21. On the External Characters of some Hystricomorph Rodents. By R. I. Pocock, F.R.S., F.Z.S.

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(Text-figures 1–28.)

Contents.

Introduction.

The classifications of the Hystricomorpha in English text-books of Zoology are based upon the one proposed by Alston in 1876 (P. Z. S. 1876, pp. 90–97), which was itself an amplification and in some particulars a modification of the arrangement suggested by Waterhouse in 1848. Alston added to the group the family Dinomyidæ, which, following Peters, he placed between the Dasyproctidæ and Caviidæ; and the Ctenodactylinæ, which he ranked as a subfamily of Octodontidæ. He also transferred *Petromys* from the Echymyina (Echinomyinæ), where it was placed by Waterhouse, to the Octodontinæ.

His system, adopted to the letter by Flower and Lydekker ('Mammals Living and Extinct,' pp. 484–491), was as follows:—

Hystricomorpha.

1. Octodontidæ.
   - Ctenodactylinæ (*Ctenodactylus*, *Pectinator*).
   - Octodontinæ (*Petromys*, *Ctenomys*, *Schizodon*, *Spalacopus*, *Octodon*, *Abrocoma*).
   - Echinomyinæ (*Carterodon*, *Myopotamus*, *Cercomys*, *Loncheres*, *Mesomys*, *Echinomys*, *Dactylomys*, *Plagiodontia*, *Capromys*, *Aulacodus*).
2. Hystricidæ.
   - Sphingurinæ (*Chætomys*, *Sphingurus*, *Erythizon*).
   - Hystricinæ (*Atherura*, *Hystrix*).
3. Chinchillidæ (*Chinchilla*, *Lagidium*, *Lagostomus*).
4. Dasyproctidæ (*Dasyprocta*, *Cœlogenys*).
5. Dinomyidæ (*Dinomys*).
6. Caviidæ (*Cavia*, *Dolichotis*, *Hydrochœrus*)

Winge (E Museo Lundi, i. pt. iii. pp. 126–135, 1888) differed from Alston in some particulars. He referred all the Hystricomorphs to one family Hystricidæ, which was divided into the following subfamilies :—

(1) Octodontini, equivalent to Alston's Octodontinæ + Echinomyinæ ; (2) Capromyini, for *Aulacodus*, *Capromys*, *Plagiodontia*, and *Myopotamus* ; (3) Ctenodactylini, for *Ctenodactylus*, *Pectinator*, and *Petromys* ; (4) Hystricini and (5) Eriomyini, equivalent to Alston's Hystricidæ and Chinchillidæ respectively ; and (6) Dasyproctini, embracing all the genera referred by Alston to the Dasyproctidæ, Dinomyidæ, and Caviidæ.

Thomas (P. Z. S. 1896, pp. 1024–1025) made the following changes in Alston's system. Following Winge, he transferred *Petromys* from the Octodontinæ to the Ctenodactylinæ, and removed *Capromys*, *Myocastor* (*Myopotamus*), and *Thrynomys* (*Aulacodus*) from the Echinomyinæ to form the subfamily Capromyinæ. He also altered the name Echinomyinæ to Loncherinæ, gave full family-rank to the Old World and New World Porcupines respectively, calling the former Hystricidæ and the latter Erethizontidæ and dividing this family into two subfamilies —Chætomyinæ for *Chætomys* and Erethizontinæ for *Erethizon* and *Coendu* (*Sphingurus*).

Tullberg (Nova Acta Sci. Upsala, (3) xviii. pp. 82–149, 1900) introduced some innovations, notably the institution of two new families—the Aulacodidæ for *Aulacodus* (*Thrynomys*), previously associated with *Capromys* and *Myocastor*, and the Petromyidæ for *Petromys* alone, severing the latter both from the Echinomyidæ and the Ctenodactylidæ. He refused, moreover, to admit the affinities of the Ctenodactylinæ with the Hystricomorphs, classifying them with his Myomorph + Sciuromorph division of Rodentia. He fused the two families Dasyproctidæ and Caviidæ of Alston into one called Caviidæ, keeping *Dinomys* provisionally as the type of a special family till more is known about it. The family-name Octodontidæ he changed to Echinomyidæ, and altered Capromyinæ to Myopotamini.

Beddard's classification ('Mammalia,' pp. 487–502, 1902) differed from Thomas's in restoring *Petromys* to a place in the Octodontinæ, where Alston put it, and in granting family-rank to the Ctenodactyline genera, *Ctenodactylus*, *Pectinator*, and *Massouteria*.

Weber (Die Säug. pp. 505–507, 1904) admitted no subfamilies, placing the genera in seven families as follows :—(1) Ctenodactylidæ (*Ctenodactylus*, *Petromys*, *Pectinator*) ; (2) Octodontidæ (*Ctenomys*, *Octodon*, *Abrocoma*, *Loncheres*, *Echinomys*) ; (3) Capromyidæ (*Capromys*, *Myocastor*, ? *Thrynomys*) ; (4) Chinchillidæ (*Chinchilla*, *Lagidium*, *Lagostomus*) ; (5) Caviidæ (*Cœlogenys*, *Dasyprocta*, *Cavia*, *Dolichotis*, *Hydrochœrus*) ; (6) Erethizontidæ (*Erethizon*, *Coendu*, *Chætomys*) ; (7) Hystricidæ (*Hystrix*, *Atherura*, *Trichys*).

Of the above-quoted papers Tullberg's is by far the most comprehensive. He dealt as exhaustively as the material at his disposal permitted with the skull, skeleton, and internal anatomy, and, in addition, described and figured the feet of several of the genera, but dismissed very briefly such external organs as the ears and rhinarium. I have been able to supplement his account so far as the organs investigated are concerned, by the examination of some genera he did not see ; and in a few particulars connected with the male external genitalia my results differ from his. Winge also figured the feet and the heads in profile view, showing the ears and vibrissæ of some genera of Loncherinæ. Boas also ('Ohrknorpel der Säugthiere,' p. 119 *et seq.*, 1912) described the ears of some genera, figuring those of *Cavia*, *Dasyprocta*, *Cœlogenys*, *Hydrochœrus*, *Lagostomus*, and *Hystrix*.

The observations set forth in the following pages have been taken mainly from fresh material examined immediately after death in the Society's Prosectorium. This has been supplemented by specimens preserved in alcohol in the Society's collection, and by dried skins where soft material was unavailable.

The Rhinarium.

In *Hystrix* and *Atherura* the rhinarium is ill-defined. In *Hystrix* it is hairy to the edge of the nostrils. In *Atherura* there is an area of naked skin both above and below these orifices. In both genera the nostrils are transversely elongated slits, expanding anteriorly and internally ; and there is a very well-defined smooth philtrum, completely dividing the upper lip into its right and left moieties, which are independently movable. (Text-fig. 1, A–C.)

The rhinarium of *Thrynomys* is well defined, although the hair encroaches upon it above and beneath laterally, leaving only a narrow naked rim above and below the nostrils, which are tolerably widely separated. It extends, as in *Hystrix*, to the edge of the upper lip, forming a philtrum, wider above than below, and completely dividing the lip into a right and left portion. (Text-fig. 1, D.)

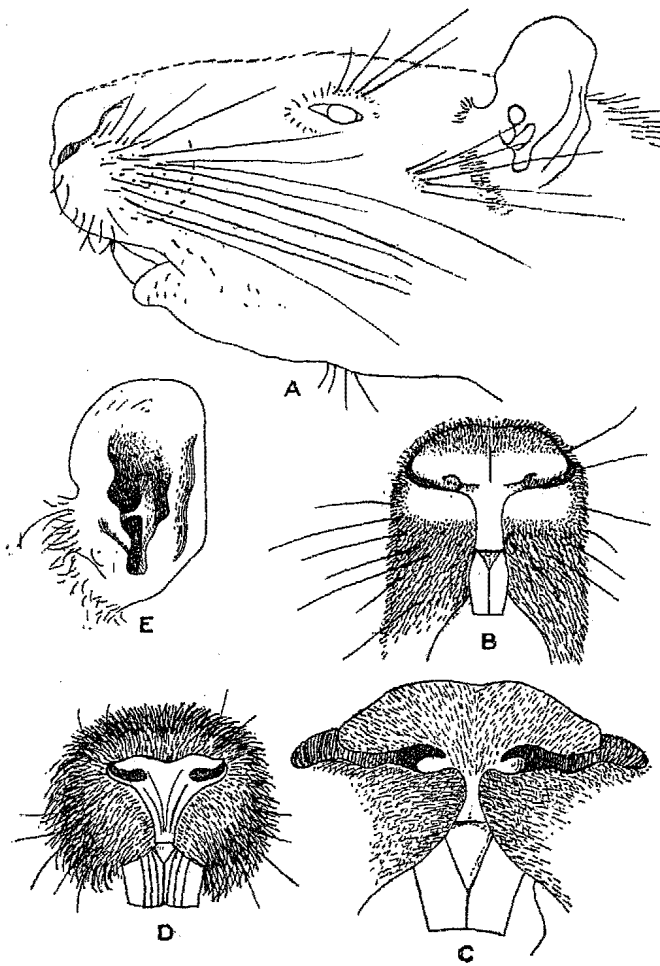
In *Dinomys*, according to Peters, the upper lip is deeply cleft—apparently very much as in *Hystrix* and *Atherura* ; and above it there is a distinct triangular rhinarium, naked in front and round the nostrils, but hairy above owing to the forward extension of the hair of the muzzle well in advance of the posterior ends of the nostrils, which are described as S-shaped, a form these orifices assume in many of the Hystricomorphs *.

Dinomys is the only American genus of Hystricomorphs, so far

* Peters seems to have regarded *Dinomys* as akin to *Cœlogenys*. He appears to have been misled in this matter by the similarity in colour between the two genera There is, however, no obvious evidence of kinship between them.

as my observations go, that has a complete philtrum continuous with the rhinarium above and cleaving the upper lip. The nearest approach to it is seen in such forms as *Cœlogenys* and

Text-figure 1.



A. Side view of head of *Atherura africana* to show the ear, rhinarium, and facial vibrissæ, the latter drawn relatively shorter than in the animal.
B. Rhinarium and upper lip of the same. × ½.
C. „ „ „ *Hystrix africæ-australis.* × ½.
D. „ „ „ *Thrynomys swinderianus*, from a dried skin. × ½.
E. Ear of *Hystrix africæ-australis.* × ½.

*Dolichotis**, for example, in which there is a parting in the hairs in the middle line of the upper lip which, especially in dried skins, sometimes simulates a small philtrum; but, although this may be the remains of a true philtrum, it is very different from that structure in *Hystrix* and *Thrynomys*.

The rhinaria of *Coendu* and *Erethizon* differ greatly from that of *Hystrix*. In *Coendu* it is hairy and the nostrils are quite small and vertical rather than transverse in direction, the postero-lateral slit being absent. In *Erethizon* the rhinarium is marked by shorter hairs than that of the area round it. The nostrils are larger and more transverse than in *Coendu* and are very close together, the space between them and their very narrow upper edge being smooth. In neither genus is there a philtrum. (Text-fig. 2, D, E.)

In *Capromys* the rhinarium is large and naked, but not very well defined laterally, where it passes into the short-haired area, surrounding it above as well as laterally and below. It is marked by a median groove in front. The nostrils are elongated and expanded anteriorly. (Text-fig. 2, A, B.) In *Myocastor* the rhinarium is wider as compared with its depth than in *Capromys*, the areas above and below the nostrils being much narrower; there is no median groove, and the nostrils themselves are much smaller, forming crescentrically valvular slits. (Text-fig. 3, A.)

