

is therefore interesting as invalidating such an interpretation, as well as the morphological significance attached by Albrecht to his specimen, the bifid limb of which, I have no doubt, was likewise produced by regeneration. Whether the case now noticed is one of reversion, as I have noticed in the scaling of the reproduced tails of Lizards, or merely comparable to the bifid or trifid tails of the same Reptiles, is a point on which I will refrain from expressing an opinion.

Mr. Boulenger also exhibited young specimens and eggs of a South-African Siluroid fish, *Galeichthys feliceps*, which had been sent to him by Mr. J. M. Leslie, of Port Elizabeth, with the information that the ova had been obtained from the mouth of the adult fish. The fact that in the genera *Arius* and *Osteogobius* the male takes charge of the eggs in this manner was well known, but Mr. Leslie's observation was of importance as adding a third, though closely allied, genus to the list of the Siluroids which thus protect their offspring. According to Mr. Leslie, the number of eggs in one fish's mouth was about thirty, each of which measures about six lines in diameter.

The following papers were read :—

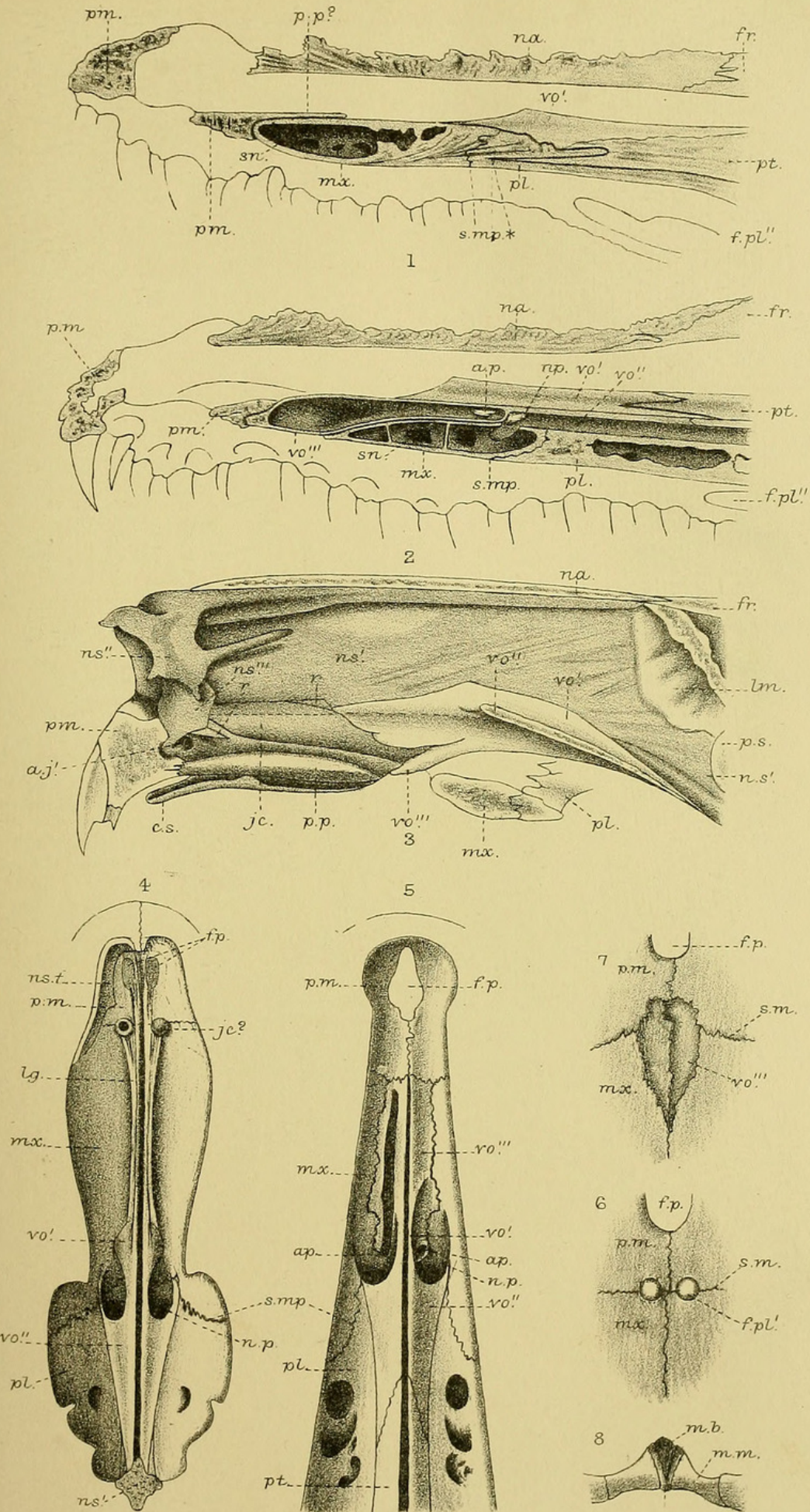
1. On the Probable Existence of a Jacobson's Organ among the Crocodilia ; with Observations upon the Skeleton of that Organ in the Mammalia, and upon the Basi-Mandibular Elements in the Vertebrata. By G. B. HOWES, F.Z.S., F.L.S., Assistant Professor of Zoology, Royal College of Science, London.

