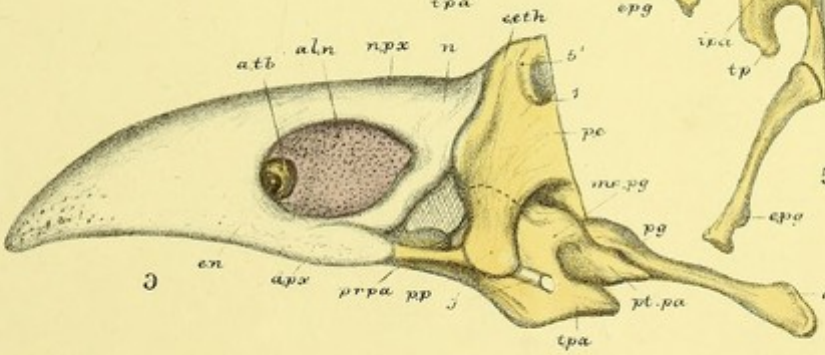

7
dpx
pr.pa
ppx
sn
atb
mx
mxp
eeth
v
pp
tpa
pas
epa
ipa
ptpa
pg
epg


eeth
aln
n
en
npx
pe
pe
mspg
pg
atb
n.n
f
mx
prpe
pt.pa
tpa
epg

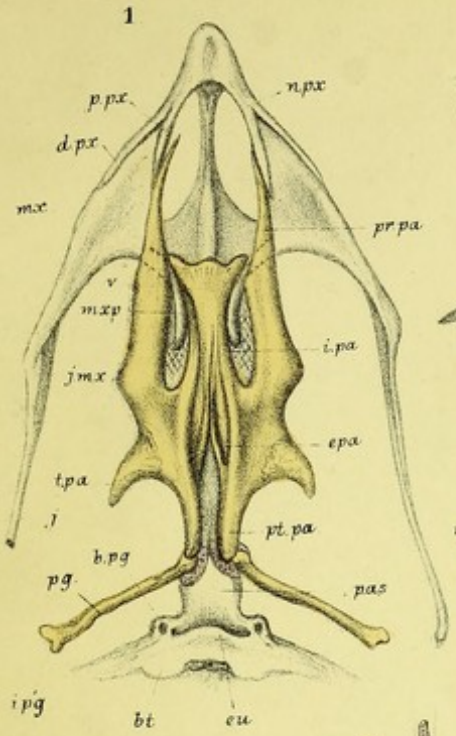
4

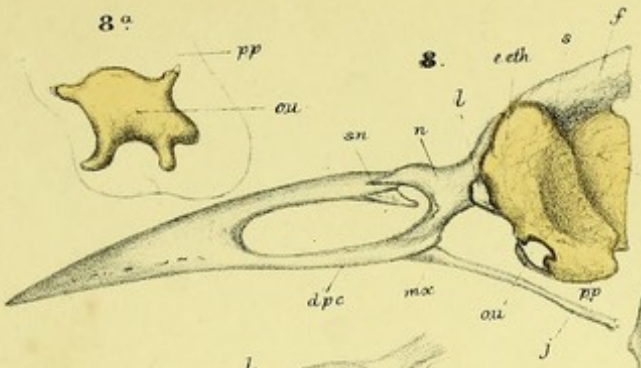

d.px
