

11. On the External Characters of the Mongooses (Mungotidæ). By R. I. Pocock, F.R.S., F.L.S., F.Z.S., Curator of Mammals.

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(Text-figures 1-10.)

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Introduction.

The facts recorded in this paper are based mainly upon an examination in the Society's Prosectorium of examples of the following genera and species, which have been exhibited during the past ten years in the Zoological Gardens :—

Mungos mungo, the common Indian Mongoose ; many specimens of both sexes.

„ *smithii* ; one female example from Ceylon.

„ *auropunctatus* ; two examples from Nepal and Chittagong.

„ *brachyurus* ; one example from the Malay Peninsula, only superficially examined, without drawings being made.

Myonax „ *gracilis* ; one unlocalised example of this African form.

Helogale undulata ; two examples from British East Africa very closely allied to this species, but with less yellow in the fur.

Ichneumia albicauda ; one female from the White Nile.

Atilax paludinosus ; one male from South Africa.

Cynictis penicillata ; one example from South Africa.

Ariela fasciata ; one female example from the Sudan, representing a local race of this species.

Crossarchus obscurus ; two examples, male and female, from West Africa.

Suricata suricatta ; two examples, male and female, from South Africa.

I have also seen, in addition to a few examples of some of the species above enumerated, a female specimen of *Bdeogale puisa*, ticketed Zanzibar (Sir J. Kirk), preserved in alcohol in the British Museum.

Although a study of the skulls and teeth has been no part of my present purpose, I have made use of the characters they

supply, in conjunction with the external features, in the attempt to discover the probable affinities of the genera with reference to a hypothetical archaic type of Mongoose. For this, the fine series of skulls in the British Museum has been indispensable.

There does not appear to have been any general work on the classification of Mongooses since the publication of Mr. Thomas's and Prof. Mivart's papers in our 'Proceedings' for 1882. The classification proposed by Mr. Thomas, and the genera he preserved, have been adopted by subsequent authors. It must be remembered, however, that his paper was written before the introduction of the more refined and modern methods of distinguishing genera. Hence there is no doubt that he would now agree in assigning generic rank to *Ichneumia*, to which at the time in question he gave subgeneric rank under *Herpestes*, now known as *Mungos*. I am not aware, however, that there has been published in any faunistic lists a proposal, either tacitly or definitely expressed, to restore *Atilax* and *Ariela* to the generic status formerly given them respectively by Cuvier and Gray. On the available material, Mr. Thomas made *Atilax* a synonym of *Herpestes* (= *Mungos*) and *Ariela* a synonym of *Crossarchus*. My reasons for restoring these names to generic rank are given in the sequel. About *Atilax* there can, I think, be no doubt, assuming the constancy of the features relied upon; and the only criticism, it seems to me, that can be made against the severance of *Ariela* from *Crossarchus* is the uncertainty, in the absence of fresh material, as to the correct generic allocation of all the forms that in recent years have been described as *Crossarchus*. This, however, does not deprive of their force the characters by which the type-species of *Ariela* can be distinguished from that of *Crossarchus*.

As regards the generic names previously proposed, it must not be forgotten that Gray and Hodgson divided what is now known as *Mungos* into several genera—e. g., *Urva*, *Tæniogale*, *Galerella*, etc.,—the type-species of which were cited by Thomas in 1882. It remains to be seen whether any of these genera will be restored in the future or not*. I have not sufficient material upon which to form an opinion of any value; but as at present constituted, *Mungos* is the only genus of Viverroid Carnivores common to the Oriental and Ethiopian Regions.

Two new generic names have been introduced since Thomas's paper, namely, *Paracynictis* for *Cynictis selousi*, and *Galeriscus* based upon *G. jacksoni*, an alleged Musteline from British East Africa, which proves to be a species of *Bdeogale* †.

* The small African Mongoose (*Mungos gracilis*), the type of *Galerella* Gray, differs in several respects from Mongooses of the *M. mungo* and *M. ichneumon* type, notably in its larger ears, less webbed feet, and in the prominence of the anterior chamber of the tympanic bulla. In all these respects it approaches the otherwise very distinct genus *Cynictis*. Another small African species, *M. pulverulentus*, appears to resemble *M. gracilis* tolerably closely, so far as can be judged from dried material.

† Ann. Mag. Nat. Hist. (8) xvii. pp. 176-179, 1916.

The Ear, Vibrissæ and Rhinarium.

The Ear.—The only description of the ear of Mongooses with which I am acquainted is that of Boas ('Ohrknorpel und äusseres Ohr der Säugetiere,' p. 140, pl. xxi. fig. 222, Kopenhagen, 1912), who examined this organ in the common Indian species *Herpestes griseus* (= *Mungos mungo*).

The ear differs in the following particulars from that of all the genera of Viverridæ discussed in my previous papers:—(1) The marginal bursa is absent; (2) the *supratragus* or *plica principalis* is converted into a large movable laminate flap; (3) above the supratragus there is a similar but smaller flap; (4) the antero-internal ridge curves abruptly backwards into the cavity of the ear, its inferior prominence being set high up and fitting into a hollow above the antitragus. By the disposition of these ridges the cavity of the ear is capable of being very completely closed when the ear is folded. The superior flap closes over the space above the supratragus, the latter similarly shuts down upon the antero-internal ridge, and the prominence of the latter fits into the space above the antitragus, which is itself applied to the ridge representing the tragus.

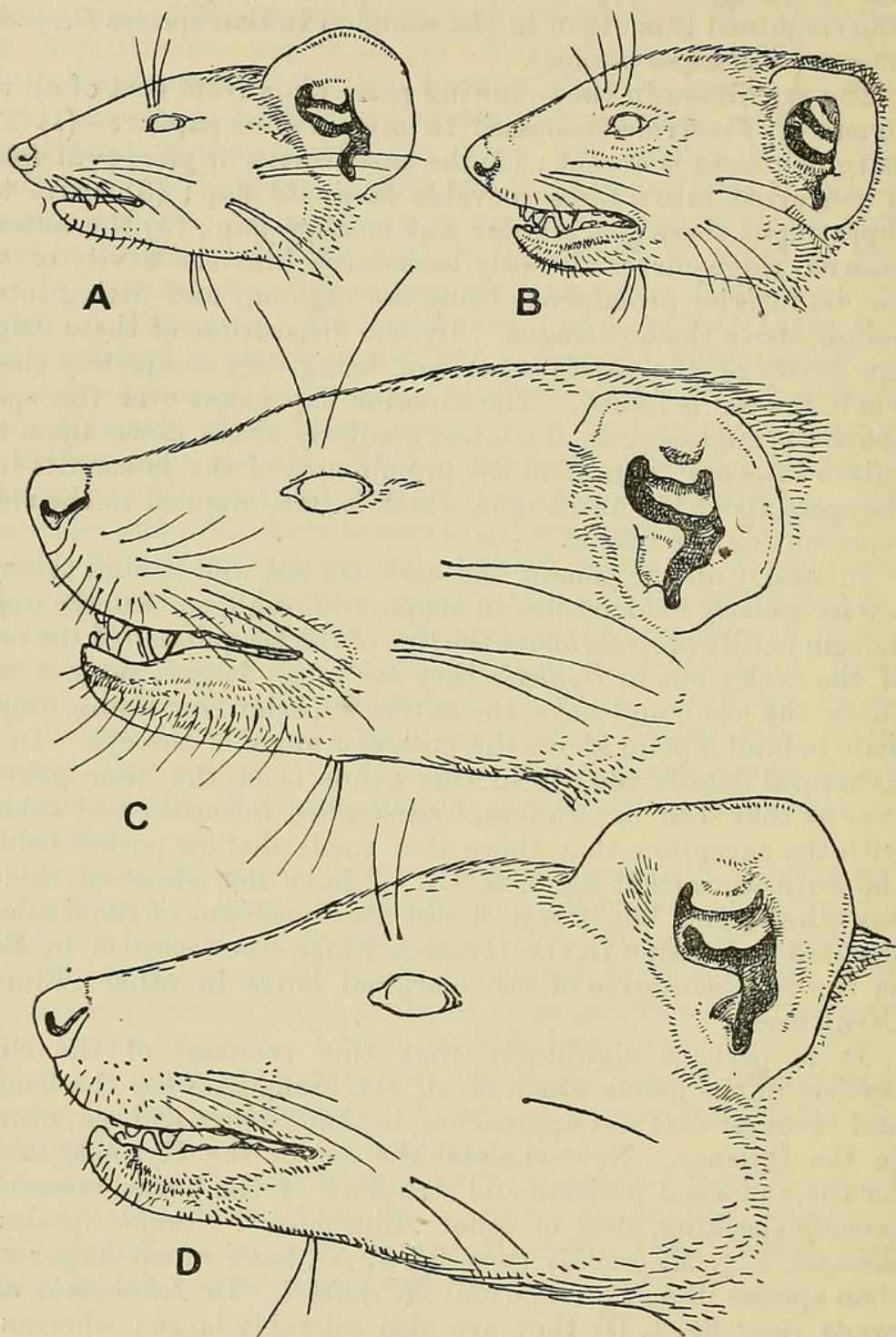
In nearly all the genera the ears are set well behind the eye, are irregularly semicircular in shape, and small, so that the upper margin hardly projects above the line of the occiput and of the nape of the neck; but in *Cynictis* they are much larger, project well above the head, and have the antero-superior rim rising only a little behind a point above the posterior angle of the eye. In its structural details the ear in this genus is of the same general type as that seen in *Mungos*, *Crossarchus*, *Bdeogale*, and others, with the exception that there is a small shallow pocket behind the antitragus (text-fig. 3, A, C). I have not observed this in any other genus, but it is no doubt the homologue of the similarly situated depression in the Hyænas, which was regarded by Boas as the representative of the marginal bursa in other Æluroid Carnivores.