In *Ctenomys*, *Octodon*, and *Cavia* the rhinarium forms a naked area round the nostrils, the areas above and below these orifices being narrow. (Text-fig. 4, C.) In *Octodon* it is mesially grooved and angled below. In *Ctenomys* it has the upper edge biconvex and mesially angled, the inferior edge transverse in the middle. (Text-fig. 4, A, B.) In *Cavia* the nostrils are wider than in the two Octodonts above described, the upper edge of the rhinarium is concave, the lower convex from side to side, and there is sometimes hair between the nostrils. (Text-fig. 4, F.)

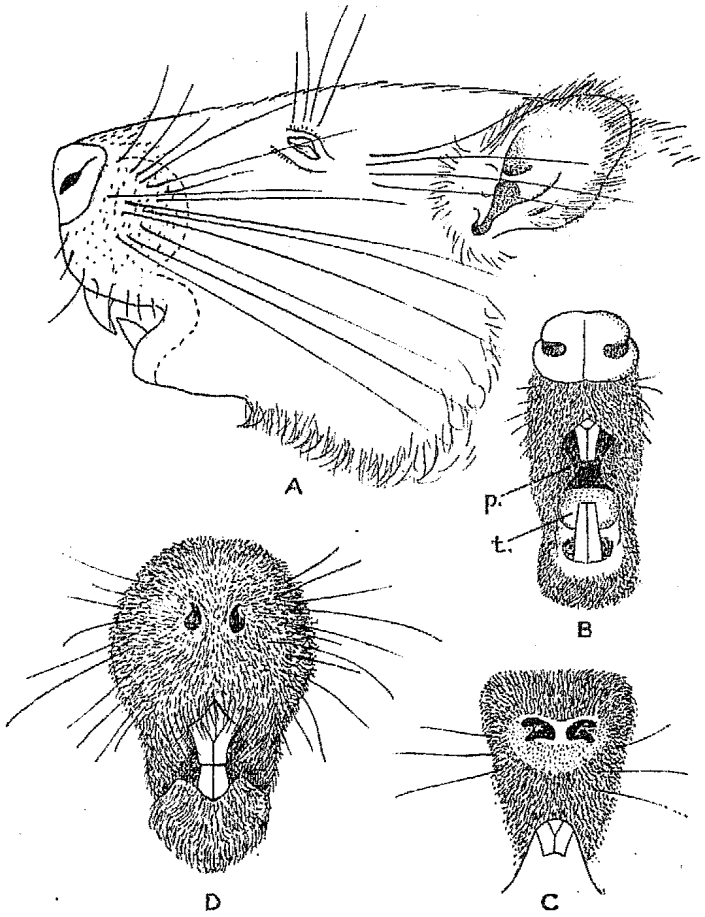
In *Dolichotis patagonica* the entire nose is large, with a wide rhinarium concave in the middle and convex at the side above and below, the finely hairy and tolerably deep areas bordering the large transversely extended nostrils above and below being thickened and muscular. In one example of this species the internarial area was hairy in the middle line, whereas in an example of *D. salinicola* it was naked; but this character is possibly not constant. (Text-fig. 3, D.)

In *Cœlogenys* the upper rim of the nostril is swollen and muscular, but the rhinarium itself is scarcely defined, being covered with very fine short hairs, leaving only a narrow hairless area above and below the elongated narrow nostrils. Judging from dried skins the rhinarium of *Dasyprocta* is very similar. (Text-fig. 3, B.)

* I am not sure about the structure of the upper lip in *Dasyprocta*. The only spirit example available had the rhinarium destroyed; but dried skins suggest the absence of a complete philtrum. In living examples there appears to be a median groove formed by a vertical fold in the skin of the upper lip.

In *Chinchilla*, *Lagidium*, and *Lagostomus* the rhinarium is also covered with fine short hairs almost up to the level of the nostrils, but whereas in *Lagostomus* the nostrils are elongated and the short-haired area around them sharply defined by the coarse

Text-figure 2.



A. Side view of head of *Capromys pilorides*, showing the ear, rhinarium, and facial vibrissæ, the mystacials shortened in the drawing.
B. Muzzle and mouth of the same from the front, the divided palatal flaps (*p*) shown above the tongue (*t*). × ½.
C. Rhinarium and upper lip of *Erethizon dorsatum*. × ½.
D. Muzzle and mouth of *Coendu prehensilis*, from the front. × ½.

hairs of the rest of the muzzle, in *Chinchilla* and *Lagidium* the nostrils are much smaller without any sharply defined short-haired area around them. (Text-fig. 3, C; 4, D.)

In *Hydrochœrus* the rhinarium is scarcely defined, although the skin between the nostrils is naked. The nostrils are very widely separated and small, without any postero-lateral slit The upper lip is exceedingly deep and naked or scantily hairy in the middle.

The rhinarium of *Ctenodactylus* is continued to the edge of the upper lip by a naked area of skin, which, like the rhinarium itself, is capable of lateral compression, being broad or narrow according to the degree of contraction of the muzzle. The upper end of this labial tract is continued on each side as a naked rim beneath the nostrils. The upper edge of the rhinarium is convex with a median angular emargination. The area above the nostrils is deep; the nostrils themselves when expanded are large orifices with very short posterior slits, and the narrow space between them is marked by a deep median groove extending from the top of the labial tract to the summit of the rhinarium. (Text-fig. 4, G.)

In view of the former association of *Ctenodactylus* with the Jerboas (Jaculidæ) it is interesting to note the close similarity between that genus and *Jaculus* in the rhinarium, not only in structural details but in its compressibility.

Facial Vibrissæ.

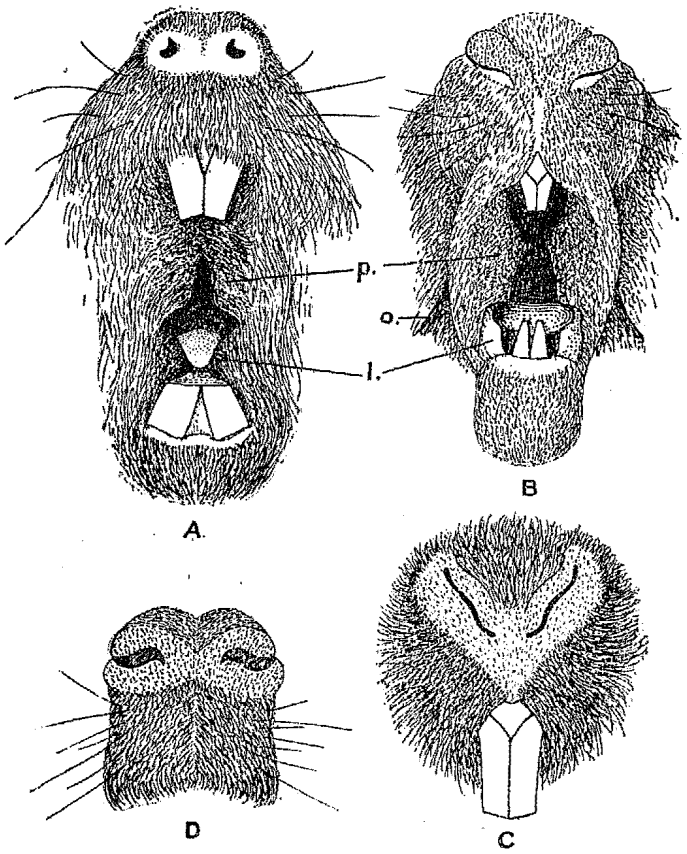
In P. Z. S. 1914, pp. 903–905, I described briefly the facial vibrissæ of several species of Hystricomorpha belonging to the genera *Atherura*, *Coendu*, *Erethizon*, *Octodon*, *Chinchilla*, *Lagostomus*, *Dolichotis*, *Cœlogenys*, *Dasyprocta*, *Cavia*, and *Hydrochœrus*, and showed the general constancy of the presence of well-developed mystacial, superciliary, and genal tufts, the latter being usually set high up the face near or even behind the posterior angle of the eye. Since then I have extended my observations, and can add several more species to the list.

In *Hystrix*, *Acanthion*, *Atherura*, and *Trichys* the vibrissæ are as originally described in *Atherura*, namely, exceedingly long and well developed, and there is always an interramal tuft. In *Thrynomys*, on the contrary, although its mode of life is tolerably similar to that of the Old World Porcupines, the mystacials are comparatively slender and short, and in two dried skins I can find no trace either of superciliary, genal, or interramal tufts in the coarse hairs clothing the head. Peters described the mystacials as long in *Dinomys* and the genals as set behind the eye, but says nothing about the interramal tuft.

In the genera of Loncherinæ figured by Winge, namely, *Loncheres*, *Echimys*, *Cannabateomys*, *Trichomys* (*Nelomys*), *Carterodon*, and *Mesomys*, well-developed mystacial, superciliary, and genal vibrissæ, the latter behind the eye, are shown, but no interramal tuft is indicated. The omission of the interramal tuft can hardly be taken as proof of its absence in these genera. Nevertheless, I failed to find it in examples of *Ctenomys* and

Octodon, which have the other vibrissæ well developed, although in *Ctenomys* the mystacials are shorter than in the other genera of Octodontidæ above quoted. In the examples of *Capromys*,

Text-figure 3.

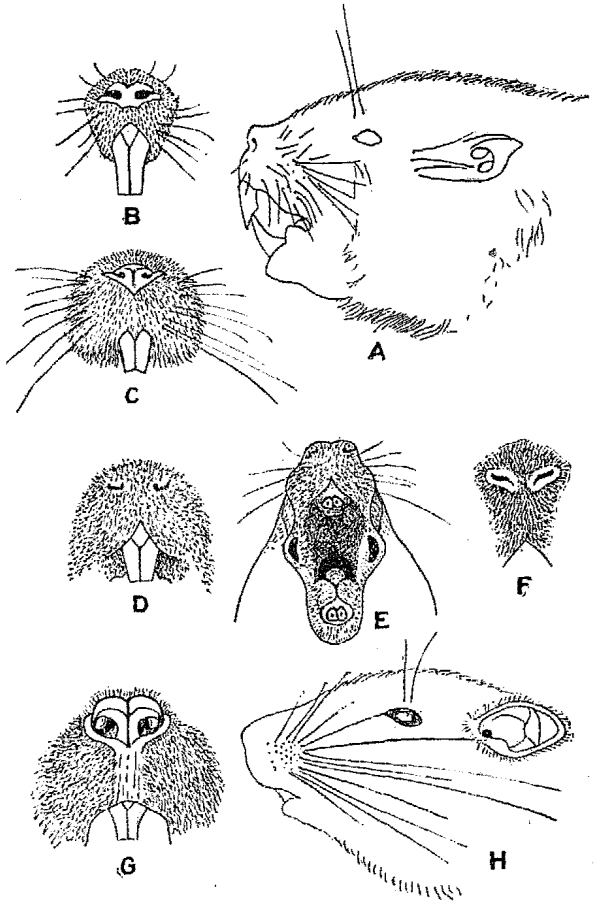


A. Muzzle and mouth of *Myocastor coypu*, from the front: *p*, palatal flaps fused behind upper incisor teeth; *l*, lingual flap. × ⅓.
B. The same of *Cœlogenys paca*. Lettering as in A, with *o*, orifice of external cheek-pouch. × ⅓.
C. Rhinarium and upper lip of *Lagostomus trichodactylus*, from dried skin. × ½.
D. The same of *Dolichotis patagonica*. × ½.

Coendu *, and *Erethizon* examined the interramal is also absent, and the same is true of all the adult specimens of *Myocastor*.

* In *C. prehensilis* the fore and hind limbs and the lower portion of the sides of the body are provided with a few long scattered tactile vibrissæ recalling those on the body of *Hyrax* (*Procavia*).

Text-figure 4.