prpa
atb
sn
mxp
v
epa
pp
pas
ipa
tp
pt.pa
pg
epg

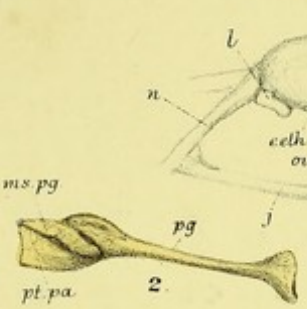
5

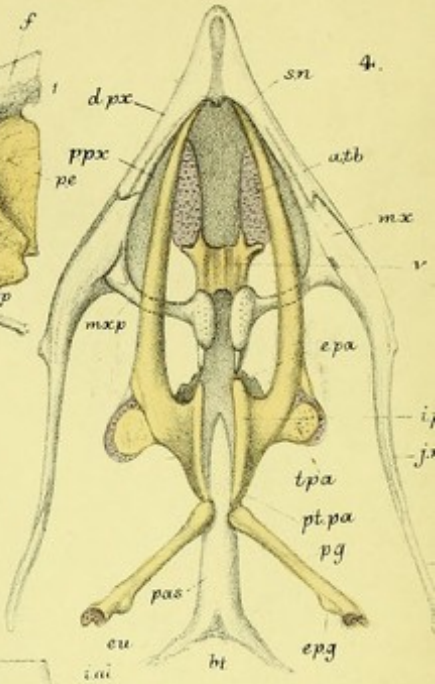

eeth
atb
aln
npx
n
b'
f
pe
mspg
pg
en
dpx
prpa
pp
f
pt.pa
epg
tpa

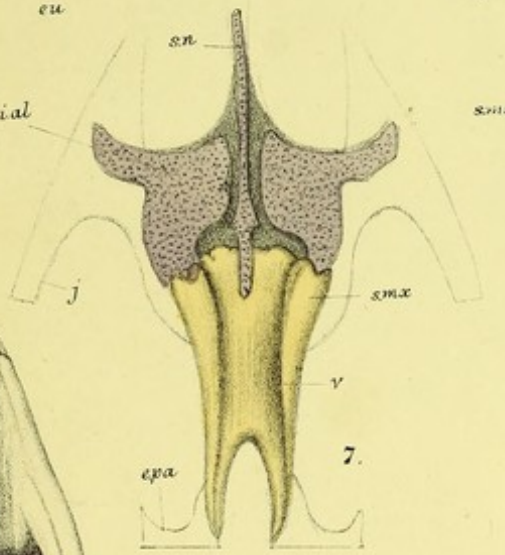
3