[Received February 17, 1891.]

(Plate XIV.)

I. The Black Caiman (*Caiman niger*), of Inter-Tropical America, is, with the exception of *Tomistoma*, the only Emydosaurian living in which the vomers are freely intercalated between the bones of the palato-maxillary series. In *Tomistoma* they are so disposed as to be visible from beneath over a short and constricted area between the posterior ends of the palatines, as was first shown by Müller and Schlegel¹. In *Caiman niger* they are, unlike those of all other Crocodilia, prolonged forwards into the premaxillo-maxillary region, and their inflated free ends (*vo.*'''', Plate XIV. fig. 7) occupy a wide inter-

¹ Cf. Huxley, Journ. Linn. Soc. Lond., Zool. vol. iv. pp. 17, 19 (1860). For synonymy see Boulenger's Brit. Mus. Cat. of Chelonians, Rhynchocephalians, and Crocodiles, 1889, p. 276.



G.B. Had. nat.
M.P. Parker lith.

West, Newman imp.

Supposed Jacobson's Organ in the Crocodilia.

space between the premaxillo-maxillary sutures (*s.m.*), to be referred to in full later on. This remarkable departure from the Crocodilian type of structure was first described by Owen¹; Huxley redescribed it seven years later²; and both writers referred it to the one isolated species named. Gray, with that mischievous originality for which he was so notorious, gave the character³ as diagnostic of the genus *Jacare*, and his error has been transcribed by Lydekker in the 'Palæontologia Indica'⁴. It remained for Boulenger to rectify matters; and in having done so, to show⁵ that the feature remains distinctive of the species (*C. niger*) in which it was originally described, and of none other.

The leading fact that the vomers of *Caiman niger* are, at their point of intercalation between the premaxillo-maxillary bones, inflated and bullate (*vo.*"', fig. 2) was apparently known to Owen (*loc. cit.*); and a detailed account of the general relationships of these bones has been given by Huxley⁶. Their remarkable characters, however, have neither received that attention which they deserve, nor have attempts been thus far made to decipher their meaning. It is precisely this gap in our knowledge which, thanks to some specimens generously placed at my disposal by Prof. Huxley, I would now attempt to fill.