It is perhaps significant that this remnant of the bursa persists in the genus which of all the Mongooses has the longest and broadest ears and approaches, in that respect at least, nearest to the Hyænas. Nevertheless, the ear of the Hyænas, except for the abnormal position and structure of the bursa, resembles, broadly speaking, that of other Æluroidæ*. Some species of *Mungos*, e. g. *M. gracilis* (text-fig. 1, A), have much larger ears than species like *M. mungo* and *M. smithii*. In *Ichneumia albicauda* (text-fig. 1, D) they are also tolerably large; whereas in *Atilax paludinosus* (text-fig. 1, C), *Ariela fasciata* and *Crossarchus obscurus* (text-fig. 2, A, B) they are comparatively small and rounded. Nevertheless, whatever their size may be, the ears conform closely to the type described in *Mungos mungo* and *M. smithii*.

* See Ann. Mag. Nat. Hist. (8) xvii. p. 333, 1916.

One genus, *Suricata*, stands quite apart from the others in the structure of the ear (text-fig. 3, B, D). This organ is small,

Text-figure 1.

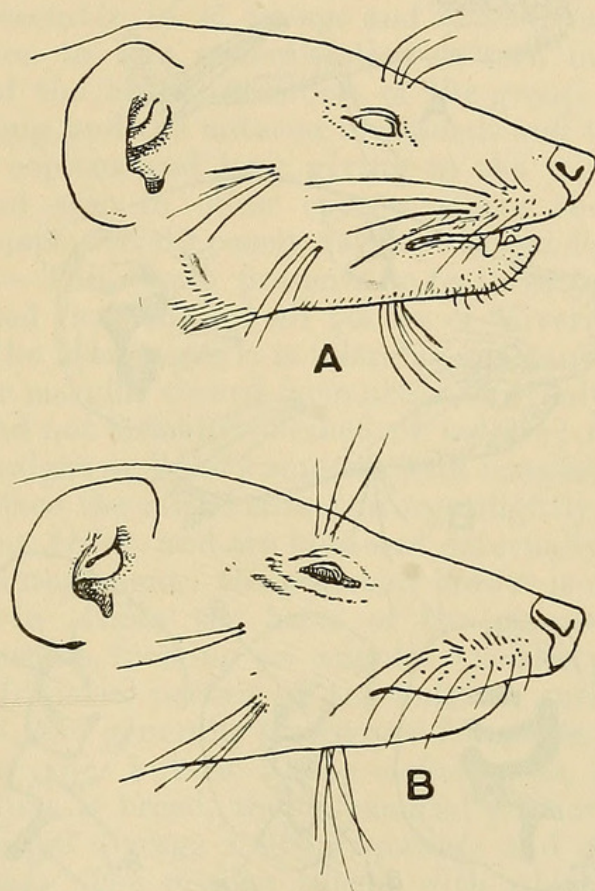


- A. Head of *Mungos gracilis*, from a spirit-specimen, with ear open.
 B. „ *Helogale undulata*, from a fresh specimen, „ „
 C. „ *Atiiax paludinosus*, „ „ „ „
 D. „ *Ichneumia albicauda*, „ „ „ „

(All $\frac{2}{3}$ natural size.)

semicircular, and set well back and low down on the head, but it is of a much simpler type than in other genera. There is no lamina above the supratragus, and the latter is a simple thickened ridge. In other respects the ear resembles that of the rest of the genera of Mongooses, differing from the ear of all the Viverridæ in the absence of the bursa and the high position of the prominence of the antero-internal ridge above the antitragus. Amongst the Viverridæ, the Galidictine* genera are those which in the structure of the ear come nearest to *Suricata*.

Text-figure 2.



A. Head of *Ariela fasciata*, from a fresh specimen, with ear closed.

B. „ *Crossarchus obscurus*, „ „ „ „

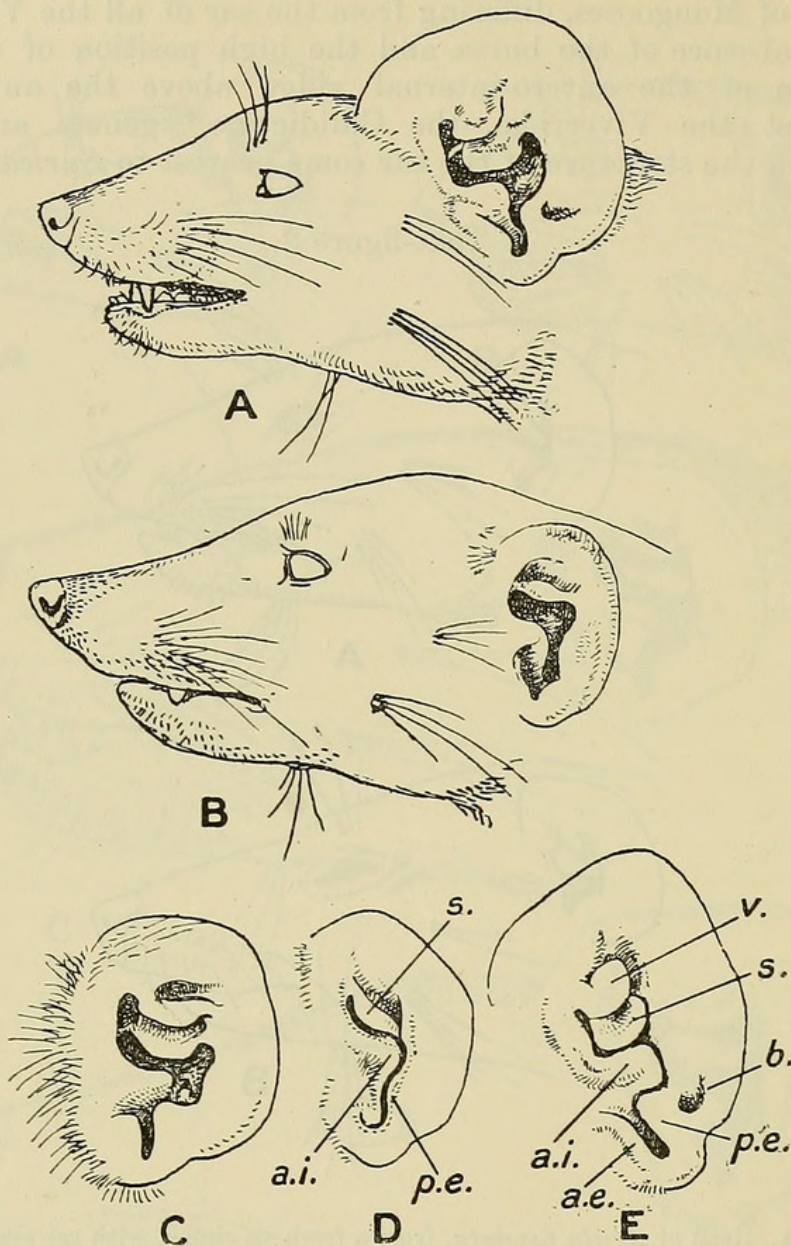
(Both $\frac{2}{3}$ natural size.)

The ear of *Suricata*, in spite of the absence of the two movable laminae, is capable of being closed as tightly as in other members of this group, the supratragal ridge assuming an oblique direction and being pressed against the antero-internal ridge when the ear is folded. That being so, it is difficult to understand the reason for the development of the two laminae in the typical Mongooses. I think, however, it is probable that the close folding of the ear is an adaptation to the known burrowing habits of this group,

* Ann. Mag. Nat. Hist. (8) xvi. p. 354, pl. xv. fig. 4, 1915.

since the Civets, Genets, and Palm Civets, with normal ears, are either scansorial or terrestrial, but not fossorial *. In that case,

Text-figure 3.



- A. Head of *Cynictis penicillata*, from a spirit-specimen, with ear open. $\times \frac{2}{3}$.
 B. „ *Suricata suricatta*, „ „ „ „ „ „
 C. Ear of *Mungos smithii*, open.
 D. „ *Suricata suricatta*, closed.
 E. „ *Cynictis penicillata*, closed.

v., upper valvular lamina; s., supratragus (plica principalis), forming lower valvular lamina; b., bursa; a.i., antero-internal, a.e., antero-external, p.e., postero-external ridges.

it seems to me possible that the method of closing the ear by means of two laminae, as above described, may serve the purpose

* Not ascertained in the case of the Galidictinæ.

of excluding dust and dirt without at the same time excluding sound-vibrations to the same extent as does the arrangement for folding seen in *Suricata*.

Facial Vibrissæ.—In number and disposition the tufts of vibrissæ are quite normal and agree with those of the Viverridæ. But they vary a good deal in development in different forms. Broadly speaking, they are longer and more numerous in smaller than in larger species, as may be seen by comparing *Mungos gracilis* with *M. mungo* or *Ichneumia albicauda* with *Ariela fasciata* and *Crossarchus obscurus*. For instance, the upper genal tuft consists of about three bristles in *M. gracilis* and *Ariela fasciata*, and generally at all events of only one, which is not always detectable, in *M. mungo* and *Ichneumia*.

An exception to this generalisation is seen in *Atilax paludinosus*, one of the largest members of the group. The normal vibrissæ are long, and the anterior mystacials and the submentals are unusually copious and long, giving to the muzzle a hirsute appearance not seen in other species where these particular bristles are comparatively poorly developed (text-figs. 1, 2, & 3).