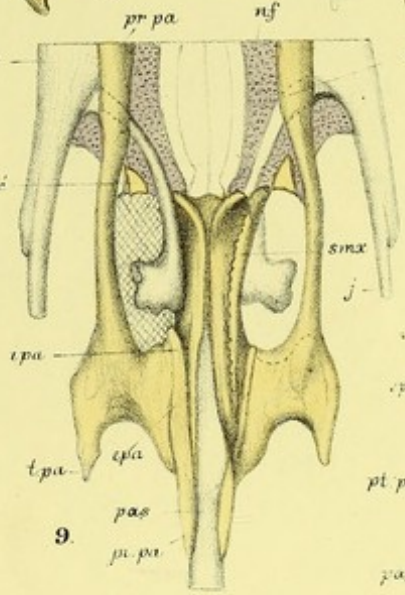


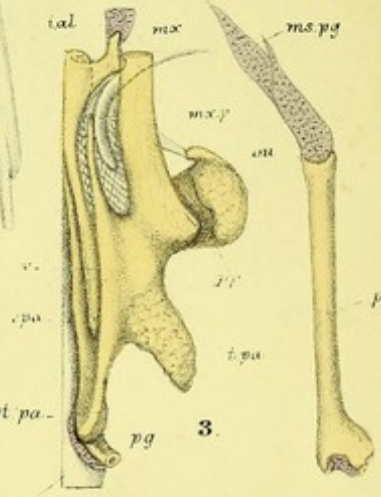


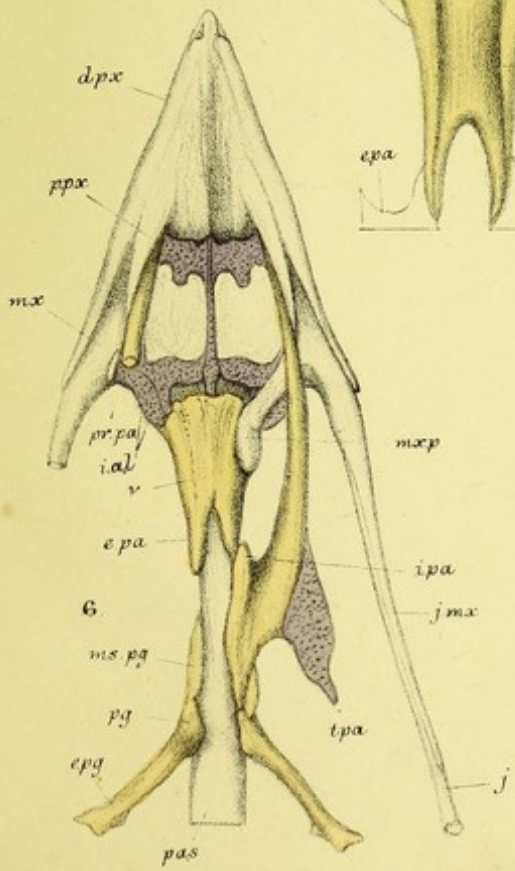


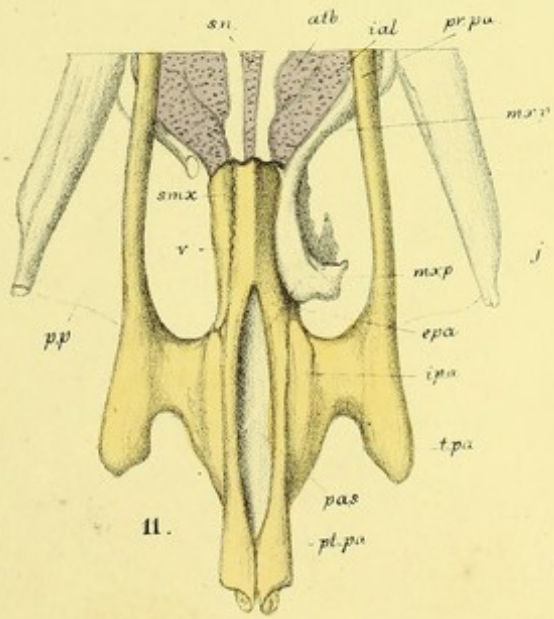


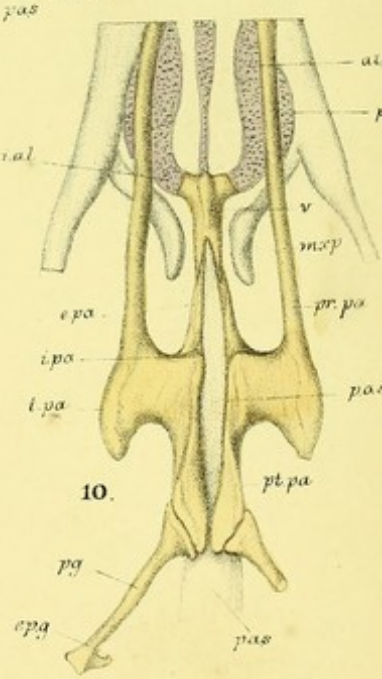










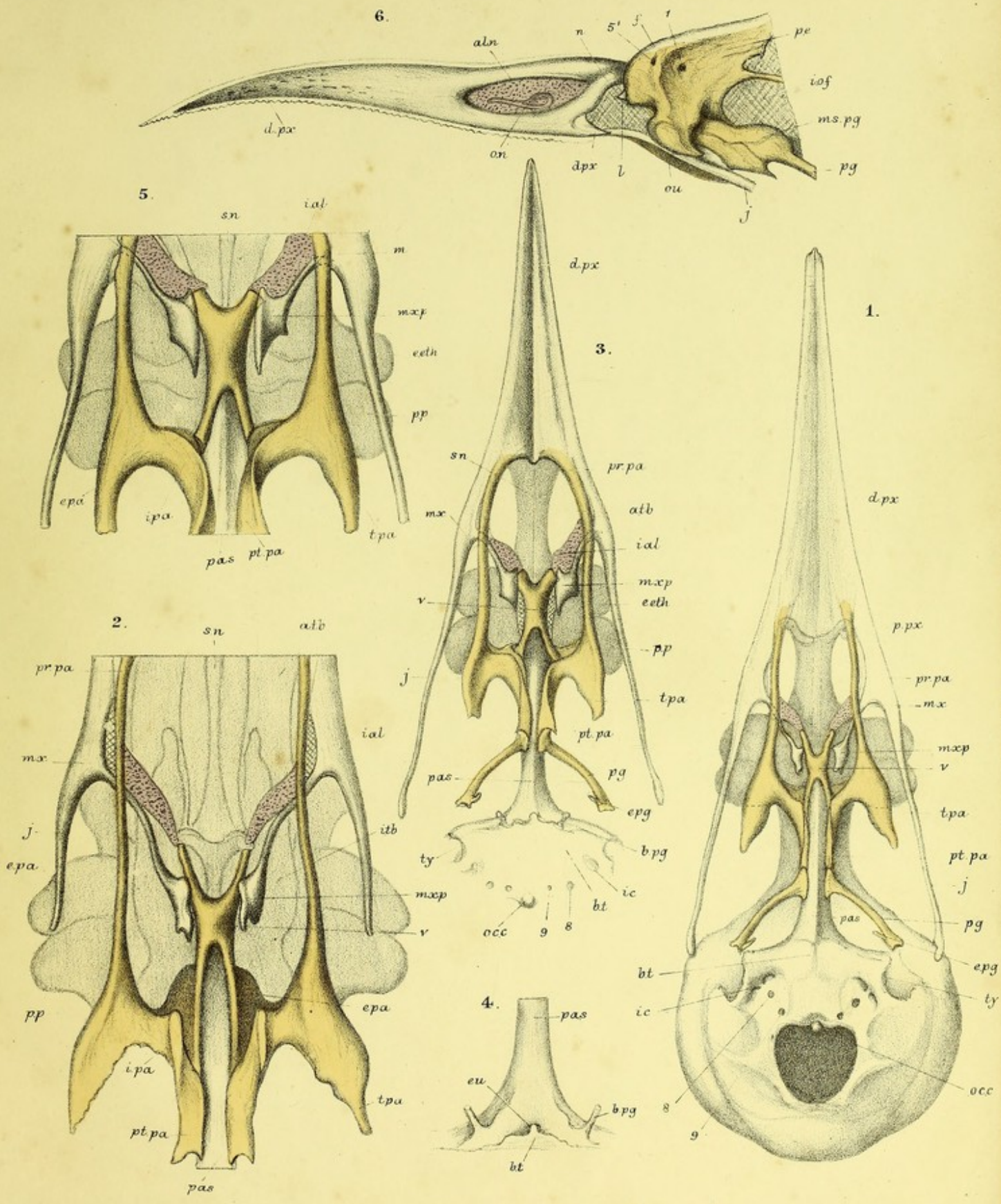


W.K.P. del. ad nat.

