

ON THE ORGAN OF JACOBSON IN THE HYRAX.

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FROM my researches among marsupials and other mammals, I have been deeply impressed with the importance of the structure and relations of Jacobson's organ as a factor in classification, and one which, from its constancy even under the most varied conditions of life, is probably one of the most valuable in determining the affinities of any obscure animal or group. Having already studied the organ and its relations in most of the mammalian orders, I was naturally very anxious to examine the condition in the Hyrax, as an examination would probably throw additional light on the affinities of this remarkable form, which, notwithstanding the many points in which it resembles the ungulates, and the marvellous agreement of the molars with those of the rhinoceros, has, it must be admitted, certain cranial characters, apart altogether from the superficial resemblance in the upper incisors, in which it agrees apparently more with the rodents. As the organ of Jacobson is in all rodents that have yet been examined constructed on a type quite dissimilar to that in the ungulates, it seemed likely that the study would at least determine whether there was any real affinity between the Hyrax and the rodents.

I am unfortunately unable to give the species of the Hyrax examined. Thomas limits the western range of *Procavia capensis* to the neighbourhood of Cape Town, but a species is found not only right through Namaqualand, but also, I am led to believe, on into Damaraland. Though the species is apparently closely allied to *P. capensis*, it differs in having only twenty-one ribs. As it is unlikely, however, that any perceptible difference will be met with in the organ of Jacobson in the various species of *Procavia*, the exact species of the Hyrax examined is not of much importance for the present purpose.

Apart from the condition of the organ of Jacobson, there are a number of points in the anatomy of the snout in which the Hyrax departs considerably from the more usual mammalian type. The transverse ridges of the palate are very well developed, and in the anterior part, and just behind the larger incisors, there is found a very large rounded pad of connective tissue, very much resembling in appearance the large papilla of the wombat and other marsupials; but though probably similar in function, it is not a true homologue, as there is a minuter true papilla further forward. This large false papilla is supported by a small downward process from the well-developed palatine process of the premaxillary. In no other mammal that I am aware of is a similar development found, though the prevomer in *Gomphognathus* has a median downward development which is strikingly like this structure in the Hyrax.

When the organ of Jacobson is examined, the condition is found to be exceedingly interesting, and in some respects different from that of any other mammal as yet examined. As would be inferred from the well-formed palatine processes of the premaxillary, the cartilages of Jacobson's organ are well developed; and though the organ is less developed than the cartilages, it extends to a little beyond the posterior end of the palatine process. Owing to the somewhat complicated condition of the cartilages in the anterior region, it will be more convenient to describe the organ from behind forwards.

Fig. 1, Plate XXII., represents a section in the transverse plane passing a little behind the posterior border of the anterior palatine foramina, and shows the condition and relations of the most developed part of the organ. In the outer side of the well-developed palatine process (*p.Pmx.*) lies the cartilage of Jacobson—irregularly U-shaped. It rests on the palatine plate of the maxillary, and is remarkable chiefly for its having attached to its outer and lower corner the posterior development of the outer nasal-floor cartilage (*o.n.f.c.*). In a number of very dissimilar types, such as in *Echidna*, *Lepus*, *Miniopterus*, etc., this outer nasal-floor cartilage is well developed posteriorly; but I am not aware of any other form in which it becomes completely united to Jacobson's cartilage, although in *Echidna* the elements are practically in contact.

A little behind this plane the outer nasal-floor cartilage is lost, and Jacobson's cartilage has on section the usual C- or U-shaped appearance. The organ itself is less developed than in most of the lower mammals, and resembles in its structure that of the ungulates much more than that in the rodents. It receives along its upper edge the ducts of numerous glands; and on its outer side, within the cartilaginous sheath, is a very irregular plexus of veins.

Fig. 2 represents a section near the middle of the anterior palatine foramen. Here, the outer and inner walls of Jacobson's cartilage are closely approximated above, and form almost a complete tube for the duct of the organ. The outer nasal-floor cartilage is more developed than in the posterior sections, but still, as in these, forms with the premaxillary a complete floor to the nasal cavity. On this plane the organ is represented by the posterior part of its long duct, which is on section somewhat rounded, and lined with columnar epithelium. There is still here, as indeed there is, up to where Jacobson's duct opens into the naso-palatine canal, a number of larger veins in close relationship to the duct.