A. Side view of head of *Ctenomys mendocinus* *.
B. Rhinarium and upper lip of the same.
C. „ „ „ *Octodon degus* *.
D. „ „ „ *Chinchilla lanigera*.
E. Muzzle and mouth of the same, with the fused palatal flaps and the small cheek-pouches.
F. Rhinarium and upper lip of *Cavia porcellus*.
G. „ „ „ *Ctenodactylus gundi*.
H. Side view of head of the same.

* In this and other illustrations in this paper, the figures labelled *Ctenomys mendocinus* and *Octodon degus* were taken from specimens that came respectively from Cordova in the Argentine (*W. A. Smithers*) and Valparaiso (*W. Goodfellow*).

The genal tuft, too, is generally indistinguishable in the latter genus, although in a young specimen I have detected both genal and interramal tufts, the former consisting of two vibrissæ close to the hinder corner of the eye.

In *Cœlogenys* and *Dasyprocta* the ordinary vibrissæ are long and numerous, especially those of the genal tuft in *Cœlogenys*, and the interramal tuft is present. In *Dolichotis* the vibrissæ generally resemble those of *Dasyprocta*; but in an example of *D. salinicola* the interramal vibrissæ, present in a specimen of *D. patagonica*, were absent. In *Hydrochœrus* all the vibrissæ are short and slender, the interramal are absent and the genal are set below the level of the eye. In the typical species of *Cavia* (*C. porcellus*), the common guinea-pig, and in *C. aperea*, the mystacials, superciliaries, and genals are as in the Octodontidæ, *Dolichotis*, and others, although relatively somewhat shorter; and the interramals appear to be absent. But in an example of *Galea littoralis* Thos.*, the interramals are represented by four long bristles arranged along the posterior border of a nearly naked area behind the chin, an arrangement recalling that of the ruminant ungulate *Tragulus*.

In *Chinchilla* and *Lagidium* the mystacial vibrissæ are exceedingly long and coarse, but the superciliaries are much finer and softer. The genals also, when present, are fine and soft, but I found them in only one example of *Chinchilla*. In another example of that genus and in a specimen of *Lagidium* I could not detect them. In *Lagostomus* the mystacials, superciliaries, and genals are all long and coarse, and this genus in addition has a long thick mat of bristles on the cheek below the eye. The interramals appear to be undeveloped in these three genera. *Ctenodactylus* has long mystacials, superciliaries of medium length, but no discernible genals or interramals.

The Mouth and Cheek-pouches.

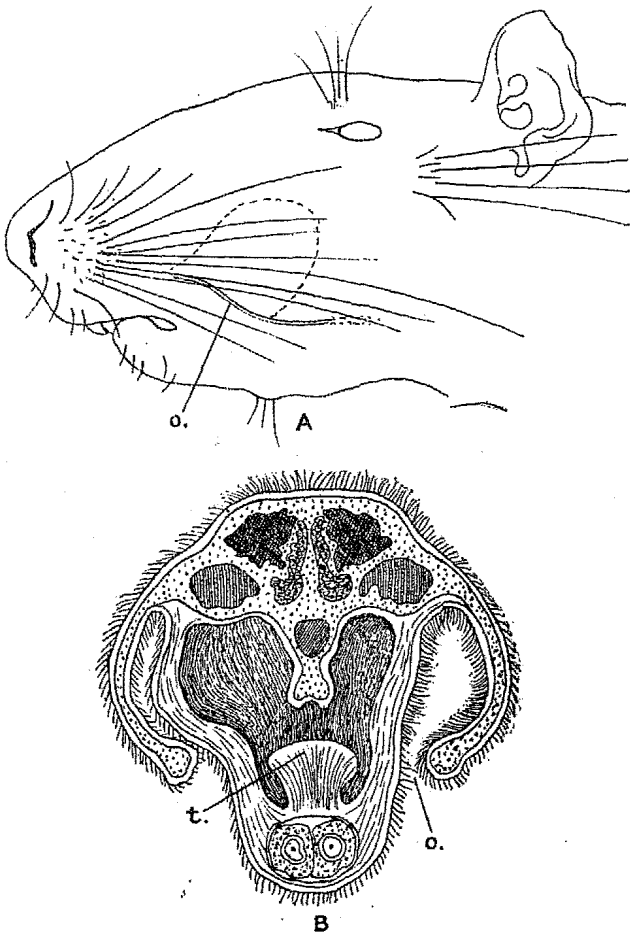
The mouth of the Hystricomorphs, as in other groups of Rodents, is provided with lobes of skin jutting into it from the cheek on each side and serving to shut off the anterior from the posterior part of the buccal cavity so as to prevent gnawed fragments of wood from passing into the throat. A pair of these, one on each side of the tongue, capable of meeting behind the lower incisor, may be called the lingual lobes, while an upper pair, capable of meeting across the palate behind the upper incisors, may be called the palatal lobes.

The lingual lobes, so far as my observations extend, always retain their distinctness and can be separated or brought together; but the palatal lobes are more variable. Typically and in most

* For the genera of this group, see Thomas's paper, Ann. & Mag. Nat. Hist. (8) xviii. pp. 301–303 (1916). I am indebted to Mr. Thomas for the correct names of the species of Cavies recorded in this paper. The specimen above referred to as *Galea littoralis* is the one I erroneously identified as *Cavia rufescens* when I described its facial vibrissæ in P. Z. S. 1914, pp. 900 and 905.

genera, such as *Hystrix*, *Atherura*, *Erethizon*, *Coendu*, *Capromys*, *Cœlogenys*, *Cavia*, *Dolichotis*, and *Ctenodactylus*, they are separated, although capable of being made to meet in the middle line, but in *Ctenomys*, *Myocastor*, *Chinchilla*, and *Lagostomus* they are fused across the palate anteriorly, although partially separated posteriorly.

Text-figure 5.



A. Side view of head of *Cœlogenys paca*, the outline of the external cheek-pouch dotted in; *o*, its orifice.

B. Transverse section of the head of the same anterior to the molar teeth, the internal cheek-pouch on the left of the figure distended; *o*, orifice of external cheek-pouch; *t*, tongue; bony tissue dotted.

The only genus of the group which has genuine cheek-pouches is *Cœlogenys*; but near the edge of the cheek, just inside the mouth, in *Chinchilla* I find a small integumental pocket on each side. These do not seem large enough for the storage of food, and I am unable to surmise what their function may be. (Text-fig. 4, E.)

The cheek-pouches in *Cœlogenys* lie on each side of the maxillary portions of the palate, mainly in front of the molar teeth, and are associated with the well-known and unique structural peculiarity of the skull from which the genus takes its name. The outer wall of each pouch is the original skin of the cheek, which inferiorly passes downwards on to the face behind the corner of the mouth. But this wall is entirely concealed from view externally by the skin-covered, arched, laminate outgrowth of the maxillary portion of the zygoma, which curves downwards below the level of the palate and the molar teeth; and this lamina itself forms the outer wall of a hair-lined external cheek-pouch the orifice of which lies on the face above and behind the angle of the mouth. Thus the original wall of the cheek, covered with hair externally and with moist mucous membrane internally, forms a partition between the internal and external cheek-pouches; and this partition, being pliable, can be thrust by pressure from inside the mouth so as to bulge into the cavity of the outer cheek-pouch so as to diminish its size and increase to a corresponding degree the size of the internal cheek-pouch. If the latter were packed full of food, the external pouch would be practically obliterated; but there would be no visible swelling on the face, such as is seen in the case of monkeys, hamsters, and other mammals provided with these food-receptacles, because of the presence of the secondary cheek formed by the bony outgrowth of the zygomatic arch. (Text-fig. 5, A, B.)

There can, I think, be no doubt that the internal cheek-pouches are used for storing food, although I have never found any food in them in dead specimens of *Cœlogenys*. I attach no importance, however, to this negative piece of evidence, because the pouches of monkeys are usually empty when they die. That the external cheek-pouches are not used for storing food is also, in my opinion, beyond doubt, because the fore feet of *Cœlogenys* are, judging from their structure, altogether unsuitable for thrusting food into them.

From the description above given, it will be evident that the laminate expansion of the maxilla acts as an external shield to the cheek-pouch when distended. But this affords no explanation of the equally remarkable expansion of the jugal portion of the zygomatic arch behind the cheek-pouch.

The Ear.

The ear in *Hystrix* and *Atherura* is comparatively small, but stands well up from the head with a tolerably evenly rounded upper border. In both genera the tragus is distinctly developed, and there is a large antitragal thickening. In *Hystrix* the antero-internal ridge descends internally to the tragus; in *Atherura* it is a rounded lobate thickening above the tragus. The supratragus is a narrow ridge concealed in front by the antero-internal ridge and ending posteriorly in a ridge which descends into the cavity of the ear. Behind the antitragus there is a long deepish groove, and behind this the posterior edge of the ear forms a flap capable of being folded forwards. (Text-fig. 1, A, E.)

The ear of *Dinomys* is simple, with a ridge-like supratragus and a thick, but not prominent antitragus. (Text-fig. 6, E.)

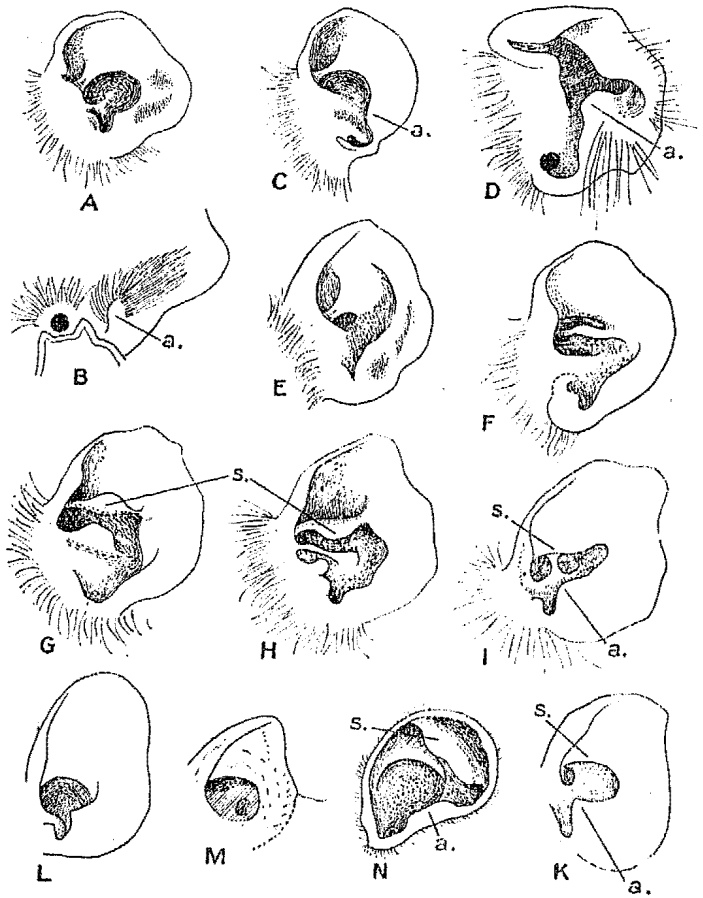
The ear in *Erethizon* is covered thickly with woolly hair and surrounded with spines. It is quite simple in structure and has a tolerably evenly convex edge, which anteriorly above is curled over and overlaps the anterior end of the simple supratragal ridge, which posteriorly curves downwards and runs into the tolerably large antitragal thickening. The lower margin of the ear beneath the "aditus inferior" is a simple shallow ridge, and the auditory orifice is not concealed by a tragal lobe, and there is no definitely developed antero-internal ridge. (Text-fig. 6, C.)

In *Coendu* the ear is of a much more specialised type. Its outline is irregularly angular. The antitragal portion is excessively developed into a high valvular thickening, and the considerably overturned antero-superior edge is jointed at the level of the supratragal ridge, so that the upper portion of the ear can be folded down upon the lower portion, reducing the size of the cavity, which can be similarly compressed from behind by the forward movement of the posterior portion. Modified as the ear is, it is clearly derivable from the type seen in *Erethizon*; and, as in the latter, the auditory orifice is not protected by a tragal lobe. (Text-fig. 6, D.)