The vomers of the short-snouted Crocodilia in ordinary (*vo.*', fig. 1) usually commence to taper anteriorly at a point more or less vertically disposed above the maxillo-palatine suture (*s.mp.*). There is much variation individually and with age in respect to the exact position of the point referred to; but while it generally lies behind the suture named, it may more rarely be situated in front of it (ex. *Alligator mississippiensis*, fig. 4). From this point forwards, each vomer rapidly tapers and disappears on the upper surface of the palatine process of its corresponding maxilla (*mx.*), and with that it may become early ankylosed (ex. *Crocodilus niloticus*). In *Caiman niger*, however, the vomers (*vo.*', fig. 2) pass on to the middle maxillary region (*i. e.* beyond that point at which these bones ordinarily cease altogether in other Crocodilia) before they commence to taper; instead of dwindling away to a pointed extremity, they descend, becoming bullate as they do so, and, thrusting themselves between the maxillary bones, terminate as aforesaid within the palatal region. These expanded intercalary extremities of the vomers (*vo.*"', fig. 2) may be appropriately termed their *palatine lobes*.

The *Crocodilia* and *Hatteria* are exceptional among living Reptilia in that their "pterygoid bones send forward median processes which separate the palatines and reach the vomers"⁷; an essentially similar condition appears to be realized in some *Chelonia* by the backward

¹ Cat. Ost. Ser. R. Coll. of Surgeons, vol. i. p. 166 (1853).

² *Loc. cit.* p. 4.

³ Brit. Mus. Cat. Shield Rept. ii. p. 25 (1872).

⁴ Vol. x. (iii.) p. 210 (1885).

⁵ *Loc. cit.* p. 293.

⁶ *Loc. cit.* pp. 4-5.

⁷ Huxley, Quart. Journ. Geol. Soc. vol. xxxi. p. 426 (1875). ..

prolongation of the vomer¹. The pterygoids of the Crocodilia (*pt.*, fig. 2) unite before reaching the vomers to form a gutter-like bed for reception of the free edge of the septum nasi (*cf.* fig. 5), in a manner repetitional of that of the Mammalian vomer. They furnish, as is well known, the median longitudinal partition for the narial pharynx (marked *pt.* in fig. 1), and the rostrum formed by their union bifurcates antero-dorsally to give attachment to the vomers, while antero-ventrally it tapers off into a delicate spur (* of fig. 1) which enters the palatines from behind, and may be traced forwards through their substance to the region of the maxillo-palatine suture (*s.mp.*). Setting this spur aside, the point of termination anteriorly of the pterygoid rostrum (*pt.*, fig. 1) is usually coincident with that of the post-palatine foramen (*f.pl.*). In *Caiman niger* (fig. 1) it lies well in front of this; and, as the vomer in that animal extends forwards to an unusual degree, it might appear that there is, so to speak, a sympathy or correlation of growth between the two bones. Indications of such a correlation are forthcoming on comparison of a series of skulls, but examination of a larger number is needed before more can be said upon this point. Another and perhaps more significant feature arrested my attention, while comparing a series of longitudinal sections of skulls of *Crocodylus palustris* and *Alligator mississippiensis* of different ages—viz. that the vomer reaches farthest forwards in the younger individuals, and that, whereas in the adult *Crocodylus palustris* the point of anterior termination of the pterygoid rostrum (*pt.*, fig. 1) closely approximates, as has been said (*suprà*), to that of the post-palatine foramen (*f.pl.*), in the young (half-grown) individual it lies well in front of it. In other words, there is evidence to show that during the early post-embryonic life of the Crocodile the vomers and pterygoids grow less rapidly than the adjacent bony parts, and become, as it were, shortened up.

II. Having adduced reason to believe that the Crocodilian vomer in all probability undergoes, in ordinary, a process of shortening up during early life, the question naturally presents itself whether the differences between the vomer of *Caiman niger* and the other short-nosed Crocodilia might not be expressive of degrees of abbreviation of that bone from before backwards; and if so, whether that which I have here termed its palatine lobe (above, p. 149) may not represent something which the remaining Crocodilia have lost. I have already shown that, among those forms examined by myself, *Alligator mississippiensis* approximates most nearly to *Caiman niger* in the forward prolongation of its vomer; and, with this fact in mind, I naturally turned to the former animal as most likely to yield traces of the missing parts. In this I was not disappointed, as the sequel will show; and my investigation has brought to light some facts of unexpected interest.