C. Berjeau lith.

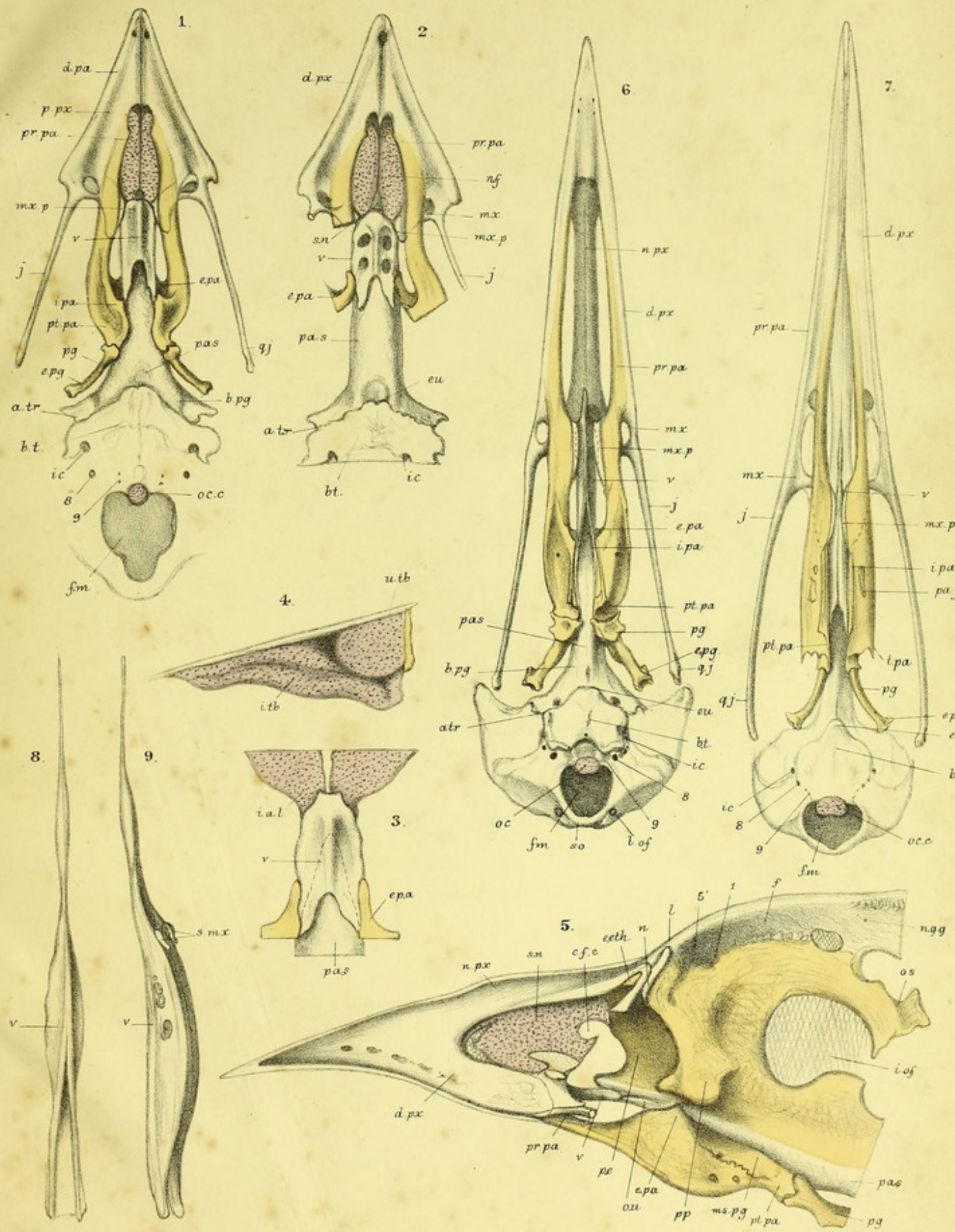
W. West & Co. imp.

ÆGITHOGNATHÆ.



W.K.P. del. ad. nat. C. Berjeau lith. W. West & Co. imp.

ÆGITHOGNATHÆ.



W.K.P. del. ad. nat.

C. Berjeau lith.

W. West & Co. imp.

ÆGITHOGNATHÆ.