The ear of *Capromys* is tolerably similar to that of *Hystrix*, but not so expanded at the summit. The antero-internal ridge descends to the auditory orifice and is continued superiorly a little above the point of attachment of the pinna, but the overfolded portion of the edge of the ear is here much narrower than in *Hystrix*. There is a small tragus concealing the orifice, and a narrow notch betwen it and the antitragal ridge which is also less well developed than in *Hystrix*, and above and behind the antitragus there is a small depression much shorter and shallower than in the latter genus. As in *Hystrix* the simple supratragus is overlapped in front by the antero-internal ridge. (Text-fig. 2, A.)

In *Myocastor* the ear is lower and rounder than in *Capromys*, and has a laminate bulge on its posterior border above and behind the antitragus. The antitragus is better developed than in *Capromys*, and is provided with a large tuft of hairs which serves to keep water out of the auditory orifice, which similarly has a crown of short hairs above it to serve the same purpose. The antero-internal ridge, instead of descending nearly vertically

Text-figure 6.



A. Ear of *Myocastor coypus*, with hairs removed.
B. Lower portion of the same with vertical cut through the intertragal notch, and the tragus turned forwards to show the fringe of hairs above the orifice and the tuft of hairs on the antitragus (*a*).
C. Ear of *Erethizon dorsatum*, with the hairs removed.
D. „ *Coendu prehensilis*.
E. „ *Dinomys branickii*, copied from Peters.
F. „ *Dasyprocta* sp.?
G. „ *Cavia aperea*, with valvular flap upturned below supratragus.
H. „ *Galea littoralis*, without valvular flap below supratragus.
I. „ *Octodon degus*.
K. „ *Loncheres armatus*, copied from Winge.
L. „ *Echimys cajennensis*, copied from Winge.
M. „ *Ctenomys mendocinus*.
N. „ *Ctenodactylus gundi*.

a, antitragus; *s*, supratragus.

to the auditory orifice as in *Capromys* and *Hystrix*, curves somewhat backwards beneath the supratragus and loses itself in a thickening occupying the cavity of the ear above the orifice. (Text-fig. 6, A, B.)

In the ear of *Octodon* the laminate portion is widely expanded, especially below behind the antitragal area, but the edge above this is distinctly emarginate. The cavity is, however, capacious, although the supratragus which borders it above and in front does not stand out as a definite shelf-like ridge. The extension of the antero-internal ridge curves backwards and then upwards, defining a deep pit as in *Cœlogenys* and *Lagostomus*. The tragus is reduced to a little excrescence, not concealing the orifice which lies behind the ridge forming the anterior border of the unusually elongated notch (*aditus inferior*). The antitragus is very large and fleshy, but has no trace of pouch. (Text-fig. 6, I.)

In the six genera of Loncherine Octodontidæ figured by Winge, namely, *Loncheres*, *Echimys*, *Cannabateomys*, *Trichomys* (*Nelomys*), *Carterodon*, and *Mesomys*, the ears are apparently simple in type, moderately large or small in size, and stand away from the head inferiorly from a point beneath the antitragus or the notch in front of it, which is distinct in all of them. The anterior edge is folded over from a point below the anterior end of the supratragus, its inferior end curving backwards and downwards into the cavity of the ear, this curvature being especially strongly marked and high up in *Loncheres*, where the ridge is curled so as to circumscribe a definite pit as in *Octodon*. This peculiarity is not so well marked in the other genera. In *Loncheres*, too, the pinna is relatively smaller and the antitragus larger. *Carterodon* has relatively the smallest antitragus of all. The tragus is small in *Echimys*, *Trichomys*, and *Cannabateomys*, and apparently undeveloped in the others. The supratragus forms a simple, scarcely a shelf-like, ridge roofing the cavity of the ear above anteriorly. The posterior border of the ear is slightly emarginate and angled above in *Loncheres*, *Cannabateomys*, *Trichomys*, and *Mesomys*, convex and angled in *Carterodon*, nearly straight and quite unangled in *Echimys*. The inferior portion behind the antitragus is well developed in all, but shows no trace of a pouch. (Text-fig. 6, K, L.)

Judging from the figures from which this description is taken, the ears of all these genera are of a simpler, more primitive type than those of *Octodon degus*.

Judging from the illustration of *Petromys*, published by A. Smith (Illustr. Zool. S. Africa, Mammalia, 1849) the ear resembles that of the typical Octodontidæ in a general way, but details are not described or figured.

The ear of *Ctenomys* is greatly reduced and simplified in adaptation to subterranean life. The apex is pointed; the posterior border is lightly concave above, but only stands freely away from the head from a point a little below the supratragus, which is not defined as a definite ridge, but is merely represented by the

anterior part of the wall of the subcircular cavity of the ear containing the large exposed auditory orifice, the tragus, antitragus, and the intervening notch being obliterated. The antero-internal ridge, forming the continuation of the strongly overfolded anterior rim of the ear, gradually disappears inferiorly at about the level of the orifice and does not curve sharply backwards beneath the supratragus. (Text-fig. 6, M.)

In *Cœlogenys* this ridge beneath the supratragus is much more sharply defined and forms the lower edge of a well-defined depression, of which the supratragus, which has a definite thickening, is the upper border, and above the supratragus there is another weaker ridge. There is a small tragus, but the antitragus is very large and thick, and is marked above and posteriorly by a small shallow pouch. Above this pouch the antitragus is continuous with a ridge curving forwards above and forming the posterior rim of the cavity of the ear. The laminate portion of the ear is small, but erect, with a slight emargination near the middle of its posterior border, a rounded summit, and an overturned anterior margin continuous below with the antero-internal ridge. (Text-fig. 7, D.)

The ear of *Dasyprocta* is wider as compared with its height than in *Cœlogenys*. As in that genus the inferior end of the overturned anterior rim juts into the cavity, forming a horizontal shelf-like ridge beneath the supratragus, which is itself a long narrow ridge with a well-defined depression above it. There is a small tragus as in *Cœlogenys*, but the antitragus is much less developed than in that genus and has no pouch above it. Above the tragus there is a little curled thickening. (Text-fig. 6, F.)

In *Cavia* and allied genera the ear resembles tolerably closely in shape that of *Dasyprocta*, although varying within the limits of the genus. But it always differs in having the supratragus converted into a laminate valvular flap. In *Galea littoralis* the ridge beneath the supratragus, which is also present in *Dasyprocta* and *Cœlogenys*, is quite thin and of uniform width throughout; the tragus is distinctly defined, and above it there is a thickening recalling that seen in *Dasyprocta* but larger; the antitragus, too, is well developed, and the portion of the pinna below and behind it is comparatively wide, wider than in *Dasyprocta*. But in *Cavia aperea* and the Common Guinea-pig (*C. porcellus*) the ridge beneath the supratragus is large and valvular, like the supratragus itself, there is scarcely a trace of tragal and antitragal thickenings, and the pinna is narrower behind the antitragal ridge. When the ear of the Guinea-pig is folded the two valves close down over the orifice, the supratragal valve lying uppermost. The ear of *Kerodon* resembles that of the two last-mentioned species of *Cavia*, although the two valves are relatively a little smaller and the tragus and antitragus are a little better developed. (Text-fig. 6, G, H.)

The ear of *Thrynomys*, like that of *Cavia*, has the supratragus valvular and the antero-internal ridge passing beneath it. There

is a small tragus and a moderately large antitragus. (Text-fig. 7, A.)

The ear of *Dolichotis* is much longer than in *Cavia* or *Cœlogenys*, and is somewhat narrowed above by the tolerably deep and long emargination of its supero-posterior edge. The supratragus is a simple ridge without the thickening seen in *Cœlogenys*. The continuation of the antero-internal ridge is very distinct and long, longer than in *Cœlogenys*, but equally simple in structure. Beneath it there is a similar ridge curving abruptly downwards to end in a thickening above the auditory orifice. The tragus is quite well developed and high, but the antitragus is not better developed than in *Cavia*. (Text-fig. 7, C.)

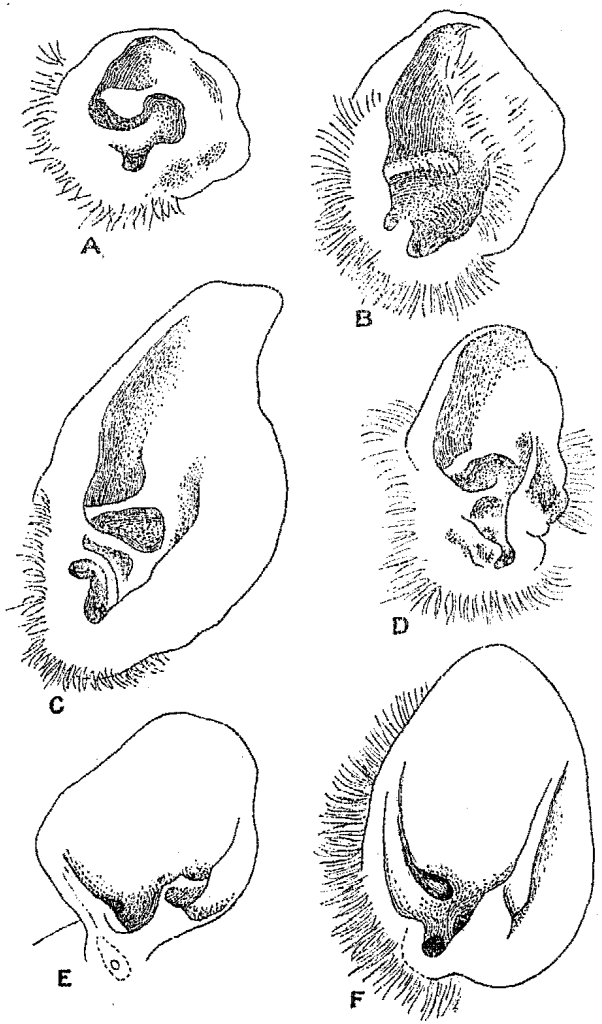
In *Hydrochœrus* the ear is very much simplified, the only strongly developed ridge being the supratragus, which terminates somewhat abruptly near the middle of the cavity. The antero-internal ridge is not turned backwards beneath the supratragus, but gradually fades away inferiorly. There is no definite tragus or antitragal thickening, and the ridge representing the latter is not continued so high as the posterior end of the supratragus. The depression in which the orifice lies is thickly overgrown with hairs covered with waxy secretion, the two combining to exclude water. (Text-fig. 7, C.)

The ear of *Lagostomus trichodactylus* is very specialised, but seems to be an extreme modification of some such type as that seen in *Cœlogenys*. Its laminate portion is very much larger and is tolerably evenly oval. There is a well-developed tragus separated by a large notch from the antitragal portion, which, however, does not form a thickened bulge as in *Cœlogenys*, but is continued obliquely upwards and backwards as a long straightish sharp ridge defined behind by a shallow depression running inferiorly into a shallow pouch, doubtless homologous to the similarly placed pouch above and behind the antitragus in *Cœlogenys*. The backwardly curved continuation of the antero-internal ridge is strong and forms the lower border of a deep depression, bordered above by the thickening representing the supratragus, but this does not form a definite ridge as in most of the ears hitherto described. (Text-fig. 7, F.)

The ear of *Chinchilla* is tolerably similar in type to that of *Lagostomus*, but is much more expanded, except at the base where it is narrower and more tubular, so that the orifice lies deeper in the ear at the bottom of the depression bordered above by the continuation of the antero-internal ridge. No trace of the supratragus remains. The tragus, too, has disappeared; but the antitragus is developed into a prominence relatively as large as in *Cœlogenys*; and this is hollowed into a deep pocket, from the centre of which arises a straight ridge corresponding to the similar straight ridge in *Lagostomus* and to the curved ridge defining the cavity of the ear posteriorly in *Cœlogenys*. (Text-fig. 7, E.)