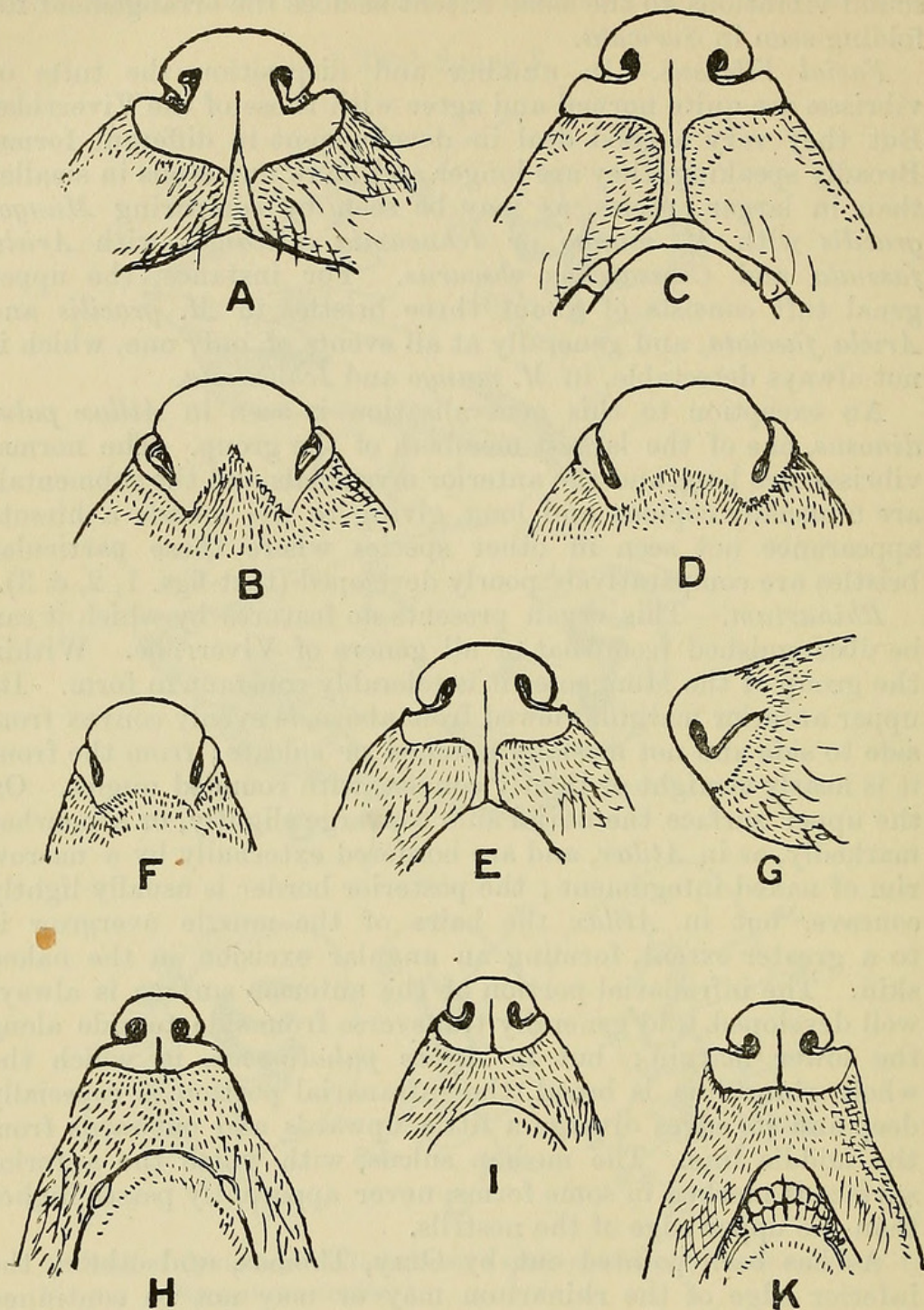
Rhinarium.—This organ presents no features by which it can be distinguished from that of all genera of Viverridæ. Within the group of the Mongooses it is tolerably constant in form. Its upper anterior margin, viewed from above, is evenly convex from side to side and not mesially notched or sulcate; from the front it is nearly straight or lightly convex, with rounded angles. On the upper surface the narial slits converge slightly, or somewhat markedly, as in *Atilax*, and are bordered externally by a narrow rim of naked integument; the posterior border is usually lightly concave, but in *Atilax* the hairs of the muzzle overgrow it to a greater extent, forming an angular excision in the naked skin. The infranarial portion of the anterior surface is always well developed, and generally transverse from side to side along the lower margin; but in *Atilax paludinosus*, in which the whole rhinarium is broad, the infranarial portion is especially deep and its edges diverge a little upwards and outwards from the middle line. The median sulcus, with which the anterior surface is marked in some forms, never apparently passes higher than the upper edge of the nostrils.

As has been pointed out by Gray, Thomas, and others, the inferior edge of the rhinarium may or may not be continued down the middle line of the upper lip as a strip of naked skin. This strip is present in the genera *Mungos*, *Helogale*, *Ichneumia*, *Atilax*, *Bdeogale*, and *Cynictis**, and absent in *Rhynchogale*†, *Ariela*, *Crossarchus*, and *Suricata*, in which the skin of the upper lip is continuously hairy across the middle line. When this strip is present, it is always grooved, and in a great majority

* In the 'Fauna of South Africa,' Mamm. i. p. 73, 1900, Mr. W. L. Sclater places *Cynictis*, with *Suricata* and *Crossarchus* (= *Ariela*), in the category in which the lip is undivided. This is an error.

† I have never seen a fresh or alcohol-preserved adult example of this genus.

Text-figure 4.



- A. Rhinarium and upper lip of *Atilax paludinosus*, from the front.
 B. " " " " " from above.
 C. " " " *Ichneumia albicauda*, from the front.
 D. " " " " " from above.
 E. " " " *Mungos smithii*, from the front.
 F. " " " " " from above.
 G. " " " " " from the side.
 H. " " " *Suricata suricatta*, from the front.
 I. " " " *Ariela fasciata*, "
 K. " " " *Crossarchus obscurus*, "

(All natural size.)

of cases the groove is continued upwards on to the rhinarium. In *Cynictis*, however, the groove does not quite reach the rhinarium and is confined to the upper lip, where it is nothing but an impressed line, not a definite gutter, dividing the median naked area of skin. In the other genera of Mongooses possessing this feature, the median naked area forms a gutter capable of expansion and contraction. When contracted, it closes up completely and is represented superficially by a linear groove, the right and left hairy areas of the upper lip being in contact in the middle line. In *Cynictis*, therefore, we have a condition of the upper lip nearly intermediate between the condition seen in *Mungos*, with the guttered upper lip, and *Ariela*, with the undivided upper lip.

The depth, or height, of the upper lip beneath the rhinarium varies. In most genera it is less than the depth of the rhinarium. But in *Ichneumia albicauda* the lip is deeper—as deep, indeed, as the rhinarium. The same applies to *Crossarchus obscurus*; but in this animal the rhinarium is relatively much deeper than in *Ichneumia*, owing to the unusual depth of the infranarial portion in front. Hence the lip itself is also relatively deeper. It is the combined depths of the rhinarium and lip which impart to *Crossarchus* the very characteristic somewhat pig-like appearance about the snout—an appearance not noticeable in any other species of Mongoose except *Suricata* *.

Normally in Mongooses, as in other Carnivores, the two portions of the upper lip to the right and left of the groove are closely in contact, the groove itself appearing as a narrow vertical line. The function of the groove is to help the separation of the two halves of the lip when raised to clear the teeth. When the groove is obliterated, the snout is raised, thus drawing the lip upwards away from the teeth, a phenomenon very noticeable in such forms as *Procyon* and *Nasua*. In all Carnivora it seems that elongation of the snout does not take place without obliteration of the groove; but the condition of the snout in *Ariela* shows that it is not true to say that obliteration of the groove always accompanies elongation of the snout.

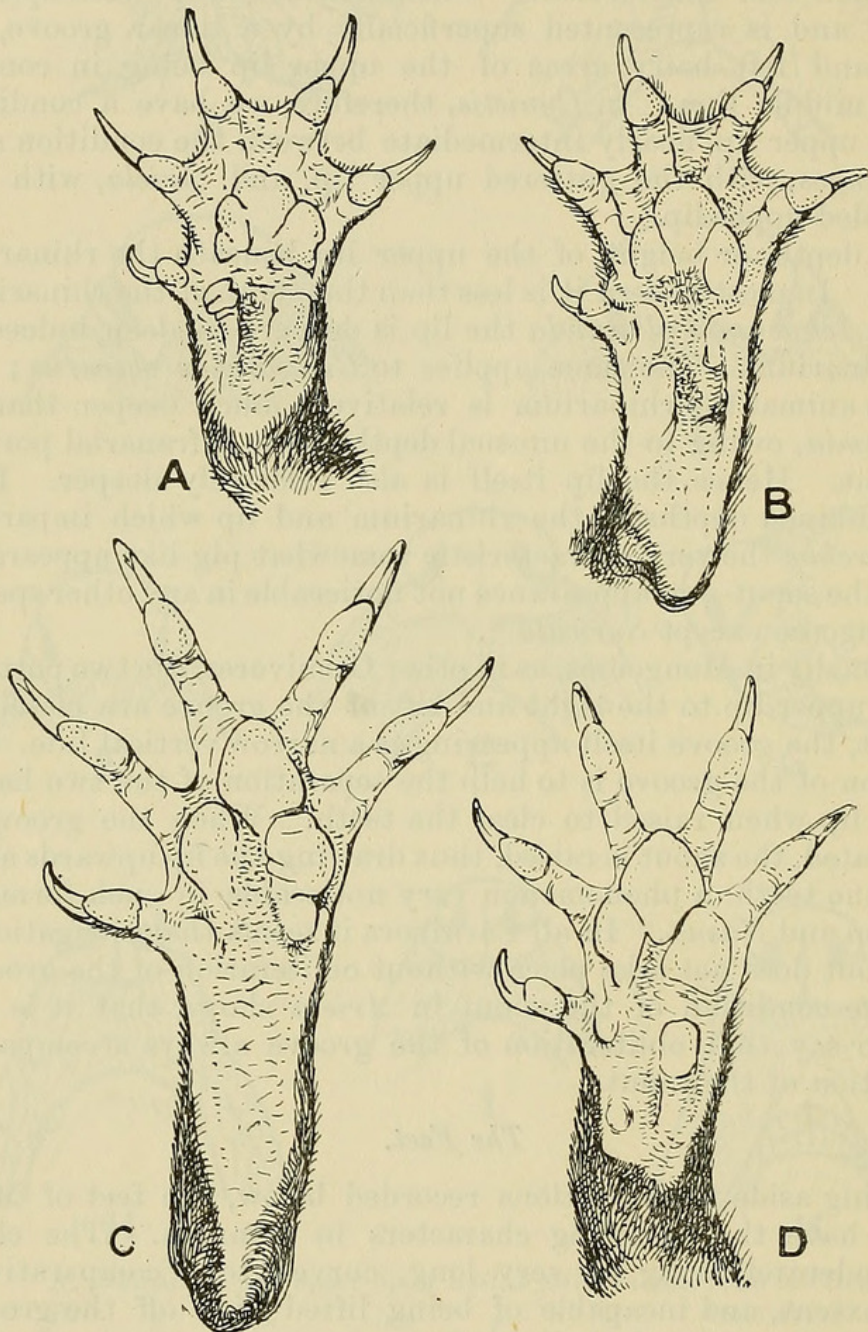
The Feet.