In fig. 3, which illustrates a slightly oblique section near the anterior border of the anterior palatine foramen, we have on the left side Jacobson's cartilage passing up by the side of the palatine process to unite with the nasal septum. Towards the lower part of the palatine process the cartilage curves inward and below it, and forms a very deep channel for the lodgment of the duct of the organ. The outer nasal-floor cartilage is still attached to the lower part of Jacobson's cartilage. On the right side of the figure, which is a little in front of the other, the premaxillary is about to unite with its palatine process, and in the angle between the two bony structures lies the upper part of Jacobson's cartilage,—united above to both the inner part of the nasal-floor cartilage proper, which rests on the palatine process, and also to the outer part which rests on the premaxillary. The uniting of the premaxillary with its palatine process shuts off the lower corner of the nasal cavity, which may now be regarded as the naso-palatine canal.

In fig. 4 the anterior development of the outer nasal-floor cartilage, which lies on the outer side of the naso-palatine canal, is now distinct from the anterior development of Jacobson's

cartilage, which protects Jacobson's duct on its upper, inner and under sides.

A little farther forward the two cartilages unite above, and, as shown in fig. 5, almost completely surround the naso-palatine canal and Jacobson's duct.

In fig. 6 the duct of the organ has opened into the naso-palatine canal.

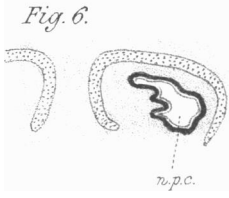
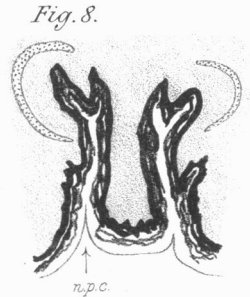
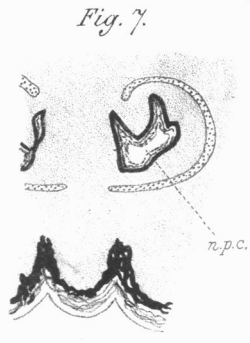
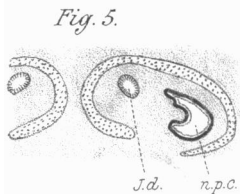
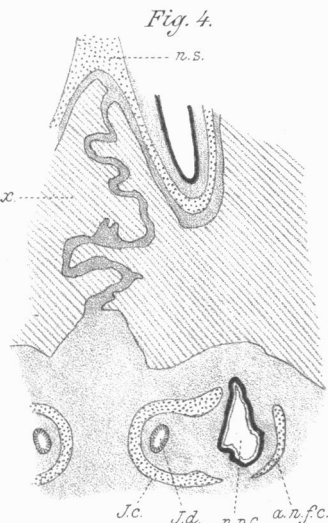
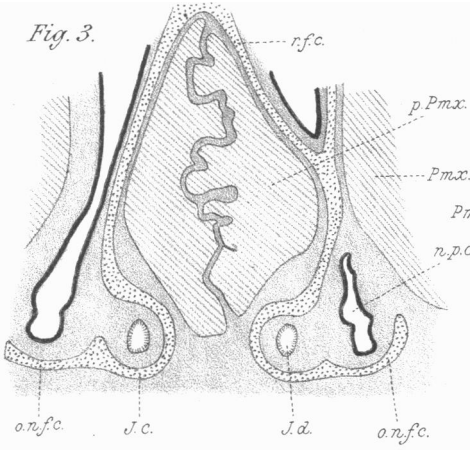
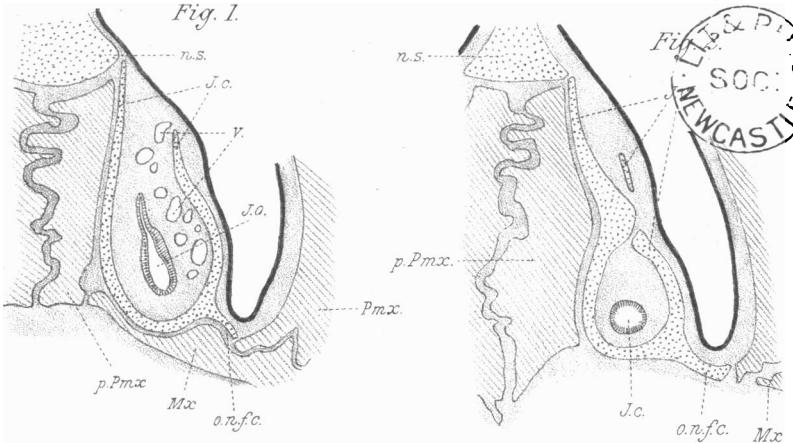
On passing still farther forward, Jacobson's cartilage becomes lost, and the canal is supported above and below and on the outer side (fig. 7).