Upon first comparison of the skulls of *Caiman niger* and *Alligator*

¹ *Cf.* Boulenger, *op. cit.* pp. 2, 17.

mississippiensis (figs. 1 and 2), the bullate cavity of the vomer of the former (*vo.*"') might appear to lie within the area of, and indeed to be represented by, the anterior divisions of the maxillary sinus of the latter (*sn.*). The distinctness in the Caiman of the two bones named shows, firstly that this cannot be the case, and secondly that the extension of the maxilla of *Alligator mississippiensis* into the region of the palatine lobe of the vomer of *Caiman niger* must have been one of the changes resulting from the loss of the latter, should that have been brought about as supposed.

The premaxillo-maxillary sutures of the adult *Alligator mississippiensis* meet at all points, and the two pairs of bones form a conjoint and complete osseous roof to the mouth. It has, however, hitherto escaped notice that matters may be otherwise in the young of this species, for the sutures in question may be, in them, interrupted by a couple of rounded fenestræ (fig. 6, *f. pl.*') having the customary relationships of the prepalatine foramina of other Amniota. On cutting away, from above, the greater portion of the olfactory organ, and then carefully dissecting off the mucous membrane and cartilaginous floor¹ of the same in the largest juvenile of *Alligator mississippiensis* which I have examined (total length 112 centim.), I was surprised to find a couple of small sacs (*jc.*?, fig. 4) lying within the embrace of the prepalatine foramina. Each is a firm and resistant structure, invested in a fibro-cartilaginous wall, and containing a soft (? vascular) lining. I have been unable to trace any connection either between the capsules of these sacs and the cartilaginous alæ of the olfactory wall, or between their central cavities and those of either the mouth or the nose. So far as I have been able to examine them, they appear to be to all intents and purposes closed vesicles, vestigial in nature. That they correspond in position with at least the anterior extremities of, and must be looked upon as directly related to, the bullate palatine lobes of the vomers of *Caiman niger*, I hold it to be sufficiently clear; and it remains now to seek the clue to the remaining portions of the latter bones.

On laying bare the nasal organ of any Crocodile from the side, it will generally be found, on removing the mucous membrane, that the anterior truncated extremity of the vomer is buried in a more or less powerful ligament (*lg.*, fig. 4) which runs forwards towards the premaxillary region. Among those genera and species which I have examined, this ligament is most powerful in *Osteolaemus tetraspis* of W. Africa; in my specimen of that animal it assumes the form of an upturned fold or keel, which, as viewed from the side, continues forwards as it were the body of the vomer, instead of the more general one of a cord-like structure continuous with its tapering extremity. This *vomerine ligament* (*lg.*, fig. 4), as already stated, may be traced forwards into the premaxillary region; its fibres usually there blend with those of the premaxillo-maxillary periosteum, and when (as for ex. in *Crocodylus palustris*, fig. 1) a "palatine process" of the premaxilla (*p.p.*) is present, they may be traced to an insertion into that. In the young *Alligator missis-*

¹ A portion of this is represented *in situ* at *ns.f.* in fig. 4.

mississippiensis, in which I found the areæ of the pre-palatine foramina to be occupied by the two small sacs before mentioned (*jc.*?, fig. 4), the fibres of these vomerine ligaments could be traced to a connection with both the membranous expansions closing the former and the fibro-cartilaginous walls of the latter. The established doctrines of morphology and the rules of precedent alike allow us to regard these ligaments as the equivalents of the "missing parts," and to look upon them and the sacs of the prepalatine foramina as the vestigial remains of the palatine lobes of the vomers of *Caiman niger* with their associated structures.