Setting aside the variations recorded below, the feet of Mongooses have the following characters in common. The claws are moderately long or very long, curved to a comparatively small extent, and incapable of being lifted high off the ground by the retraction of their phalanx upon the outer surface of the penultimate phalanx, and the tips of the digits at the base of the claws are never provided with lobes of skin or thickly-growing hair. The digital pads are small. The plantar pad is

* The name *Rhinogale*, and its substitute *Rhynchogale*, suggest a similar modification of the snout in that genus. The adult of this rare animal is, however, known to me only from dried skins, in which the real length of the snout cannot be determined.

well developed, cushion-like and trilobed, and the area between it and the digital pads, whether webbed or not, is naked. The hallux and pollex, when present, are shortish or very short and set above the plantar pad; and the hallucal and pollical lobes of

Text-figure 5.

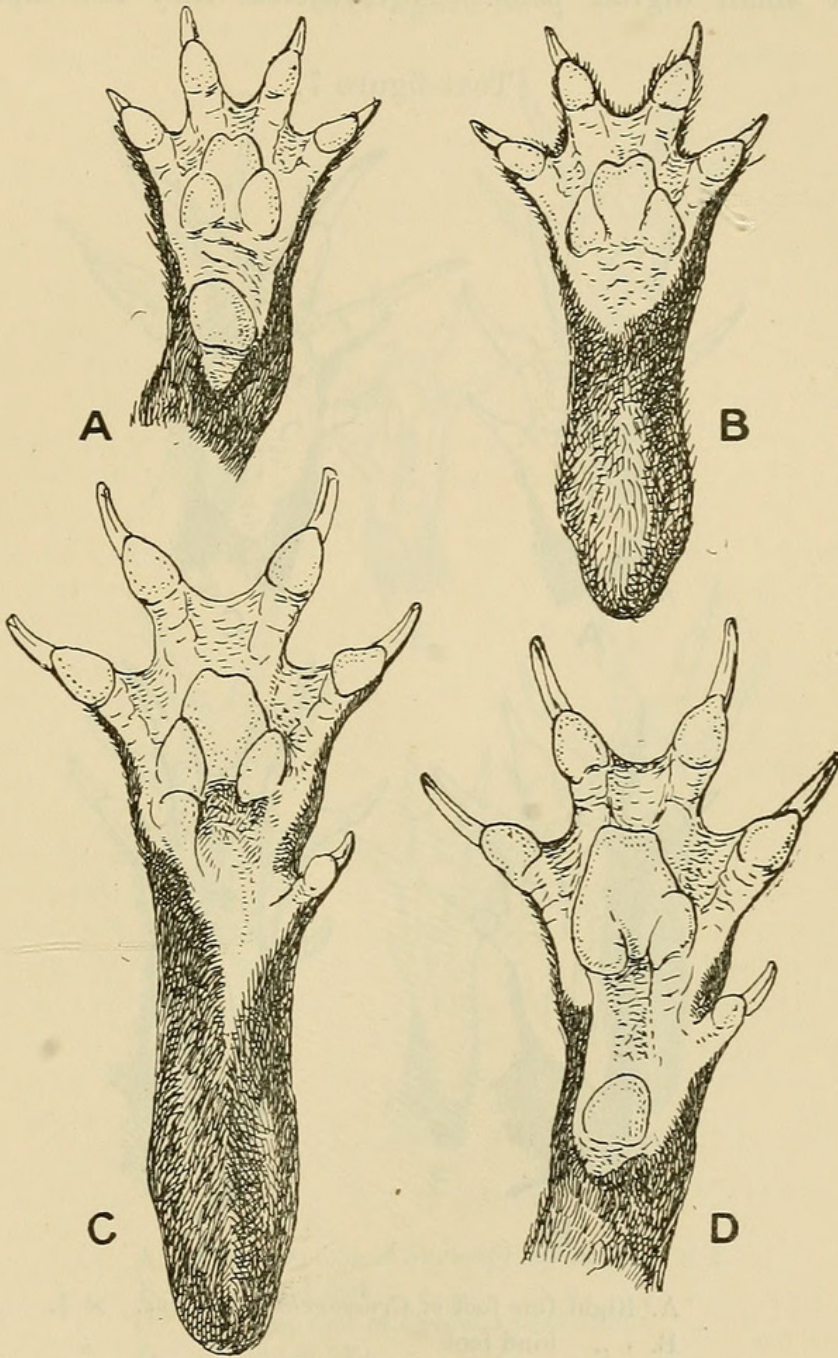


- A. Left fore foot of *Mungos smithii*. $\times \frac{2}{3}$.
 B. „ hind foot „ „ „ „
 C. „ fore foot of *Atilax paludinosus*. „ „
 D. „ hind foot „ „ „ „

the plantar pad are small or obsolete, and detached from the plantar pad. A single or double carpal pad is always present, and separated by a naked tract from the plantar pad.

Judging from the analogy supplied by other Carnivores, the ancestral foot of the Mongooses was pentadactyle and plantigrade, and furnished with well-developed interdigital webs and naked soles.

Text-figure 6.

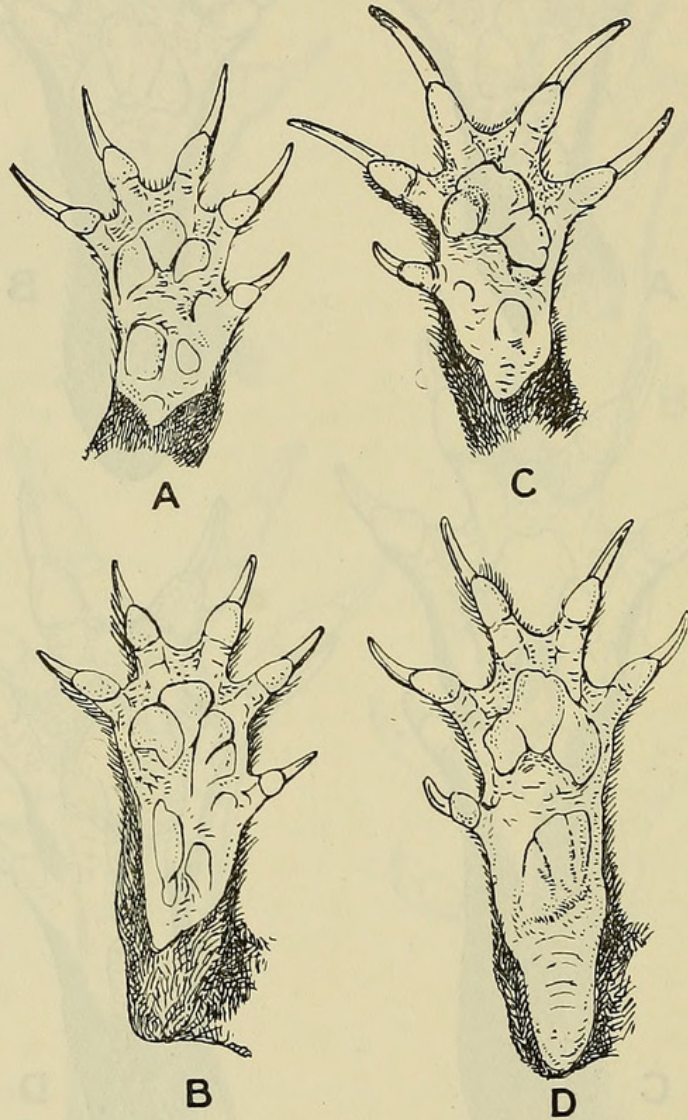


- | | | |
|----|--|------------------------|
| A. | Right fore foot of <i>Bdeogale puisa</i> . | $\times \frac{2}{3}$. |
| B. | " hind foot " " | " |
| C. | " " <i>Ichneumia albicauda</i> . | " |
| D. | " fore foot " " | " |

The feet of several of the genera conform to this type, and those of *Mungos* may be taken as an illustration and as a standard with which the feet of other genera may be compared.

In a specimen of *Mungos smithii*, a Ceylonese species, the fore foot is entirely naked beneath as far back as the carpus. The digits, when spread, are seen to be slightly asymmetrically arranged. The four main digits are united by webbing which extends proximally up to the inner or admedian portion of the rather small digital pads. Nevertheless they are capable of

Text-figure 7.

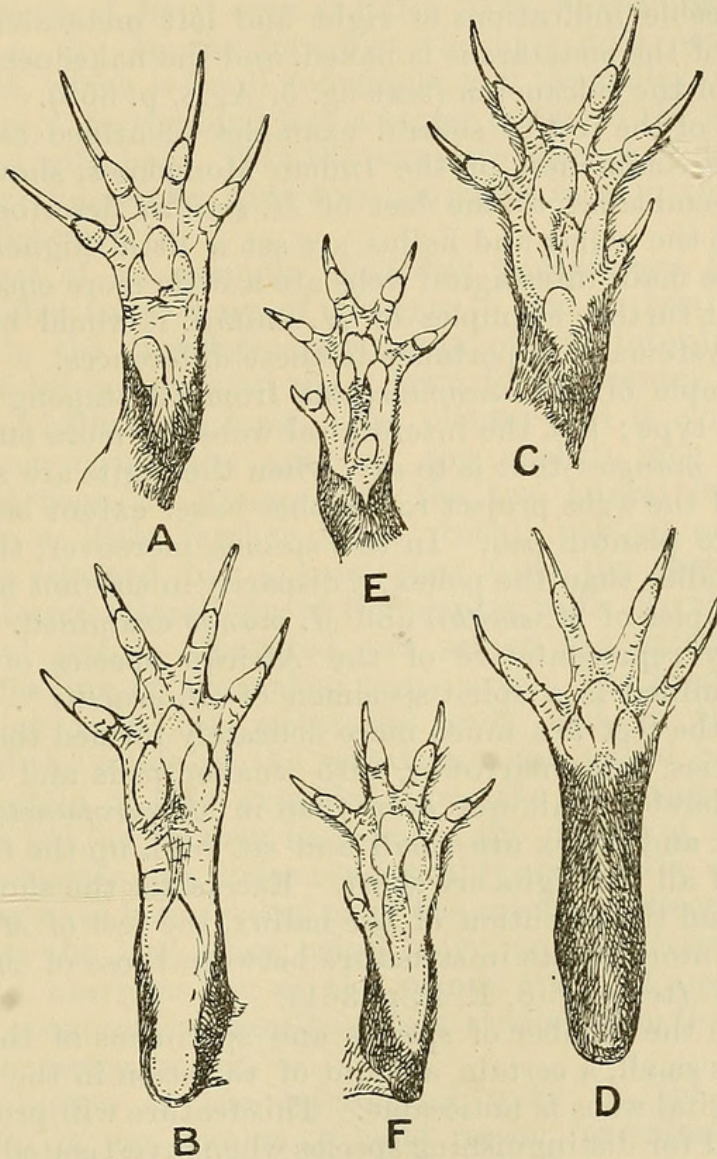


- A. Right fore foot of *Crossarchus obscurus*. $\times \frac{2}{3}$.
 B. „ hind foot „ „ „ „
 C. Left fore foot of *Ariela fasciata*. „ „
 D. „ hind foot „ „ „ „