The ear of *Ctenodactylus* is tolerably small, projects but little, is sloped backwards, and is covered with hair behind and on the

Text-figure 7.



A. Ear of *Thrynomys swinderianus*, from dried skin.
B. „ *Hydrochœrus capybara*.
C. „ *Dolichotis patagonica*.
D. „ *Cœlogenys paca*.
E. „ *Chinchilla lanigera*, the position of the orifice dotted in.
F. „ *Lagostomus trichodactylus*.

edge of the cavity. The edge or rim is raised all round, defining a deep hollow divided into two by a large valvular supratragus, which separates the upper third from the lower two-thirds of the cavity. There is no tragus; but the antitragus forms a long, narrow, infolded, naked ridge, from the upper end of which a short ridge runs obliquely forwards, upwards, and inwards to terminate in the middle of the cavity beneath the supratragus. A corresponding ridge occupies a similar position in the anterior half of the lower two-thirds of the cavity. The orifice of the auditory meatus is a large hole situated just within the lower half of the antitragal ridge. (Text-fig. 6, N.)

According to Dobson, the ear of *Pectinator* resembles that of *Ctenodactylus* except that it retains the antitragal thickening which the latter, he alleges, has lost. Since, however, there is a long low antitragus in the examples of *Ctenodactylus* I examined, this distinction does not hold. Dobson probably overlooked this structure in *Ctenodactylus* owing to its being normally folded inwards. Assuming that their ears are similar, these two genera differ markedly not only from all the Hystricomorphs, but from all other Rodents known to me in the structure of this organ.

The Feet.

In *Hystrix*, *Acanthion*, and *Atherura* the fore foot is short and broad. The four main digits are short, subequal, moderately widely separable, and united by naked integument up to the proximal end of the large smooth digital pads. The claws are tolerably long, strong, and fossorial. The pollex, on the other hand, is greatly reduced and represented externally merely by its nail and small pad. It arises alongside the outer distal extremity of the radial or inner carpal pad, behind or above the inner lobe of the plantar pad. The plantar pad is smooth, about twice as wide as long, and three-lobed. The median lobe projects in the middle line and is larger than the lateral lobes, of which the inner is smaller than the outer. The posterior border of the pad is almost straight from side to side. Immediately behind it are two large smooth carpal pads, separated by a naked space, or nearly in contact, and behind the pads there is a short area of naked skin overlapped by the bristly hairs above it.

The digits and plantar pad of the hind foot are, in general features, tolerably similar to those of the fore foot, except that the hallux is better developed than the pollex and arises just in front of the inner lateral lobe of the plantar pad. The sole of the foot behind the plantar pad is smooth and naked back to the heel, and is occupied for the most part by two large, but not well-defined, metatarsal pads. (Text-fig. 8.)

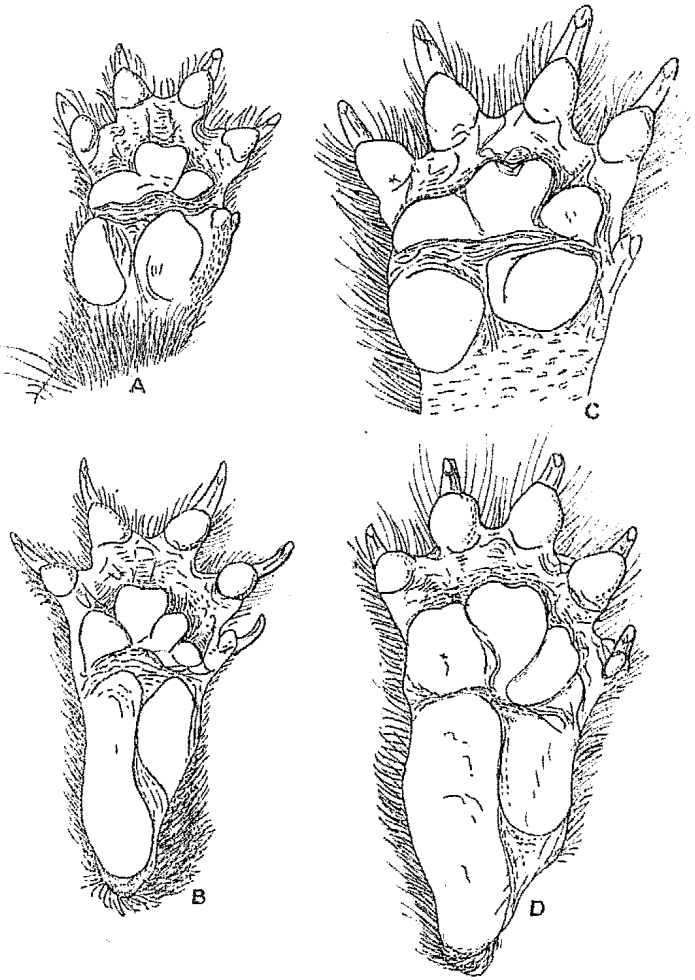
The feet of *Dinomys*, judging from the description and figures published by Peters*, appear to be more like those of *Hystrix*

* Festschr. Ges. Nat. Berlin, 1873, p. 228, pl. iii. figs. 2, 3.

than of any other genus of Hystricomorpha, and are unlike the feet of *Cœlogenys* with which Peters compared them.

The pollex and hallux, which are quite short and practically functionless in *Hystrix*, have disappeared; but, as in *Hystrix*,

Text-figure 8.



A. Right fore foot of *Atherura africana*.
B. „ hind „ „ the same.
C. „ fore foot of *Hystrix africæ-australis*.
D. „ hind „ „ the same.

digits 2–5 are short, thick, and strongly developed, 3 and 4 being subequal and a little longer than 2 and 5, which are themselves

subequal, 2 being set a little more forwards than 5. The interdigital webbing, however, does not perhaps extend so far distally as in *Hystrix*, and the soles are—in part, at all events—covered with squamiform papillæ instead of being smooth. The plantar pad of the fore foot seems to be of much the same form as in *Hystrix*, and just behind it and in contact with it there is an immense carpal pad with a median depression indicating its division into the two normal elements. The plantar pad of the hind foot is reduced to three smooth isolated prominences rising from the papillate integument; and the metatarsal area shows no trace of the two pads, but is uniformly papillate in its distal portion, where it is scarcely defined from the plantar portion, and smooth and swollen in its proximal portion up to the heel. (Text-fig. 19, A, B, p. 402.)

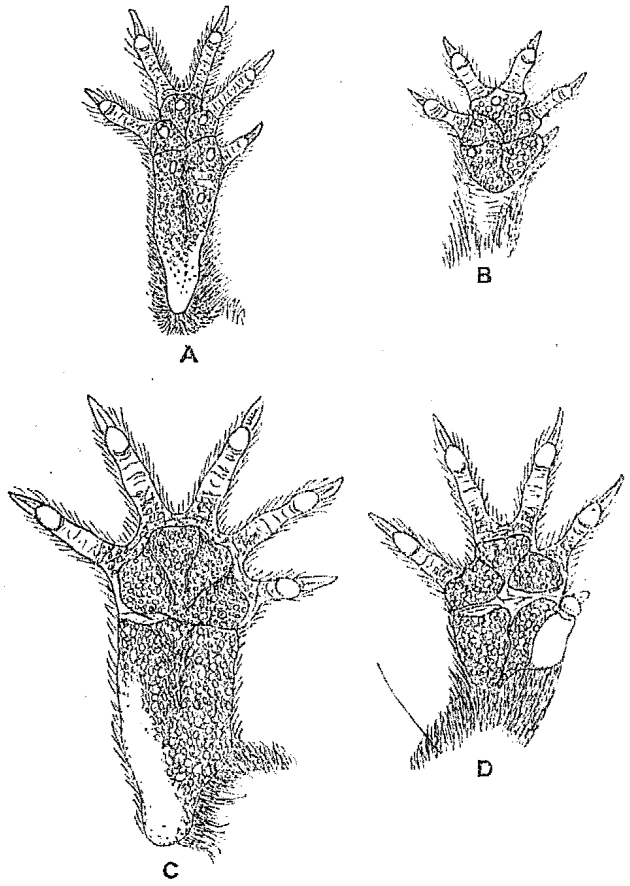
In *Octodon degus* the fore foot is artiodactyle, the third and fourth digits being paired and subequal and a little longer than the second and fifth, which are also subequal, the fifth, however, being a little the shorter of the two. These four digits are stout, shortish, with sharp moderately long claws; the pollex is quite short and represented externally by little more than its claw. The plantar pad is large, as wide as the foot, considerably wider than long and markedly three-lobed, the median lobe being larger than either of the others. It is covered with papillæ, which spread on to the base of the digits, and each lobe is provided with a single large papilla opposite the three interdigital spaces. The double carpal pad of which the two elements are mesially in contact, the outer being a little the larger, is a little larger than the plantar pad and, like it, covered with papillæ, with a single enlarged papilla at the antero-external corner of each. Behind this pad there is a naked triangular area of skin. (Text-fig. 9, B.)

In general features the hind foot is like the fore foot, but the digits are much longer and the plantar pad narrower and the hallux is relatively much longer than the pollex. There is a single enlarged circular papilla opposite the four interdigital spaces, and two others on the metatarsal area, one set forwards on the ulnar side just behind the outer moiety of the plantar pad and the other farther back on the radial side some distance behind the papilla opposite the space in front of the hallux. The whole plantar surface is covered with small papillæ, except the heel, which is naked; and there is a median groove defining the two elements of the metatarsal pads. I regard the feet of *Octodon* as the most generalised type found in the Hystricomorph Rodents. (Text-fig. 9, A.)

Winge's figures of the feet of several genera of Loncherinæ (*Loncheres*, *Echimys*, *Trichomys* (*Nelomys*), *Carterodon*, *Mesomys*) show that, with variations in detail, they conform tolerably closely with those of *Octodon degus*. They are pentadactyle with greatly reduced pollex and short hallux; the primary interdigital elements of the plantar pads are separated, but they are relatively much larger than in *Octodon*, and the papillate areas of

integument between them are correspondingly reduced; and the same applies to the carpal and metatarsal elements. Also the fifth digit both in the fore and hind foot is relatively shorter and set farther away from the fourth in *Echimys*, *Carterodon*, and

Text-figure 9.

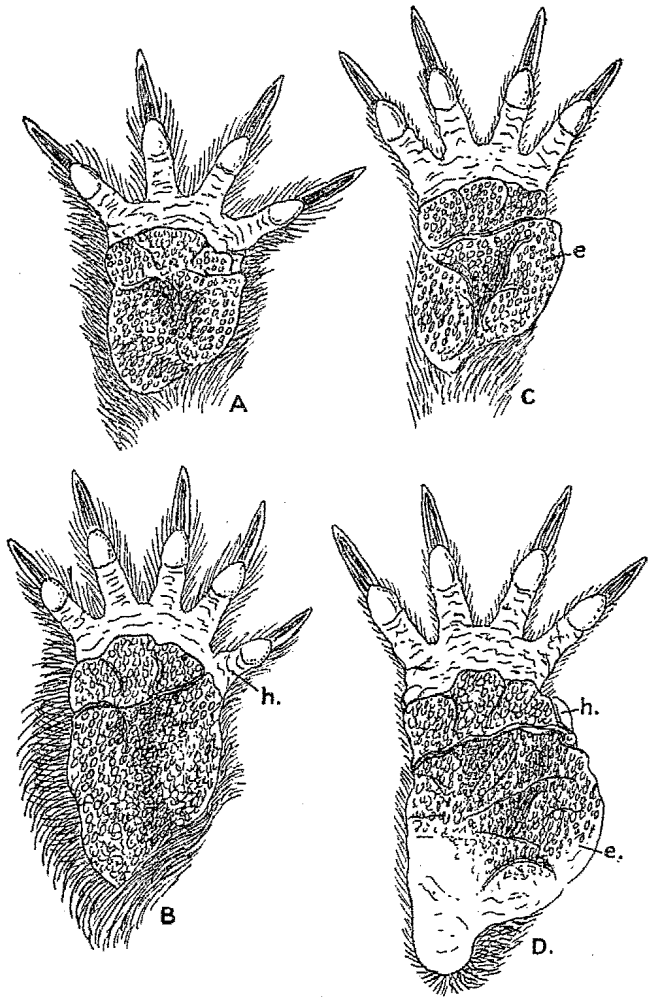


A. Right hind foot of *Octodon degus*.
B. „ fore „ „ the same.
C. „ hind foot of *Capromys pilorides*.
D. „ fore „ „ the same, showing the smooth area of the carpal pad behind the pollex.