I have unfortunately been unable to obtain the head of a *Caiman niger* in spirit; but inasmuch as in a small *C. sclerops* of 125 centim.¹ I have found pre-palatine foramina to be present in a form identical with that of *Alligator mississippiensis*, the conclusion formulated above receives additional support. I find the pre-palatine foramina to be present in most, but not all, of the skulls of *Alligator mississippiensis* which I have examined smaller than the one afore dealt with in detail (total length 112 centim.); while in the skulls of two adults preserved in the Natural History Museum, which Mr. Boulenger has kindly afforded me an opportunity of examining, I find (on the left side of the one and the right side of the other) an insignificant perforation which may perhaps be a last vestige of the prepalatine foramen (?), but this is doubtful. It is clear, from all, that the structures possessed by my specimen here figured (figs. 5 and 6) when present must disappear with advancing age; and it has yet to be ascertained if their like is not to be found in other allied genera and species.

III. The only structure with which it is possible to homologize a cartilaginous sac in intimate relationship with the prepalatine foramen of a Reptile is the Organ of Jacobson. This has of late years received an exceptional amount of attention. Leydig has described² its general features and relationships in certain Lacertilia, in that masterly manner so peculiarly his own. Its more detailed characters and origin have been incidentally dealt with by Born, in the course of a series of lengthy monographs³ devoted to a comparative study of the nasal chamber and its ducts; while Solger, Wright, and others⁴ have furnished details about it in certain reptilian forms. Concerning the *Crocodylia*, its absence is everywhere proclaimed; and Beard, who has most recently investigated the facts of its early development, specially states⁵ that he "searched for it in Chelonians and in embryo Crocodiles, but in vain."

All recent inquiry has rendered it more and more clear that the

¹ Tail broken; measurement taken to posterior extremity of cloacal orifice.

² Die in Deutschld. lebend. Arten d. Saurier. Tübingen, 1872, pp. 96-99.

³ Morph. Jahrb. Bd. ii. bis, viii. (1877-1883).

⁴ For a full bibliography with detailed references, see Beard in Zoolog. Jahrb. Bd. iii. pp. 778-780 (1889).

⁵ *Loc. cit.* p. 772.

essential functional constituent of Jacobson's organ is to be regarded "as a highly specialized portion of the olfactory epithelium"¹. As it exists among Reptiles it may be defined as a distinct sac lying (on each side) immediately beneath the anterior portion of the nasal chamber, and communicating with the mouth-cavity by means of a delicate duct, which arises posteriorly and passes obliquely downwards and forwards, immediately external to the vomer, to reach its anterior extremity². Examination of any ordinary Lizard will show that the organ itself lies immediately above and to the outer side of the vomer, and that the point of communication between its duct and the mouth lies within the embrace and at the anterior end of a fold of mucous membrane common to it and the posterior nostril.

Jacobson's organ, as is well known, attains its greatest differentiation among Mammals. Its more minute structure has been worked out by Klein³, Harvey⁴, and others; and a more general communication upon it has been recently published by Herzfeld⁵, in which a classification has been attempted, in accordance with the presence or absence of naso-palatine canals and with other leading features described. This organ lies, in Mammals, within the embrace of a cartilaginous sheath (*jc.*, fig. 3) derivative of a downgrowth (*ns.*) of the alary cartilage of the nose (*ns.*), and it is in communication with the olfactory chamber by a wide orifice (*e.j.*) which overlies the naso-palatine (Stenson's) canal (*c.s.*). The main body of the organ of each side, with its surrounding cartilage, is supported upon a scroll-shaped prolongation of the premaxilla (*p.m.*) usually termed its palatine process (*p.p.*) This passes back and at the posterior extremity of the entire organ meets a special lobe of the vomer (*vo.*): between the latter bone and the supporting apparatus of the Jacobson's organ there is invariably an intimate relationship.

Comparison of the Mammal (fig. 3) with the Crocodilian *Caiman niger* (fig. 2) shows that there is a fundamental similarity in position between the so-called "palatine process" of the premaxilla in the former (*p.p.*), and that which I have herein termed the palatine lobe of the vomer in the latter (*vo.*). Albrecht⁶, Sutton⁷, and Parker⁸ have directed attention to the fact that the so-called "palatine process" of the Mammalia may be distinct in origin from the body of the premaxilla with which it ankyloses. I have long been suspicious of a similarly distinct origin of the same for the Common Rabbit (*Lepus cuniculus*) here figured; and my pupil, Mr. R. H. Burne, who, at my request, has looked into the matter, has shown me that such is the case in embryos measuring 8 centim. in length. Parker has described the vomer of certain *Edentata*, *Insectivora*,

¹ Ramsay Wright, Zoolog. Anzeiger, 1883, p. 393.