being more widely divaricated than is the case in the arboreal or terrestrial genera of Viverrinæ and Paradoxurinæ. The claws are longish. The pollex is quite short, does not project laterally so far as the second digit, and is inserted higher up the foot than the adjacent portion of the plantar pad; its claw is well

developed, but smaller than that of the other digits. The plantar pad is swollen, trilobed and asymmetrical, the external lateral lobe being a little larger and extending higher up the foot than the internal lateral lobe. The distal margin of the median lobe

Text-figure 8.



- A. Right fore foot of *Suricata suricatta*. $\times \frac{2}{3}$.
 B. „ hind foot „ „ „ „
 C. „ fore foot of *Cynictis penicillata*. „
 D. „ hind foot „ „ „ „
 E. Left fore foot of *Mungos gracilis*. „
 F. „ hind foot „ „ „ „

is broadly truncated, and extends obliquely backwards and outwards to the point where it meets the external lobe. There is a small pollical lobe, but it is detached from and higher up than the posterior extremity of the internal lateral lobe of the plantar pad. The larger carpal pad occupies a similar position with

regard to the posterior end of the external lateral lobe. It is on the outer side of the middle line of the foot, and between it and the edging of hair there is a naked area of considerable size.

The hind foot agrees with the fore foot in all essential respects, but the digits are more symmetrically disposed and the claws are shorter. There is a small detached hallucal lobe, and above the latter and on the corresponding area on the outer side of the foot there are feeble indications of right and left metatarsal ridges. The whole of the metatarsus is naked, and the nakedness extends to the tip of the calcaneum (text-fig. 5, A, B, p. 358).

Sketches of the feet of several examples identified as *Mungos mungo*, the commonest of the Indian Mongooses, show a close general resemblance to the feet of *M. smithii* described above, except that the pollex and hallux are set a little higher and the edges of the main interdigital webs are a little more emarginate; but without further examples of *M. smithii*, it would be unwise to attach systematic importance to these differences.

An example of *M. auropunctatus* from Chittagong also has feet of this type; but the interdigital webs are more emarginate than in *M. mungo*—that is to say, when the digits are separated the edges of the webs project to a rather lesser extent beyond the lobes of the plantar pad. In this species, moreover, the hallux is much smaller than the pollex, a disparity in size not noticeable in the examples of *M. smithii* and *M. mungo* examined.

The only representative of the African species of *Mungos* I have examined is a spirit-specimen of *M. gracilis* *. In this individual the feet are much more delicately formed than in the Indian species, being narrower, with smaller pads and with the webs considerably shallower even than in *M. auropunctatus*, and both hallux and pollex are small and set high up the foot; but the claws of all the digits are short. Except for the shortness of the claws and the retention of the hallux, the feet of *M. gracilis* are nearly intermediate in structure between those of *M. mungo* and *Cynictis* (text-fig. 8, E, F, p. 361).

Although the number of species and specimens of this genus examined is small, a certain amount of variation in the depth of the interdigital webs is noticeable. This feature will probably be found useful for distinguishing species when investigated in forms hitherto unexamined.

One other character is known to be variable, as Thomas has shown for the African and Blanford for the Indian species, namely, the extent to which the heel is covered with hair. This feature may vary within the limits of a single species, e. g. *M. ichneumon*; and in *M. urva* the upper part of the metatarsus as well as the tarsus is hairy.

In *Helogale* the feet recall those of the Indian species of *Mungos*, but, if anything, are more robust, with the webs

* Peters figured the soles of the feet of this species under the name *M. ornatus* ('Reise nach Mossambique,' Säug. pl. xxvi., 1852). The shallowness of the webs is shown, but details of the plantar pads are not indicated.

more deeply emarginate. The hair on the carpus reaches the carpal pad, which has a supplementary lobe at the base on the inner (pollical) side. In the hind foot the hallux is small, smaller than the pollex, as in *Mungos auropunctatus*, and the heel is hairy, when the hairs are not worn off.

Peters' figures of the feet of typical *H. undulata* from Mozambique differ in some respects from those of the examples of this genus I have seen ('Reise nach Mossambique,' Säug. pl. xxv., a, b). In the fore foot the hair does not reach the carpal pad, which is small and single, and the pollex is set higher up the foot. In the hind foot a larger extent of the underside is overgrown with hair. But the complete absence of detail in the outline of the plantar pads does not attest care in the execution of these figures*.

The feet of an example of *Atilax paludinosus* from South Africa differ from those of *Mungos* in one or two particulars, notably in the complete suppression of the interdigital webs, the digits being separated right down to the plantar pad. Both pollex and hallux are long. The plantar pad is elongated and distally narrowed, the apex of the median lobe being less truncated than in *Mungos*, and the two lateral lobes are set relatively a little farther back. Small pollical and hallucal lobes are retained, but are detached from the posterior angle of the internal lateral lobe of the plantar pads. In the fore foot, the carpal pad is elongated and set on the external side of the middle line of the naked carpal area. The hind foot shows no distinct traces of metatarsal pads, and in the example examined the whole of the metatarsus was naked beneath, and a naked strip of skin extended along the underside of the heel to its tip, but, as Thomas has shown, the degree of hairiness of the tarso-metatarsus varies considerably within the species, this area sometimes being naked as in the specimen described above, sometimes the heel alone being hairy, and sometimes the hair extending nearly as low as the plantar pad. I am not aware whether geographical races have been studied from the standpoint of this character, or not.

The absence of the interdigital webs in this Mongoose constitute, in my opinion, a valid reason for resuscitating the genus *Atilax* (text-fig. 5, C, D).

In an example of *Ichneumia albicauda* from Dufle (White Nile) the feet are slender and longish, with decidedly emarginate webs, recalling in these respects those of *Mungos gracilis* rather than of *M. mungo* or *M. smithii*. The hallux and pollex, about equal in size, are set well above the plantar pad. The carpal pad is semielliptical, of moderate size and higher than the

* In systematic works, *Helogale* is merely distinguished from *Mungos* by the suppression of the diastema between the canine and pm.² of the upper jaw, pm.¹ being absent, as sometimes occurs in *Mungos*. As living animals, *Helogale* and *Mungos* are very different in appearance, the former being a squat little creature with a comparatively short tail and a broad head with short, pointed muzzle.

pollex, with only a narrow strip of naked skin above it. In the hind limb the hairs, as recorded by others, extend all over the back of the metatarsus practically down to the hallux. Judging from dried skins, there does not appear to be any marked variation within the species in the hairiness of the metatarsus (text-fig. 6, C, D, p. 359).

This Mongoose is more digitigrade and stands higher on its legs than any member of the group of which I have seen living specimens, not excepting even perhaps *Atilax paludinosus*.

In *Ariela fasciata* the fore foot closely resembles that of *Mungos* except that the digits and the naked area behind the plantar pad are relatively a little shorter, the claws longer, and the interdigital webs somewhat shallower. The hind foot is rather narrower than in *Mungos*, the lateral interdigital webs are much more deeply emarginate, whereas the median web between the third and fourth digits is about as deep as in *Mungos* but ties the toes a little closer together. The hallux is as large as the pollex. The sole of the foot is naked back to the tip of the calcaneum, and a little behind the plantar pad there are traces of suppressed metatarsal pads (text-fig. 7, C, D, p. 360).

The fore foot of *Crossarchus obscurus* does not differ from that of *Ariela fasciata* except that the carpal pad is larger and has a small supplementary lobe on its inner or pollical side, as in *Helogale*, but detached from the main part of the pad. The hind foot is relatively shorter than in *Ariela fasciata*, owing to the shortness of the third and fourth digits. In the specimens examined, the heel, when unworn, is hairy *, the naked area of the metatarsus corresponding exactly with that of *Helogale*. This area exhibits a pair of low elongated metatarsal pads, of which the external projects farther forwards than the internal (text-fig. 7, A, B).

In *Cynictis penicillata* the hind foot, as has been often stated, is hairy below down to the plantar pad, and differs from that of the genera hitherto recorded in the total suppression of the hallux. The whole foot is comparatively long and narrow, and the webs are very shallow, those between the second and third and the fourth and fifth digits extending only slightly beyond the plantar pad on each side, and although the web between the third and fourth digits is a little deeper, it only passes about half-way up the admedian margin towards the digital pads, which, like the digits themselves, are narrow. The claws are long. The three lobes of the plantar pad form a tolerably evenly cordate mass narrower than in *Mungos* and *Crossarchus*. The fore foot closely resembles the hind foot, but the claws are longer, the interdigital webs are a little deeper, and the pollex, carrying a long claw and set high above the plantar pad, is retained, although short. The area between the plantar pad and the small submedian carpal pad is quite naked (text-fig. 8, C, D, p. 361).

* Perhaps a variable character, since Thomas (P. Z. S. 1882, p. 86) mentioned the nakedness of the hind soles amongst the generic characters of *Crossarchus*.