Mesomys. In *Mesomys* the feet are more fossorial in type, being broader, and supplied with shorter digits and longer stronger claws. Moreover, the fourth digit of the exceptionally wide fore foot is considerably shorter than the second and third.

The fore foot of *Capromys* is very like that of *Octodon*, except that the four main digits are relatively considerably longer,

Text-figure 10.

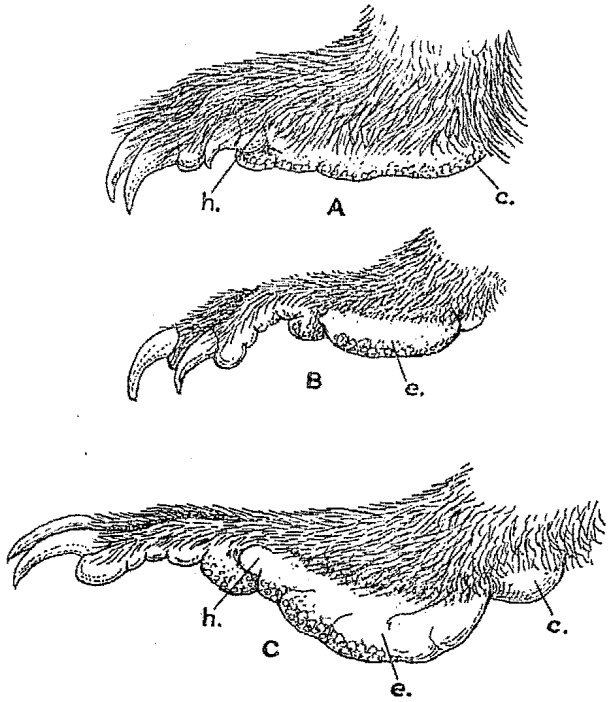


A. Right fore foot of *Erethizon dorsatum*.
B. „ hind „ „ the same (the sole is sometimes more expanded behind the hallux).
C. „ fore foot of *Coendu prehensilis*.
D. „ hind „ „ the same.
h, hallux; *e*, prehensile expansion of sole.

there are no enlarged papillæ on the plantar or carpal pads, and the external moiety of the carpal pad is relatively larger and

quite smooth on its postpollical portion. The hind foot is also like that of *Octodon*, but is relatively broader and shorter, being actually broader, instead of narrower, than the fore foot. Moreover, the hallucal or inner element of the plantar pad is not fused with the metatarsal pad, but forms part of the plantar pad itself, which is thus four-lobed instead of three-lobed as in *Octodon*, and there is no trace of divisional line on the metatarsal pads, and there are no enlarged papillæ either on the plantar or metatarsal pads. (Text-fig. 9, C, D.)

Text-figure 11.



A. Right hind foot of *Erethizon dorsatum*.
B. Right fore foot of *Coendu prehensilis*.
C. Right hind „ „ the same.
h, hallux; *c*, heel; *e*, prehensile expansion of sole.

Except that they are broader and shorter, with shorter digits, partially webbed basally, much longer claws, and the component elements of the plantar and carpal pads less clearly defined, the feet of *Erethizon* are like those of *Capromys*. The above-mentioned differences, together with the suppression of the pollex, externally attest higher specialisation of the feet, in accordance probably with greater adaptation to arboreal life.

Specialisation of the feet on the lines indicated in *Erethizon* is carried a stage further in *Coendu*, where an excrescence on the inner side of the plantar area, giving greater width to the sole, takes the place of the pollex, while a very much larger, nearly semicircular expansion, occupying the whole length of the sole of the hind foot, takes the functional place of the hallux*. This expansion is movable up and down to a certain extent, and enormously increases the supporting area and gripping power of the foot. As in *Erethizon*, the plantar, carpal and metatarsal, and the digital pads are covered with squamous papillæ. (Text-figs. 10, 11.)

In the disposition and proportionate length of its digits the fore foot of *Myocastor* resembles that of *Capromys*, but the four main digits are relatively shorter and stouter, and have thicker blunter claws. The pads are better developed, being relatively larger and more cushion-like. The median lobe of the plantar is approximately twice the size of either of the laterals, and there is a deep or shallow division between the two elements of the carpal pad. The radial moiety of the latter is also covered, like the rest of the carpal pad, the plantar, and the digits, with squamiform papillæ. I found no trace of carpal vibrissæ. (Text-fig. 12, B.)

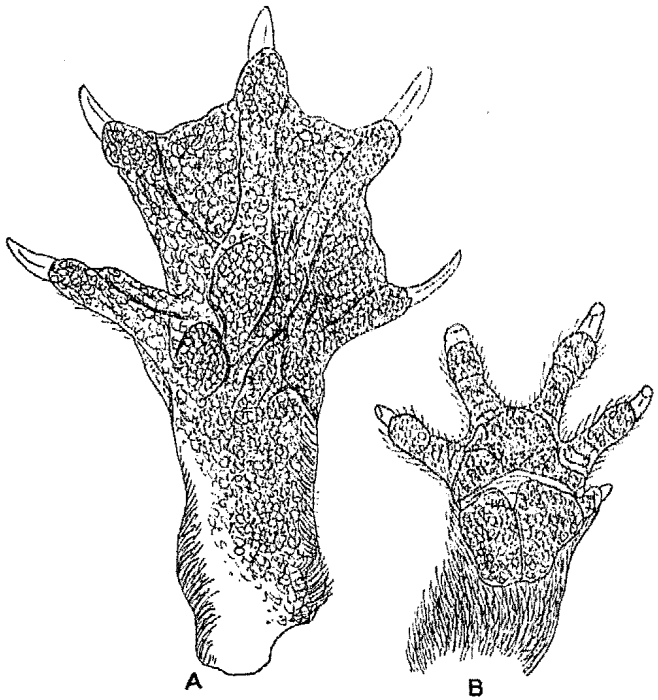
The hind foot is very much larger than the fore foot†, mainly owing to the elongation of the digits, of which the third is the longest, the second and fourth a little shorter and subequal, the fifth considerably shorter than the fourth and the first than the fifth. The first, second, third, and fourth are united by swimming-webs extending up to the digital pads; but the only trace of web between the fourth and fifth is a flap of skin running along the inner edge of the fifth digit, which is thus left free for the purpose, I believe, of acting more efficaciously as a skin-scraper. The plantar pad is indistinctly defined, being represented by lobes of skin at the base of the first, second, third, and fifth digits. The comparatively short metatarsus is naked back to the heel. Its anterior portion, like the plantar area and the digits, is covered with squamous papillæ, but a varying amount of the heel is smooth, especially on the outer side. (Text-fig. 12, A.)

The feet of *Dactylomys* and *Cannabateomys* are very different from those of the typical genera of Loncherinæ. In *C. amblyonyx*, as figured by Winge and Tullberg, the lower sides of the digits and soles are uniformly and closely covered, except on the heel, with squamous papillæ, lineally arranged on the digits, but show no trace of definite pads apart from the integumental grooves resulting from the folding of the digits on the soles. The fore foot has a minute functionless pollex close to the base of the second digit, which rises nearly on the same level as the fifth,

* In a young example of *C. prehensilis* there was a larger external hallux occupying the same position as the hallux in *Erethizon*.
† Precisely as in the Otters and for similar reasons.

but exceeds it in length, although much shorter than the third. The third and fourth are long, thick, and subequal. The fifth only reaches the distal end of the first phalange of the fourth. The ends of the digits are thick and bluntly rounded, and furnished with nail-like claws, which are concealed from the inferior aspect. The sole is marked with a Y-shaped groove, the branches of which run to the margin at the spaces between the second and third and fourth and fifth digits, the upright

Text-figure 12.



A. Right hind foot of *Myocastor coypus*.
B. „ fore „ „ „

presumably marking the original line between the two elements of the carpal pad. The hind foot has the sole short, only a little longer than in *Ctenomys*, and, as in that genus, broad in front and narrowed behind. The second, third, fourth, and fifth digits bear much the same relation to each other in length as those of the fore foot, but the hallux is well developed as compared with the pollex and stands well away from the sole. The nails are as in the fore foot, except that on the second digit the nail is claw-like, according to Winge, and projects beyond the tip of the digit, acting, no doubt, as a scratcher.

In *Cœlogenys* the fore foot is five-toed and artiodactyle. The pollex is greatly reduced and represented externally merely by its small nail, which is set some distance above the second digit. The third and fourth digits are thick and subequal, and united by webbing halfway between the plantar and digital pads. The second is as thick as the third and considerably shorter; but it is stouter and longer than the fifth, and set a little more forwards. The web between the second and third and fourth and fifth is less extensive than that between the third and fourth. These four digits have powerful claws and well-developed smooth pads. The carpal pad is large, three-lobed, and projects in the middle in front, this portion having a truncated anterior margin. It is roughened with papillæ, if not all over, at least in the middle line and laterally at the base of the second and fifth digits. Separated from the plantar pad by a space of naked wrinkled skin are the two well-developed nearly smooth carpal pads which are in contact in the middle line. The whole of the inner side of the wrist as far forward as the base of the second digit is covered with very short hair as in *Dasyprocta* and *Kerodon*. (Text-fig. 13, A.)

The hind foot is also five-toed, but is perissodactyle. The first and fifth digits are short and slender, the first being a little smaller than the fifth; and they arise nearly opposite one another far up the sides of the foot, only a little in front of the metatarsal pads and a long way behind the main mass of the plantar pad. The second, third, and fourth digits are thick and strong, the second and fourth being shorter than the third which lies between them. There is a shallow web between them at the base. The claws and digital pads are similar to those of the fore foot. The main portion of the plantar pad is an irregularly shaped cushion-like mass with two especially strongly papillate areas corresponding to the interdigital spaces and attesting the origin of this pad from two plantar interdigital elements. The remaining two interdigital elements, seen in *Octodon*, for example, have travelled away from the main portion of the pad, and are represented by small pads at the base of the first and fifth digits, although the one at the base of the first digit (pollex) is not always distinguishable. The metatarsal area is covered by a large horny shield, distinctly double at its distal end, but only indistinctly divided in two elsewhere. (Text-fig. 13, B.)

The feet of *Dasyprocta* are in many respects very different from those of *Cœlogenys*, but seem to be derived from that type. They are much thinner and longer. The fore foot is perisso-dactyle; the pollex is even more reduced than in *Cœlogenys*. The fifth digit also is relatively smaller; it is, moreover, set high up the foot, almost on a level with the pollex, some distance behind the plantar pad and slightly in advance of the carpal pad. The second, third, and fourth digits are well developed, the second is slightly shorter than the fourth, and both are shorter than the third which lies between them. There is no visible basal webbing.