² Cf. Leydig, *op. cit.* pp. 96, 99, and pl. viii.

³ Quart. Journ. Micr. Sci. n. s. vol. xxi. pp. 219 & 549 (1881).

⁴ *Ibid.* vol. xxii. p. 50 (1882).

⁵ Zoolog. Jahrb. Bd. iii. p. 551 (1889).

⁶ Corresp. deutsch. anthrop. Gesellsch. München, 1883, no. 11, p. 170.

⁷ P. Z. S. 1884, p. 566.

⁸ Phil. Tr. pt. i. 1885, pp. 1-275.

and *Marsupialia* as consisting, in the young animal, of a series of distinct elements, for the most part paired, which he asserted¹ may be (*Cuscus*) as many as ten in number. Sutton, following in the same wake, has proposed to homologize the "prepalatine" centre of the mammalian maxilla with the vomer of the *Ichthyopsida*, and to interpret the vomer of the former as the parasphenoid of the latter. He relies chiefly upon discoveries of Albrecht's, which have been shown by Sir W. Turner² to be of exclusively pathological interest; and, even were this not so, the subsequent researches of Parker are, in themselves, sufficient to show that his conclusions will not stand the test of further inquiry (*cf. infra*). The joint observations of these three observers, however, testify to a feeling of doubt as to the exact homologies of those bones lying about the base of the septum nasi and its immediately adjacent structures.

The vomer of the *Ichthyopsida* and lower *Amniota*, be it paired or single, is invariably a non-repetitional bone lying immediately behind the premaxilla; and there is considerable evidence to show that the apparently "single vomer" of some of these animals really represents the pair so often present, in a confluent condition. When, in accommodation to the enlarging olfactory organ and the posterior nares, this bone becomes shifted backwards or laterally expanded, its anterior extremity generally remains true to its relationship with the premaxilla. It is necessary to stand firmly upon these facts in dealing with the question now in hand.

Parker's observations show, among other things, that there is no constancy of position and extent of the apparently single portion of the vomer of young mammals. They thereby completely undermine the older conception of that bone, based upon analogy to the adult man, which regarded it as a median element. They suggest, with much forcibility, that we may the more reasonably look upon the mammalian vomer in all its variations as morphologically paired, and that the argument deduced above from the study of the vomers of the *Ichthyopsida* and lower *Amniota* may apply throughout. With this Sutton's second conclusion above cited must remain in abeyance.

Chief among the supernumerary elements which Parker has described as giving origin to the Mammalian vomers, together with the palatine processes of the premaxillæ, are certain bilaterally symmetrical ossicles to which he applies the terms "anterior" and "posterior paired vomers." Critical examination of his monograph will show that he has in all probability described the same elements in some embryos as "posterior paired vomers," and in others as "ethmo-turbinals;" and further investigation must show whether he has, as I believe, or has not confused the two with each other, if with nothing else. Concerning his "anterior paired vomers," however, there is less, if any, room for doubt. He has shown that these, together with the "palatine processes" of the premaxillæ, may arise early, before the full differentiation of the bodies of the pre-

¹ *Loc. cit.* pp. 270-271.