The genus *Paracynictis* *, recently established for the species described by de Winton as *Cynictis selousi*, seems to resemble *Cynictis* in the structure of the feet except that the pollex is suppressed, as well as the hallux. In this respect the feet resemble those of *Suricata* and *Bdeogale*.

The feet of two species of *Bdeogale*, namely, *B. puisa* and *B. crassicauda*, have been figured by Peters †. Although the details of the plantar pads are not very clearly shown, the drawings are tolerably accurate, judging from a spirit-preserved example of *B. puisa*, ticketed "Zanzibar (Sir J. Kirk)," in the British Museum. In this example the feet are, on the whole, very symmetrical with respect to the plantar pads and the digits. The latter are shorter and a little thicker than in *Mungos*, but are webbed approximately to the same extent. There is no trace externally of hallux or pollex. The carpal pad is large and submedian in position, but with a slight external inclination. Behind it there is a small triangular area of naked skin, and in front of it a broad naked area separates it from the plantar pad. All trace of the pollical lobe has disappeared with the pollex. In the hind foot there is a semicircular area of naked skin behind the plantar pad. Apart from this, the entire posterior surface of the metatarsus is covered with hair; and judging from dried skins, the hair in some species extends right down to the plantar pad. In other respects the structure of the feet in this genus is apparently tolerably uniform (text-fig. 6, A, B).

The last of the tetradactyl Mongooses is *Suricata*. In length and narrowness the feet resemble those of *Cynictis*. The claws are perhaps a little longer, and the webs are deeper, but they are not so deep as in *Mungos*, being developed to approximately the same extent as in *Ariela*. On both the fore and the hind foot the web between the third and fourth digits is deeper than the others, and on the hind foot the web between the third and fourth is deeper than that between the fourth and fifth digits. The digits are less symmetrical than in *Cynictis*, and markedly asymmetrical as compared with those of *Bdeogale*. The carpal and plantar pads are normal in development, and the external lobe of the plantar pad of the hind foot is larger, sometimes much larger than the internal lobe. The area above the plantar pad on the hind foot is naked to the tip of the heel, and towards the heel this area rises into a wide, low, laterally expanded pad-like eminence which gives a sinuous outline to the naked tarso-metatarsal area ‡ (text-fig. 8, A, B).

* Ann. Mag. Nat. Hist. (8) xvii. p. 177, 1916. An examination of dried skins suggests that the area between the carpal and plantar pads may be overgrown with hair, thus contradicting the generalisation (p. 358) as to the nakedness of this area in Mongooses.

† 'Reise nach Mossambique,' Säug. pls. xxvii. & xxviii., 1852.

‡ Accounts of the metatarsal area vary. Thomas and, following him, W. L. Slater correctly described this area as naked. But Mivart and, following him, Flower and Lydekker wrongly described it as covered with hair. Its naked condition does not seem to be subject to variation.

From the accounts above given, it is clear that the feet of Mongooses exhibit a wide range of variation in such characters as the numbers of the digits, the hairiness of the tarso-metatarsal area, and the presence and extent of the interdigital webs. These characters are either invariable or subject to much less variation in other groups of corresponding rank amongst the *Æluroidea*. There is only one group of the suborder, however, which possesses feet structurally recalling those of the Mongooses, namely, the *Galidictinæ*, the feet of which I have recently described and figured*. Between the feet of *Galidictis* and one of the pentadactyle, semiplantigrade Mongooses, like *Mungos*, there appear to be only two differences which call for notice. In *Galidictis* (and in *Galidia*) the pollex and the hallux are set lower on the foot and project therefrom on a level with the internal lateral lobe of the plantar pad, and the pollical and hallucal lobes of this pad are better developed and in contact with the internal lateral lobe. Hence the plantar pad is quadrilobate, whereas in *Mungos* and all other genera of Mongooses the plantar pad is trilobate. It may also be added that the metatarsal and carpal pads in *Galidia* and *Galidictis* are better developed than in the Mongooses and are double.

These differences are interesting because they show that the feet of the *Galidictines* are of a more primitive type and, on the whole, more *Viverrine* than are those of the Mongooses. Nevertheless it cannot be claimed either that the feet of *Mungos* differ more from those of *Galidictis* than they differ from the feet of *Bdeogale*, *Atilax*, or *Suricata*, or that the feet of *Galidictis* differ more from those of *Mungos* than they differ from the feet of the *Paradoxurine* genera or of *Eupleres*.

The Glandular Anal Sac.

The presence of a glandular anal sac in Mongooses has long been known; but its invariable occurrence within the group has been disputed. I have found it without exception in all the specimens I have examined, even in those belonging to species in which its existence has been denied. Cuvier, for example, said that the Marsh-Mongoose, which he named *Atilax vansire* †, is without it. It happens, on the contrary, to be rather exceptionally well developed in that form (text-fig. 9, B, C). It is also present, though small, in *Mungos auropunctatus*, despite Mivart's statement ‡ that in a living example he examined "the anus opened most distinctly on the surface of the body, and not into a saccular depression." Since Mivart was probably the authority for Blanford's declaration § that "this character is

* Ann. Mag. Nat. Hist. (8) xvi. pp. 351-356, pls. xiv., xv., 1915.

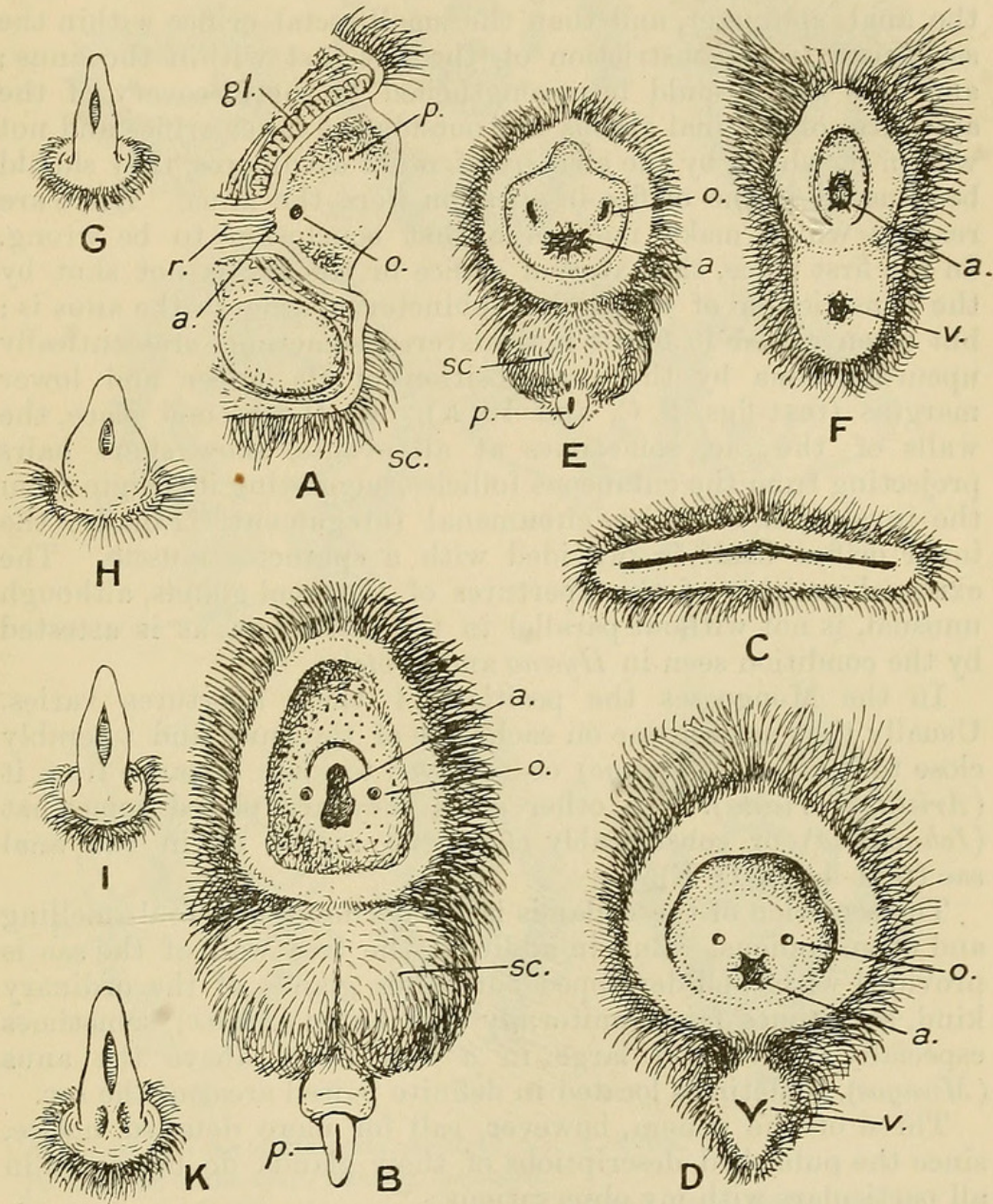
† St. Hilaire & Cuvier, Hist. Nat. Mamm. ii. pt. 54, pl. 198, 1826.

‡ Proc. Zool. Soc. 1882, p. 178.

§ 'Fauna of Brit. India': Mammalia, p. 119, 1888. It is a pity Blanford did not particularise the species, and say whether his information was based upon his own observations or not. It may here be recalled that Murie and others entirely failed to find the large anal sac in a living Spotted Hyæna.

ill-marked or absent in some of the common Indian species" [of *Mungos*], it may be explained at once that Mivart evidently

Text-figure 9.