The claws and pads on these three digits and on the fifth are well developed, the pads being smooth. The plantar pad is very different from that of *Cœlogenys*, consisting of two elements opposite the interdigital spaces of the three main digits. The third, or outer, element of this pad is small and circular, and has accompanied the backward migration of the fifth digit. The carpal pads, two in number, are narrow, indistinct behind, and in contact mesially, the inner pad being larger than the outer and projecting further distally. They are separated by a longish area of naked skin from the plantar pad. The inner side of the wrist is covered with short hair, sometimes almost naked, as in *Cœlogenys*. (Text-fig. 13, C.)

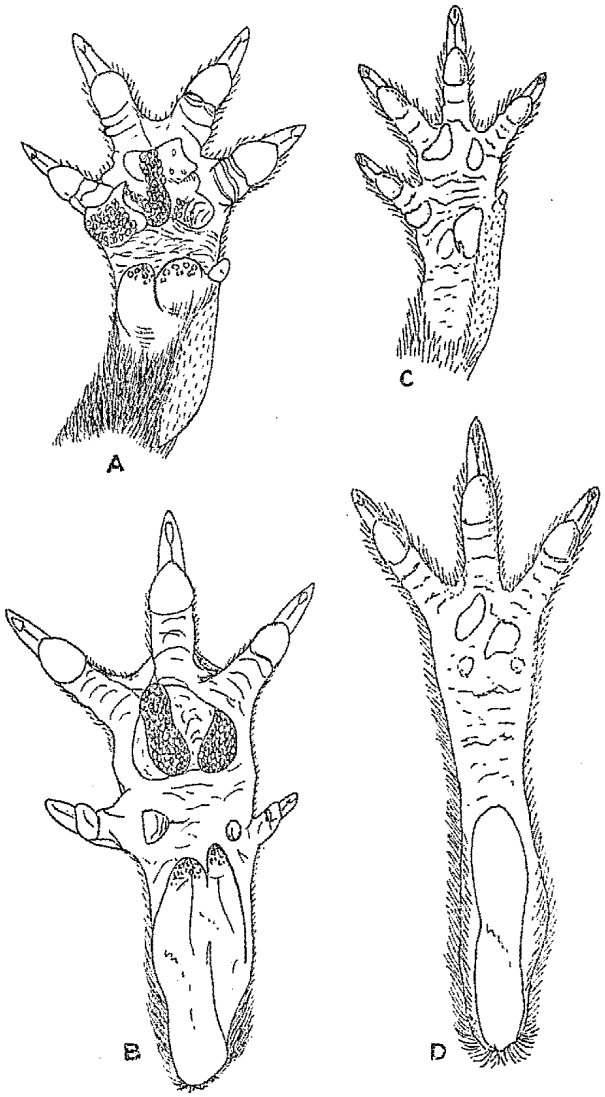
The hind foot is like that of *Cœlogenys*, except that the first and fifth digits have entirely disappeared, the three main digits are longer, thinner, and unwebbed, the plantar pad is much smaller, consisting of two larger but small pads at the base of the inner and median digits, and of a very small circular pad at the base of the fourth or outer digit. Assuming this pad to be the homologue of the small pad at the base of the fifth digit in *Cœlogenys*, it occupies a very different position. The metatarsal pad is a long way behind the plantar pad, and shows at most indistinct signs of a divisional line on its inner side. (Text-fig. 13, D.)

The feet of *Chinchilla* are derivable from the type seen in *Cœlogenys*, with the basal webbing eliminated. In the fore foot the digits are thinner, with relatively larger compressed pads and shorter claws adapted to a life amongst rocks, but their number, relative length, and disposition are similar. There is a distinctly three-lobed plantar pad and a large two-lobed carpal pad, which, however, is larger than the plantar pad and not smaller as in *Cœlogenys*. The wrist, however, is uniformly covered above and laterally with long hairs. The hind foot is longer and thinner, and the hallux has entirely disappeared; but the remaining four digits are similarly placed, although, as in the front foot, they have relatively broader pads and much shorter claws. The plantar pad is two-lobed, its external element, larger than in *Cœlogenys*, has travelled up the foot in company with the fifth digit and lies laterally nearly midway between the plantar and metatarsal pads, the latter being defined by a sulcus which expands into a notch distally. A specialisation is the development of fringes of longer hairs on the inner sides of the second and third digits, those on the second forming a stiff comb. (Text-fig. 14, A, B.)

In general features the feet of *Lagidium* are like those of *Chinchilla*, except that the under sides of all the digits, apart from the digital pads, are thickly covered with hairs and the digital pads themselves are compressed and furnished, as in *Cerodon*, with a rounded median keel. The three elements of the plantar pad of the fore foot are very large and in contact. Behind these

are two very large carpal pads which are also in contact. In the hind foot there is a very large bilobed plantar pad; the third or

Text-figure 13.

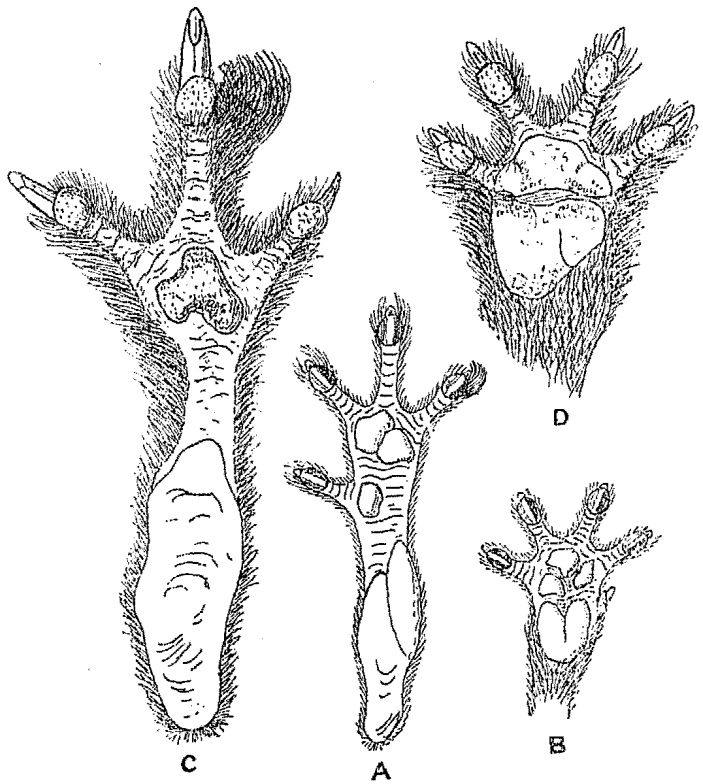


A. Right fore foot of *Cœlogenys paca*. × ⅓.
B. „ hind „ „ „
C. „ fore foot of *Dasyprocta* sp.? × ⅓.
D. „ hind „ „ „

outer lobe, which is also very large, has separated itself from the main mass of this pad and travelled up the foot in company with the fifth digit, as in *Chinchilla*; and, as in the case of the front foot, the hairs of the sides encroach laterally more over the sole than in *Chinchilla*. (Text-fig. 15, C, D.)

In *Lagostomus* the fore foot differs from that of *Chinchilla* and *Cœlogenys* in the suppression of the pollex, but is otherwise

Text-figure 14.



A. Right hind foot of *Chinchilla lanigera*.
B. „ fore „ „ „
C. „ hind foot of *Lagostomus trichodactylus*.
D. „ fore „ „ „

tolerably similar in type, with adaptations for a life in the open plains as opposed to a rocky or forest habitat. The digits are shortish with well-developed pads and claws; the third and fourth are subequal and longer than the second and fifth: the second also is longer than the fifth, but not quite to the same extent as in *Chinchilla* and *Cœlogenys*. They are thus

more symmetrically artiodactyl. The plantar pad is wider as compared with its length than in *Cœlogenys*, and its three component elements are less well defined than even in that genus, and markedly less so than in *Chinchilla*. As in *Chinchilla*, the carpal pad is larger than the plantar pad and closer to it than in *Cœlogenys*, but it is not so distinctly divided into two as in those genera, and, as in *Chinchilla*, the outer side of the wrist is normally hairy.

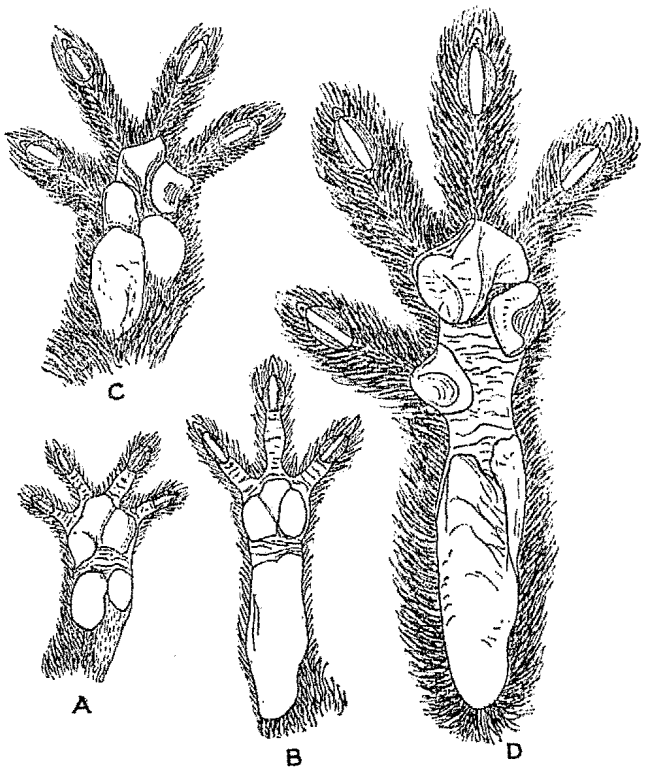
The hind foot differs from that of *Chinchilla* and *Cœlogenys* in the complete suppression of the fifth digit and of the corresponding element of the plantar pad. The second digit, moreover, is very markedly shorter than the fourth*, and the latter, too, although long, is shorter in comparison with the long third digit than in *Chinchilla* and *Cœlogenys*. The claws of these three digits are as powerful relatively as in *Cœlogenys*. The plantar pad, as in those genera, is composed of two elements, but they are very indistinctly defined, and the whole pad is three-lobed with emarginate antero-lateral and posterior borders. The metatarsal pad is large and horny, but undivided. A peculiarity of the foot is the encroachment of the hairs of the outer side nearly up to the middle line, overlapping, with those of the opposite side, the area between the plantar and metatarsal pads; and a further difference from *Chinchilla* is the development of a thick bunch of stiff bristles on the inner side of the third digit. *Chinchilla* has long hair in this position, but the brush, or comb, is specially developed upon the second digit. The feet of this genus are interesting, because they connect those of the Chinchilline with those of the typical Caviine section of the group of Rodents. The hind foot is also modified on much the same lines as that of *Dasyprocta*, although the fore foot is very different. (Text-fig. 14, C, D.)

The feet of *Cavia porcellus*, the domesticated Guinea-pig, have been figured and described by Mivart and Murie (P. Z. S. 1866, pp. 383–417), and by Tullberg. In the artiodactyle fore foot the pollex is suppressed and the four remaining digits are moderately long and subsymmetrically arranged, the third and fourth being subequal and longer than the second and fifth, which are also subequal. The claws project well beyond the normally shaped digital pads. The plantar pad is well defined and three-lobed, the median lobe being the largest. Behind the plantar pad there is a single carpal pad, separated from it by an area of naked skin. The hind foot is perissodactyle, with only three toes, whereof the median (the third) is the longest. The claws are longer than in the fore foot. The plantar pad is moderately well defined and two-lobed, the inner lobe being much smaller than the outer. The metatarsal area has no large horny plate representing the pads, which are merely indicated by a single

* It must be remembered that the numerical terms applied to the digits throughout this paper are used in a homological sense, as if the limbs were normally pentadactyle.

median semicircular pad near the centre of the area some distance behind the plantar pad. In a wild-caught example of *Cavia aperea*, the feet agree in all essentials with those of *C. porcellus*; as also do those of *Galea*.