² *Journ. Anat. & Phys.* vol. xix. p. 198 (1885).

maxillæ is effected. He asserts that in some of the forms he examined he regarded the anterior paired vomers as the sole representatives of the palatine processes of the premaxillæ. In describing some embryos, his language is only to be so construed as to show that he regarded the latter as representing (*Erinaceus*, p. 149, *Talpa*, p. 179, *Galeopithecus*, p. 253) a fusion of true palatine spurs of the premaxillæ with his anterior paired vomers so often alluded to. In having declared that in the Mole the "anterior paired vomers . . . are slightly separated from the palatine processes of the premaxillaries" (*loc. cit.* p. 166), that in the same animal the "antero-lateral vomers . . . have a very temporary and doubtful existence independent of these processes of the premaxillaries" (p. 179), and that while the palatine processes of the premaxillaries of the Shrew in having "no separate antero-lateral vomer attached to them" have "the same deficiency" as the Mole (p. 200), he has both involved himself in a contradiction and shown that he was unable to draw a sharp distinction between the palatine processes of the premaxillæ and his anterior paired (or lateral) vomers. The salient conclusions which arise out of Parker's investigation are (α) that we can no longer regard those structures ordinarily described among mammals as "palatine processes of the premaxillæ" as throughout homologous; and (β) that the latter are, in a number of cases, no parts of the premaxillæ at all, but rather referable to the vomerine category. In his discovery of the complex nature of the (non-pathological) premaxilla of mammals Parker is at one with Albrecht, who has shown that there is reason for regarding the premaxillæ of the adult *Ornithorhynchus* as a combination of distinct elements¹.

All those mammals for which Parker has recorded the presence of "anterior paired vomers" are long-nosed². Comparison of the skulls of the adults with those of the young, as figured by him, will show that while the bones in question may in some cases pass over to the true vomers, they more generally remain exclusively related to Jacobson's organ, which they ensheath in the form of the so-called premaxillary palatine processes, and their products of fusion and metamorphosis lie, for the most part, within the area of the latter as ordinarily described—occupy, that is to say, that of the palatine lobe of *Caiman niger* (*vo.*" fig. 2), in which the present inquiry finds its focus. Putting all together, nothing is clearer than that the vomers and palatine processes of the premaxillaries, which have been, I take it, sufficiently shown to be serial elements of a common category, lie collectively within the area of the vomers of the lower Amniota on one hand, and of the Crocodilian *Caiman niger* on the other. Collating these facts with those before recapitulated concerning the non-duplication and fundamental relationships of the vomers in the lower Vertebrata, we may most reasonably conclude that the bones referred to as anterior paired vomers and palatine processes have "become separate by absorption" (most probably

¹ Anat. Schriften, Hamburg & Leipzig, Op. 31, 1883.

² *Centetes*, *Cyclothurus*, *Erinaceus*, *Galeopithecus*, *Manis*, *Orycteropus*, *Rhynchocyon*, *Sorex*, *Talpa*, *Tatusia*.

under elongation of the snout, with its accompanying specialization) in the manner suggested by Parker himself for the "inter-palatines" of *Tarsipes*¹.

IV. The foregoing considerations justify us in regarding the palatine process of the mammalian premaxilla, which, be it remembered, ensheaths the organ of Jacobson, and the palatine lobe of the vomer of *Caiman niger* as, at least provisionally, one and the same element; and it is necessary now to turn to the latter, by way of inquiring how far its inner capsule may or may not be found to agree with that of the organ named.

There can be now no doubt that that structure sometimes referred to in the Amphibia as an organ of Jacobson is a maxillary sinus, non-homologous with the Jacobson's organ of the higher Vertebrata. The latter exists, in that which the known facts of development show to be most nearly its original form, among the Lacertilia. Its general relationships in these animals have been already described (above, p. 153). That the naso-palatine canal of the quadrupedal mammals (c.s., fig. 3) is the representative of the closed duct of the Lizards can hardly be doubted, on comparison of the two types; it has been shown by Herzfeld to be regularly absent in some mammals, while the aperture of communication between the body of Jacobson's organ and the floor of the nasal chamber (*a.j.*', fig. 3), met with in most mammals, is unrepresented in reptiles. On a survey of the known facts, I incline to the belief that the development of the last-named orifice is to be correlated with the loss of communication between the naso-palatine duct and the body of the organ, and that its appearance may have led up to that suppression of the duct in question seen in some forms (ex. *Equus*²). Be this supposition worth what it may, the accepted principles of morphology forbid our looking upon the Jacobson's organs of Reptiles and Mammals as in any way distinct.