- A. Longitudinal section of anal area of *Atilax paludinosus*, ♂. *p.*, anal pouch; *gl.*, cutaneous glands of pouch; *o.*, orifice of anal gland; *a.*, anus; *r.*, rectum; *sc.*, scrotum with testis.
- B. Anal area of the same. Lettering as in A, with *p.*, penis.
- C. Anal pouch of the same.
- D. Anal pouch of *Ichneumia albicauda*, ♀. Lettering as in A, with *v.*, vulva.
- E. The same of *Cynictis penicillata* (young ♂). Lettering as in B.
- F. The same of *Bdeogale puisa*, ♀. Lettering as in D.
- G. Glans penis of *Crossarchus*, from below.
- H. The same of *Suricata*.
- I. The same of *Cynictis*.
- K. The same of *Mungos mungo*.

did not distinguish between the orifice of the sac and that of the rectum which lies within it. That this would be a difficult task in a living animal is quite credible. Indeed, in such a form as *M. auropunctatus*, it is easy at first sight to believe that the sac itself is merely an enlarged anus, that its thickened rim is the anal sphincter, and that the small rectal orifice within the sac arises from constriction of the gut just within the anus; and this view would be strengthened by the discovery of the apertures of the anal glands well outside the inner orifice and not within it, where, by the analogy of other carnivores, they should be situated if the orifice in question were the anus. There are reasons which make me judge that conclusion to be wrong. In the first place, the external orifice of the sac is not shut by the constriction of a circular sphincter muscle as the anus is; but when closed it forms a transverse, sometimes crescentically upcurled, rima by the juxtaposition of its upper and lower margins (text-figs. 9, C, and 10, A). In the second place, the walls of the sac, sometimes at all events, show short hairs projecting from the cutaneous follicles, suggesting its origin from the involution of hairy circumanal integument. Finally, the inner orifice itself is provided with a sphincter muscle. The external position of the apertures of the anal glands, although unusual, is not without parallel in the Carnivora, as is attested by the condition seen in *Hyæna* and *Proteles*.

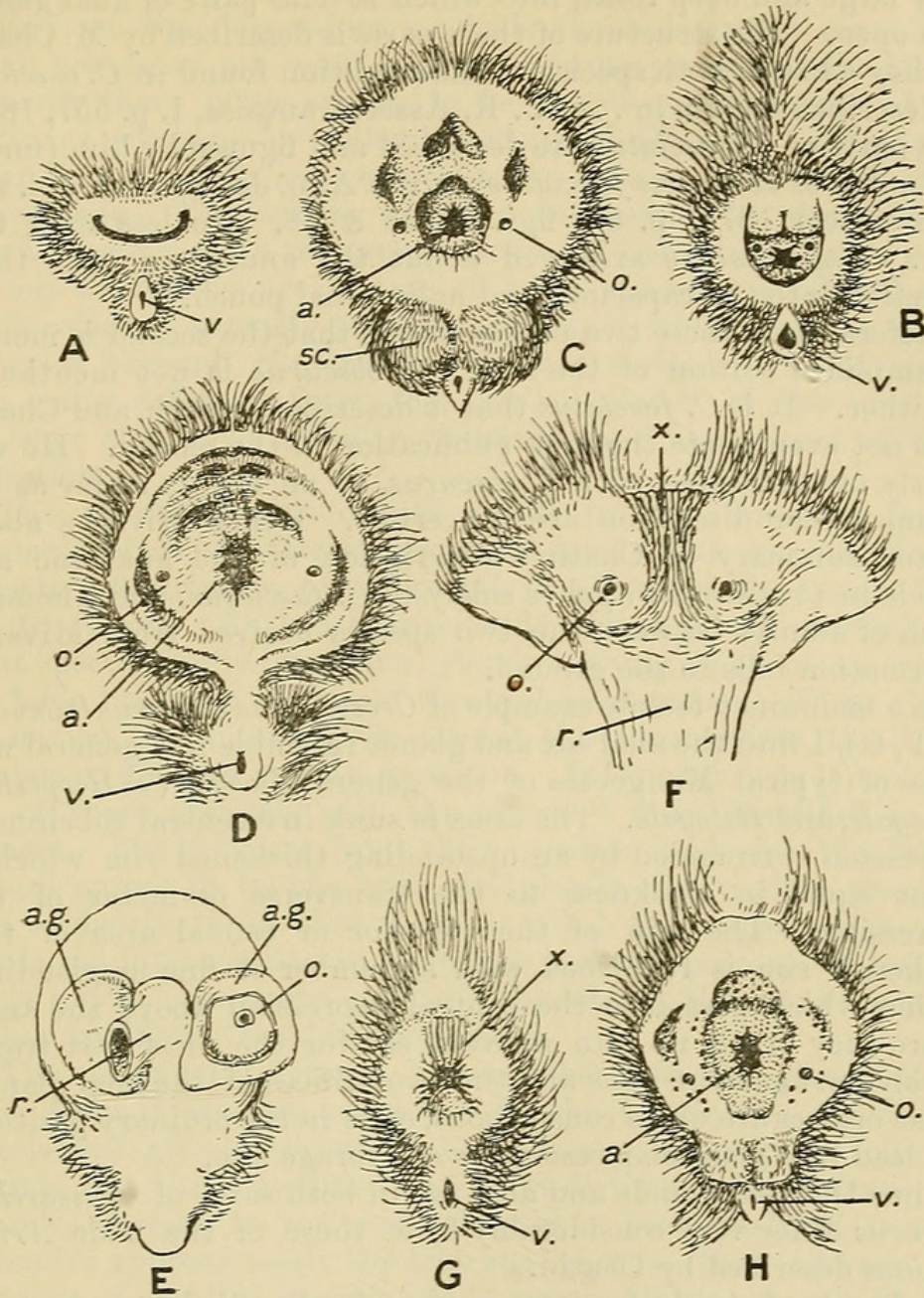
In the Mongooses the position of these apertures varies. Usually they are set one on each side of the anus, and tolerably close to it (*Mungos mungo*) or removed to some distance from it (*Ariela*, *Suricata*). In other cases they are placed somewhat (*Ichneumia*) or considerably (*Cynictis*) higher up in the anal sac (text-fig. 9, D, E).

The secretion of these glands is always liquid and foul-smelling and often copious. But, in addition, the free wall of the sac is provided with well-developed cutaneous glands of the ordinary kind, sometimes fairly uniformly distributed (*Atilax*), sometimes especially active and large in a half circle above the anus (*Mungos*), sometimes located in definite paired areas of the sac.

Three of the genera, however, call for more detailed notice, since the published descriptions of their glands do not agree in all particulars with my observations.

When claiming for the first time the close and congeneric affiliation between *Crossarchus obscurus* and *Ariela fasciata*, Thomas added the following paragraph (P. Z. S. 1882, p. 86, note):—"Since the above was written, Prof. Mivart has pointed out to me that the researches of Chatin into the structure of the anal glands of the Carnivora (Ann. Sci. Nat. (5) xix. p. 89, 1874) fully confirm the opinion here expressed as to the generic relationship of the Striped Mongoose (*C. fasciatus*) with *C. obscurus*." Chatin does not, however, mention *C. obscurus* in the paper referred to; and that Thomas was misled by Mivart is clearly shown by the remarks of the latter on the subject in question

Text-figure 10.



- A. Closed anal sac of *Helogale undulata*, ♀. v., vulva.
 B. Anal sac of the same, partially distended.
 C. Anal sac of *Helogale undulata*, ♂, on a larger scale, fully distended, and showing glandular pouches or depressions. a., anus; o., orifice of anal gland; sc., scrotum.
 D. The same of *Ariela fasciata*, ♀. Lettering as in preceding figures.
 E. The same, dissected and seen from within, showing the single pair of normal anal glands (a.g.), that of the left side opened to show orifice (o.) into sac; r., rectum turned aside.
 F. Anal sac of *Crossarchus obscurus*, ♀, cut from below and spread open. r., rectum, cut open; x., fine cutaneous ridges extending from upper margin of sac to anus; other lettering as above.
 G. The same anal sac shown partially distended when the tail is raised.
 H. Anal sac of *Suricata suricatta*, ♀, distended to show the glandular depressions, with the scrotum-like swelling between the vulva and the lower rim of the sac.

(P. Z. S. 1882, p. 183):—"The anus opens into the middle of a very large and deep fossa, into which several pairs of anal glands also open. The structure of these parts is described by M. Chatin as they exist in both species. The condition found in *C. obscurus* is described by him in . . . C. R. Assoc. française, i. p. 557, 1872. The parts of *C. fasciatus* are described and figured by him (under the name of *Herpestes fasciatus*) in the Ann. des Sc. Nat. vol. xix. (5th series) 1874, p. 89, figs. 29-33 & 38. No less than five pairs of glands are arranged about the anus, and pour their secretion into the capacious and naked anal pouch."

Reference to these two papers shows that the second is merely an amplified edition of the first. *C. obscurus* is not mentioned in either. It is *C. fasciatus* that is described in both, and Chatin does not even quote the first publication in the second. He was clearly unacquainted with *C. obscurus*, at all events so far as the organs under discussion are concerned. Hence Mivart's above quoted summary of Chatin's description of the anal sac and glands in *Crossarchus* applies solely to *C. fasciatus*, and Thomas's claim of affinity between the two species derived from Mivart's information falls to the ground.

In a male and a female example of *Crossarchus obscurus* (text-fig. 10, F, G), I find the anal sac and glands resemble in a general way those of typical Mongooses of the genera *Mungos* (= *Herpestes*), *Bdeogale*, and *Helogale*. The anus is sunk in a central subcircular depression surrounded by an upstanding thickened rim which is about equal in thickness to the transverse diameter of the depression. The skin of the superior or caudal area of this thickened rim is furnished with a number of fine longitudinal laminae which pass into the central depression above the anus, where they break up into wrinkles set for the most part transversely between the anus and the two orifices of the anal glands. These orifices are quite conspicuous, open in the ordinary position, and lead into glandular reservoirs of average size.

Thus the anal glands and anal sac in both sexes of *Crossarchus obscurus* differ very considerably from those of the male *Ariela fasciata* described by Chatin.

A female of *Ariela fasciata*, or of a closely-allied form brought by Mr. G. Blaine, F.Z.S., from the Sudan (text-fig. 10, D, E), has a very large anal sac as compared with that of most species of Mongooses. Its surface is marked with three pairs of integumental folds or depressions—two pairs above and one pair at the sides of the anus. The depressions of the upper of the supra-anal pairs are situated close together immediately beneath the upper rim of the anal sac, and are sunk in a common fold of the skin. Those of the lower of the supra-anal pairs are beneath them, but more widely separated and nearer the anus. Those of the lateral pair are placed far out towards the lateral rim of the anal sac. They are much longer than the others, and approximately follow the curvature of the rim of the sac, but come to an

end on each side before reaching the middle line beneath the anus.