Almost at the very front of the palate, and between the two large incisors, the naso-palatine canal opens by the side of the small papilla, as shown in fig. 8.

As I have recently shown,¹ the organ of Jacobson, with its cartilages and related structures, throughout the mammalia follows one of two main types. The first is seen in its most developed, though somewhat specialised, condition in the monotremata, and in a less developed and simpler condition in the marsupialia. With slight modifications the same type is followed in the edentata and rodentia. Here the inner part of the nasal-floor cartilage becomes Jacobson's cartilage; and though the organ may either open into the posterior part of the naso-palatine canal or on to the nasal floor, the cartilage is always simple, and never has any anterior or downward prolongation away from the part forming the anterior nasal floor. In the other type, which is seen in the cheiroptera, insectivora, lemuridæ, carnivora, and ungulata, Jacobson's organ, when developed, always opens into the naso-palatine canal, and there is always a complex arrangement of the cartilages. What is manifestly Jacobson's cartilage behind, is always found, on tracing it forward, to divide into an upper part which becomes the cartilage of the nasal floor, and a lower part which passes forwards and protects the duct of the organ on its inner side. For the two groups into which the Eutheria can thus be divided, I have proposed the names—Archæorhinata and Cænorhinata.

From the examination of the organ in the Hyrax, it will be at once seen that this animal must be placed in the latter of the

¹ "A Contribution to the Comparative Anatomy of the Mammalian Organ of Jacobson," *Trans. Roy. Soc. Ed.*, vol. xxxix. pt. i., 1897, p. 231.



two groups, as the relations of the organ are quite unlike those found in the rodentia and lower forms, and agree closely with those seen in the ungulata. Unfortunately the organ has only been carefully examined in a very few ungulate types; and though later researches may find in the organ of the rhinoceros or other form a closer agreement with the condition in the Hyrax, at present the organ in the Hyrax finds its nearest ally in that of the sheep and ox. The only feature of note in which the Hyrax organ differs from the normal ungulate type is in the possession of the well-developed outer nasal-floor cartilage. This is a primitive character now lost in most of the Cænorhinata, and still retained in many of the lower forms. Owing to the early obliteration of the naso-palatine canal in the horse, the condition of parts is so modified, and many of the structures so aborted, that the type is of little use for purposes of comparison. So far as can be seen, there are no features in the organ of the horse which approach more nearly to those of the Hyrax than do those of the sheep.

EXPLANATION OF PLATE XVIII..

References:—*a.n.f.c.*, anterior development of outer nasal-floor cartilage; *J.c.*, Jacobson's cartilage; *J.d.*, Jacobson's duct; *J.o.*, Jacobson's organ; *Mx.*, maxillary; *n.s.*, nasal septum; *n.f.c.*, nasal-floor cartilage; *n.p.c.*, naso-palatine canal; *o.n.f.c.*, outer nasal-floor cartilage; *Pmx.*, premaxillary; *p.Pmx.*, palatine process of premaxillary; *v.*, blood-vessels.

Fig. 1. T. section of Jacobson's organ in Procavia, behind anterior palatine foramen.

Fig. 2. T. section near middle of anterior palatine foramen.

Figs. 3-8. T. section through anterior palatine region, showing course of Jacobson's duct and naso-palatine canal.