The vomerine bulla of *Caiman niger* (*vo.*''', figs. 2 and 5) occupies an essentially similar position to the body of Jacobson's organ in both Mammals and Reptiles. Its aperture of communication with the nasal pharynx lies, like that of the duct of the Jacobson's organ in the Lizards (and less conspicuously, but no less surely, like that of mammals), within the area of the true posterior nostril. As I have been unable to examine a spirit-preserved head I am not in position to state whether, as seems not unlikely, a tubular duct may have arisen at this point or not. While, however, I have been unable to detect in any other Crocodile the entrance thereabouts of any nerve or blood-vessel such as might conceivably have been transmitted by it, sufficient of the dried remains of its lining membrane was present to enable me to assert, with assurance, that it contained a prolongation of the olfactory mucous membrane. This being so, its orifice might be not inaptly compared either to that of the Jacobson's organ of a

¹ Stud. Mus. Univ. Coll. Dundee, vol. i. p. 80 (1890).

² Herzfeld, *loc. cit.* p. 556.

Lizard in a backwardly displaced position, such as it might have come to assume under changes incident on the elongation of the snout, or to that of communication between the body of this organ and its duct—the latter having presumably disappeared.

From the foregoing facts and considerations, the conclusion seems, to me, inevitable that those animals from which both Crocodilia and Mammals have descended must have possessed, among other things, a vomer which met the pterygoids behind, and, like that of the Ichthyopsida and lower Amniota, extended to the premaxillary region in front,—in a word, the vomer of the living *Hatteria*. Born has shown¹ that the Jacobson's organ of the Lacertilia is largely supported upon the vomer; did that bone completely enclose it, a condition of the parts essentially like that of the bullate palatine lobe of *Caiman niger* would result. Klein has shown² that whereas in the *Rabbit* the cartilaginous sheath of Jacobson's organ (*je.*, fig. 3) is a complete tube and its bony sheath an incomplete one, in the *Guinea-pig* the latter tends to form "an almost complete capsule" anteriorly. In this, the palatine process of the premaxilla of the mammal, assuming its apparent vomerine homology, clearly approximates towards the condition of the palatine lobe of the vomer of *Caiman niger*.

Putting the foregoing facts and considerations together, the probability that the vomer of *Caiman niger* may lodge a (perhaps modified) Jacobson's organ becomes very great indeed; especially if, as is sometimes stated, that organ may³ "degenerate into a mere air-sinus."

I am fully alive to the possibility that, on the grounds laid down by Parker, the vomer of *Caiman niger* may be perhaps a compound structure. I should be exceedingly grateful to anyone who would procure me well-preserved heads of this animal, old and young, for the further elucidation of the questions raised.

If the characters and relationships of the vomer are to be taken as criteria of affinity, I need hardly point out that the facts herein dealt with indicate that the short-snouted Alligators, as represented by *Caiman niger*, must be considered to be the least modified of living Emydosauria,—the prevailing view to the contrary notwithstanding.

V. The Crocodilian premaxilla (*p.m.*, fig. 1) often bears that which might at first sight be taken to represent a palatine process (*p.p.*); and the existence of this spur of bone appears to have been generally overlooked. It is very variable in its individual development, and my own skulls of *Crocodylus palustris* show that it increases in length with advancing age. It is absent in *Caiman niger*; and, when present in other forms, it invariably overlies the maxilla as represented in fig. 1. These facts, in conjunction with

¹ *Op. cit.* Bd. v.

² *Loc. cit.* pp. 554-555.

³ Wiedersheim, *Lehrb. d. vergl. Anat.*, Aufl. 2, p. 400 (1886).



Howes, George Bond. 1891. "1. On the Probable Existence of a Jacobson's Organ among the Crocodilia; with Observations upon the Skeleton of that Organ in the Mammalia, and upon the Basi-Man-dibular Elements in the Vertebrata." *Proceedings of the Zoological Society of London* 1891, 148–159.
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