Each of the depressions or folds above described contains a small glandular pit with several secreting pores, and the glands beneath these pores appear to be simple enlargements of the ordinary sebaceous or follicular glands of the skin. It is quite clear that none of them represents the true anal glands of other Carnivores. The orifices of these are situated on each side of the anal sac close to the inner margin of the lateral folds. The glands themselves are a pair of large muscular sacs filled with dark-coloured, strongly smelling, oily fluid which escapes to the exterior through the orifices above described. These glands are quite different from the smaller glands of the anal sac in their size, their saccular character, and the nature of their secretion.

The character of the anal glands in this Sudanese female example of *Ariela fasciata* explains much that was puzzling in Chatin's description of the glands in a male of the species from South Africa. As has been already stated, Chatin assigned to that species five pairs of anal glands opening by as many orifices in folds upon the surface of the anal scent-pouch. These glands he named the anterior, the lateral, the intermediate, the lateral posterior, and the median posterior. It is not easy to homologize all of these precisely with the glands I have described in the female. But judging from their position and size, the lateral glands appear to be the true anal glands, the median posterior are evidently those that I have called the upper supra-anal, while the intermediate and anterior probably correspond respectively to the lower supra-anal and the lateral, the lateral portions being undifferentiated in the female.

The principal difference, however, between the glands of the two animals consists in this:—In the female the secondarily specialised glands appear to be ordinary sebaceous or follicular glands but little modified and quite distinct from the true anal glands, whereas in the male they have been modified so as to resemble approximately the true anal glands—that is to say, each consists of a wall of secreting cells surrounding a sac or hollow for storing the secretion, which is similar in nature to that of the anal glands in being brown in colour and fœtid in odour. This secondarily acquired similarity—an exceedingly interesting fact—seems to have misled Mivart into thinking that the two normal anal glands present in all *Æluroid* Carnivores had become broken up, as it were, in the male *Ariela fasciata* into the five pairs of glands described by Chatin (Ann. Sci. Nat. (5) xix. pp. 89–93, pl. iv. figs. 29–30, 1874).

The existence of a pair of saccular anal glands in *Suricata* was, as Mivart states, recorded by Daubenton. To this Mivart adds:—“The anus opens into the middle of a very deep fossa, deeper than that of *Bdeogale* and like that of *Crossarchus*. . . . I strongly

suspect, from the form of the anal pouch, that there are here, as in *Crossarchus* *, several pairs of anal glands."

This is not the case in the examples of *Suricata suricatta* I have examined.

In a male the anal sac resembles that of *Mungos mungo* in a general way, but is relatively larger. It is marked on each side of the anus by a transversely oblique slit-like depression, and not with several depressions as in *Ariela fasciata*. Its surface is pitted with comparatively large and quite conspicuous hair-follicles, and from most of these, perhaps all normally, a single hair or a little tuft of hairs arises. Under pressure liquid secretion can be squeezed from the pores of these follicles, which are particularly numerous in the oblique depression above described. When expanded, the depression is seen to curve downwards towards the lateral margin of the anal pouch, and the orifice of the anal gland is situated just below its deepest portion, but is concealed within it when the depression is unexpanded. There is a single moderate-sized gland on each side, as Daubenton said; and I can find no evidence for the multiplication of similar glands such as Chatin described in the male *Ariela fasciata*. On the contrary, sections of the highly glandular hair-follicles show them simply imbedded in the thickened skin of the anal pouch without coalescing to form composite glands with reservoirs for the storage of secretion. In its glandular character the anal pouch recalls that of the female *Ariela fasciata*, with the exception that the hair-follicles are more irregularly scattered and not aggregated in so many definite integumental depressions.

In a female (text-fig. 10, H) the gland is similar to that of the male, and apparently as well developed. The two orifices of the anal glands perforate the walls of the sac nearly midway between its lateral border and the anus. The integument of the sac round about them is pitted with large hair-follicles. These also extend to the middle line of the sac both above and below the anus, and there is an aggregation of larger pores lodged in a depression just above the orifice of the gland on each side. As in the male, this depression lies in the crease of skin formed when the superior part of the sac closes over the inferior part when the tail is lowered. There appears to be no definite storage-sac beneath this cluster of follicles, and, as in the female *Ariela fasciata*, the only reservoirs for secretion are those of the pair of anal glands proper.

The only other genus which requires particular mention in this connection is *Helogale*. In the male and the female of the species identified as *Helogale undulata* (text-fig. 10, A, B, C) the anal sac is well developed and provided with supplementary pouches. The anus itself lies in the centre of a slight depression defined above by a fine but distinct cutaneous ridge. On each

* By *Crossarchus* Mivart meant the species referred in this paper to *Crossarchus obscurus*, which he erroneously believed to have multiple anal glands, and *Ariela fasciata*, in which many anal glands had been described by Chatin.

side of the depression there is a small supplementary pouch a little higher up than the anus. In the middle line of the sac, nearly midway between the anus and the root of the tail, there is a moderately large unpaired supplementary pouch, and on each side of this, but a little lower down and about half-way between the anus and the margin of the sac, there is another moderately large pouch. The orifices of the anal glands open just below these in a line with the anus, but outside the central depression in which the anus lies. Thus the anal sac of *Helogale* approaches that of *Suricata*, and differs from the sac of any species of *Mungos* I have examined.

Function of the Anal Sac.

On the material at my disposal I was unable to substantiate a higher grade of development of the anal sac and its associated glands in the male than in the female, or *vice versa*. On the evidence, therefore, this composite glandular structure cannot be included in the category of sexual organs except on the plea that the secretions may help the sexes to find each other.

Captive Mongooses have the habit, also observed in Genets and Civets, of rubbing the glandular surface against the walls or projecting angles in their cage or against the legs of chairs and tables in a dwelling-room. Hence it may be inferred that one of the functions of the secretion is to make the animal's surroundings smell of itself, and the scent so applied serves, I believe, the purpose of familiarising the Mongoose with every square yard of its environment, so that, independently of vision, if need be, it can find its way with precision over any road it has once travelled*.

Several of the Mongooses, too, like *Cynictis*, *Suricata*, *Ariela*, and *Helogale* are gregarious†; and of one species of *Helogale* at least the habit of hunting in packs has been recorded. One of the larger Indian species of Mongoose (*M. vitticollis*)‡ has been seen combining in pairs in pursuit of prey. And since specialised cutaneous glands very often attain exceptional development in gregarious animals for the purpose, presumably, of helping individuals to keep together, it is not improbable that the secretion of the glandular anal sac has a functional significance in that respect in some of the Mongooses.

Finally, Hodgson's record§ that the secretion of the paired anal glands in *Mungos urva* is "aqueous, horribly foetid, and projectile to a great distance by the living animal," suggests that

* It is well known that most mammals have the habit of keeping to definite beaten tracks. The advantage of this to species like rats and rabbits is very evident. I have frequently seen rats escape from dogs by knowing exactly the position of a pipe or of a hole in a wire-net fence. They make a bee-line for the spot at full speed, and, apparently without ever seeing the hole, go straight through it, knowing the precise direction to take by complete familiarity with the track, owing, I believe, to the scent it holds.

† See W. L. Slater, 'Fauna of S. Africa': Mammalia, vol. i. p. 69, 1900.

‡ Quoted by Blanford, 'Fauna of Brit. India': Mammalia, p. 129.

§ Journ. As. Soc. Bengal, vi. pt. ii. p. 563, 1837; also my paper in Ann. Mag. Nat. Hist. (8) viii. p. 756, 1911.

this species at least makes use of the secretion in the same way as the Skunk. I have never seen this species alive, and have never noticed any Mongoose practise the habit; but I have seen the secretion of a dead Marsh-Mongoose (*A. paludinosus*) issue, under pressure of the gland, in a narrow jet as if propelled by a squirt; and since Mr. W. L. Sclater states that this animal is able to diffuse a strong odour described as "sweet-sickening" from its anal glands, I suspect it is endowed with the same power as *M. urva*. To me the scent of the secretion in *A. paludinosus* is very nauseous.

The External Genitalia.

In the male the glans penis is always short and smooth, and emerges close in front of the scrotum as in the Felidæ and *Nandinia*. The orifice of the urethra is apparently always a large and elongated slit opening in the middle of the underside of the glans and not at its tip. The glans is laterally compressed, usually much longer than wide, attenuated towards the apex, and carries a bone or "baculum" which reaches the tip. In *Suricata*, however, it is markedly piriform and considerably expanded proximally, so that its width nearly equals its length (text-fig. 9, G, H, I, K).

The vulva is only a short distance below, or in front of, the inferior edge of the anal sac. The naked area is sometimes broadly continuous with that of the sac, as in *Bdeogale puisa* (text-fig. 9, F), sometimes connected with it by a narrow naked tract, as in *Ariela fasciata* and *Crossarchus obscurus* (text-fig. 10, G), or separated therefrom by a narrow tract of hair, as in *Helogale undulata* (text-fig. 10, A).

In the female of *Suricata* Mivart drew attention to the presence of a perineal swelling just below the anal sac, and compared it to a small scrotum (text-fig. 10, H). A somewhat similar swelling is present in the female of *Mungos smithii* I examined. This swelling occupies the position of the perfume-gland of the Civets and Genets. Since Mivart did not dissect the swelling in *Suricata*, it may be recorded that it appears to consist of fatty and not of glandular tissue. It is, in my opinion, exactly comparable to the scrotum-like excrescence so often noticed in female Hyænas and to the apparently similar structure observed by Lönnberg* in a female *Cryptoprocta*. Since the Mongooses resemble the Hyænas and *Cryptoprocta* in possessing a large anal sac, and have been compared with them in other respects, the remarkable differences in the structure of the penis in the three groups must be borne in mind. In the Hyænas (and *Proteles*) this organ is very long, fleshy, pendulous, and the glans is short and boneless. In *Cryptoprocta* the glans is exceedingly long, copiously armed with strong spicules, provided with a long bone, and emerges a long way in front of the scrotum.

* Bih. Svensk. Vet.-Akad. Handl. xxviii. Afd. iv. no. 3, 1902.



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