Text-figure 15.



A. Right fore foot of *Kerodon rupestris*, from dried skin.
B. „ hind „ „ „ „ „
C. „ fore foot of *Lagidium peruanum* „ „
D. „ hind „ „ „ „ „

The feet of *Kerodon* differ from those of *Cavia* in some respects. The number and disposition of the digits is the same, but the claws are much shorter and blunter, especially on the fore foot. The digital pads are larger, compressed, and somewhat pointed at their distal ends. The plantar pads are very large, well-defined, cushion-like thickenings, separated by a short strip of wrinkled integument from the carpal and metatarsal pads. The carpal pads are very well developed and two in number, a larger outer and a smaller inner, the two together

approximately equalling the plantar pad in size. On the inner side of the fore foot there is an area covered with short hairs, as in *Dasyprocta* and *Cœlogenys*. In the hind foot the greater part of the metatarsal area is covered with a large horny shield, like that of *Dasyprocta*. (Text-fig. 15, A, B.)

In *Dolichotis patagonica* the fore foot is symmetrically artiodactyle, the second and third digits being subequal and longer than the fourth and fifth, which are likewise subequal. The pollex is absent. The claws are moderately long but blunt, and the digital pads are very well defined. The plantar pad is a large, thick, irregularly hexagonal cushion set far forwards beneath the digits. Its edges are emarginate opposite the interdigital spaces, and its posterior border is mesially notched. It is exceedingly deep, and the gait of this genus is markedly digitigrade. The metacarpal area behind the plantar pad is remarkably long, and there is a single very small carpal pad remote from the plantar pad. The hind foot, as in *Cavia*, *Dasyprocta*, and *Hydrochærus*, is perissodactyle and furnished with three digits, which resemble those of the fore foot in essential particulars. The plantar pad is relatively as large and high as in the fore foot, but differently shaped; its edges are more evenly convex, and there is a single median process in front corresponding to the median or third digit. It is composed of two indistinctly defined elements. This foot, like the fore foot, is markedly digitigrade, the posterior portion of the plantar pad projecting like a heel. The metatarsal area is very long, and its posterior half is covered with a single horny shield, upon which the animal squats, like *Hydrochærus*, *Dasyprocta*, *Kerodon*, and others. In both the fore and the hind foot the naked lower side of the digits and of the area behind the plantar pads is overlapped by the hairs of the sides of those parts. (Text-fig. 16.)

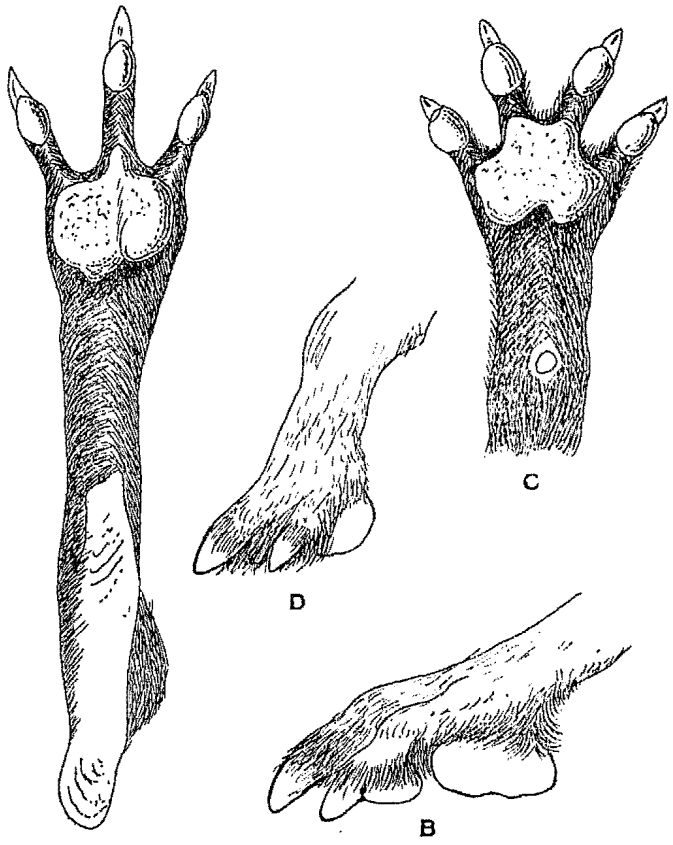
Dolichotis salinicola has feet closely resembling those of *patagonica*, except that, judging from the single example examined, the metacarpal area of the fore foot is shorter and the carpal pad a little larger and closer to the plantar pad.

If the habits of *Dolichotis* were unknown, it would not be difficult to infer from the structure of its feet that the animal is adapted for swift running over hard ground. The differences the feet present from those of *Cavia* may be ascribed to adaptation to that mode of life.

The feet of *Hydrochærus* differ in several important respects from those of *Cavia*. This is particularly the case with the fore foot, which, as in *Cavia*, has no pollex, but is perissodactyle, the third digit being the largest and situated in the middle line, with the second and fourth, which are subequal, flanking it laterally; and these three digits are united by narrow webbing up to the digital pads. The latter, however, are scarcely recognisable as such, being represented by a softish thickening of integument blending without line of demarcation with the skin of the digit behind and with the claw in front and forming a

kind of heel to the claw, which, although narrowed distally, is broad and hoof-like, and horny below as well as above. The plantar pad forms a cushion provided with two flat horny plates. Hence it is derived from two elements, not from three as in *Cavia*, and it is set far forwards beneath the three digits, which

Text-figure 16.

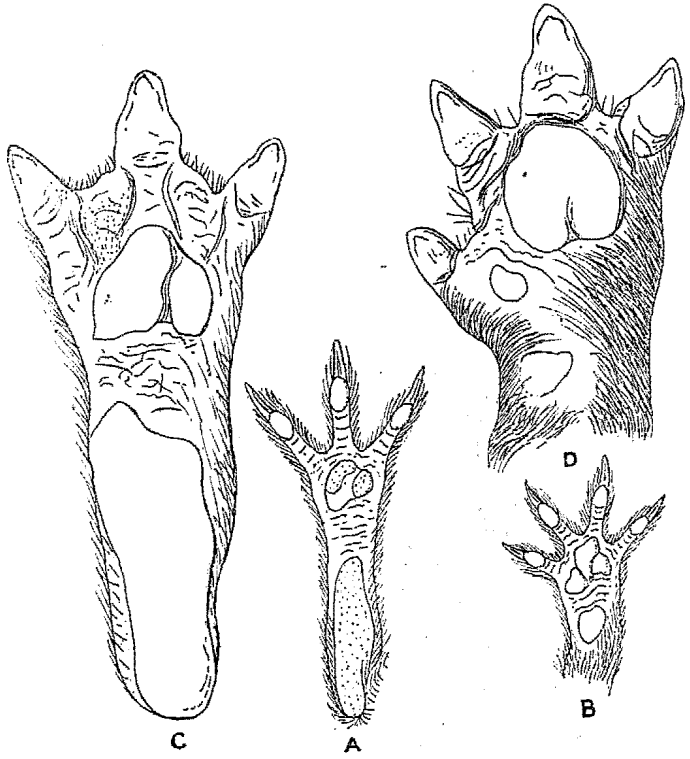


A. Right hind foot of *Dolichotis patagonica*. × ¼.
B. Side view of extremity of the same.
C. Right fore foot of the same.
D. Side view of the same.

thus appear to be very short when viewed from the under side. The fifth digit, on the other hand, arises considerably behind the fourth, approximately on a level with the posterior line of the plantar pad, and the element of the plantar pad corresponding to this digit is a comparatively small horny pad entirely separated

from the main mass of the plantar pad, as in the hind foot of *Cœlogenys*, *Chinchilla*, and *Lagostomus*. Owing to the backward position of the fifth digit and the forward position of the plantar pad, the Capybara walks on hard soil upon that pad and upon the second, third, and fourth digits, the fifth scarcely reaching the ground. There is, as in *Cavia*, a single conical or semicircular

Text-figure 17.

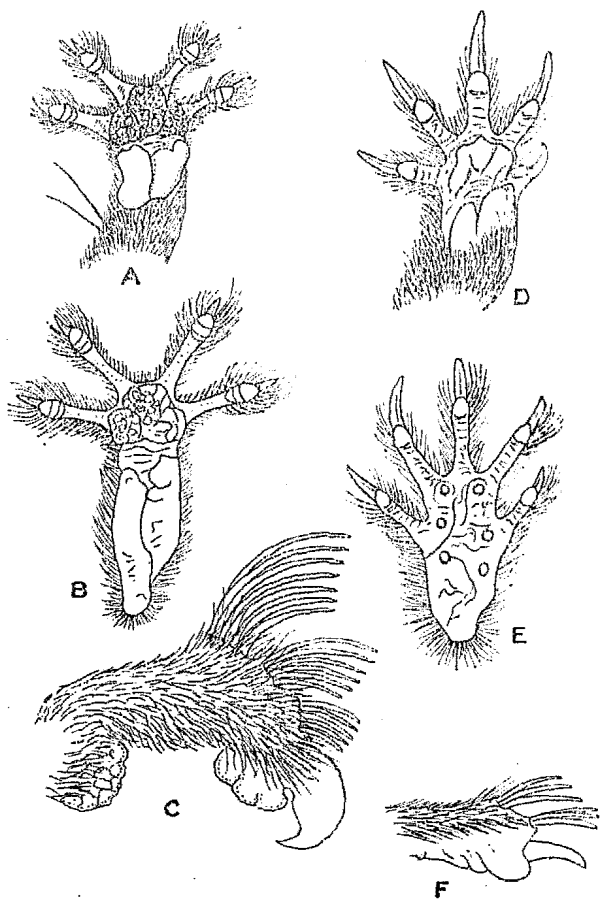


A. Right hind foot of *Galea littoralis*.
B. „ fore „ „ „
C. „ hind foot of *Hydrochœrus capybara*.
D. „ fore „ „ „
(In some examples of *Hydrochœrus*, the horny plates on the plantar pads are much more clearly represented than in C and D.)

carpal pad, which is set well on the outer or ulnar side of the limb above the base of the external border of the fifth digit. The area between the carpal and plantar pads is covered with wrinkled skin overlapped by the sparsely growing long hairs of the sides of the foot. (Text-fig. 17, D.)

The hind foot differs from that of *Cavia* in the webbing of the digits and the hoof-like claws, which are like those of the fore foot, except that the webs are wider and, owing to the more backward position of the plantar pad with its two horny plates,

Text-figure 18.



A. Right fore foot of *Ctenodactylus gundi*.
B. „ hind „ „ „
C. Inner or second digit of hind foot of same, showing combs.
D. Right fore foot of *Ctenomys mendocinus*.
E. „ hind „ „ „
F. Tip of second digit of hind foot of same, showing combs.

apparently longer. The metatarsal area resembles that of *Kerodon* in having the posterior three-fourths of its length covered by a thick horny plate. (Text-fig. 17, C.)

In *Ctenomys* the fore feet are fossorial. The four main digits are short and thick, and armed with long and strong claws. The digital pads are not well defined from the thickened transversely-grooved skin on the under side of the digits. Digits 2, 3, and 4 are not markedly unequal in length, but 5 is considerably shorter. The pollex is abbreviated, but armed with a strong, sharp, curved claw. The plantar pad is irregularly three-lobed and not well defined, but the two carpal pads close behind it are well developed and conical, especially the inner, which projects as an excrescence immediately behind the base of the pollex. (Text-fig. 18, D.)

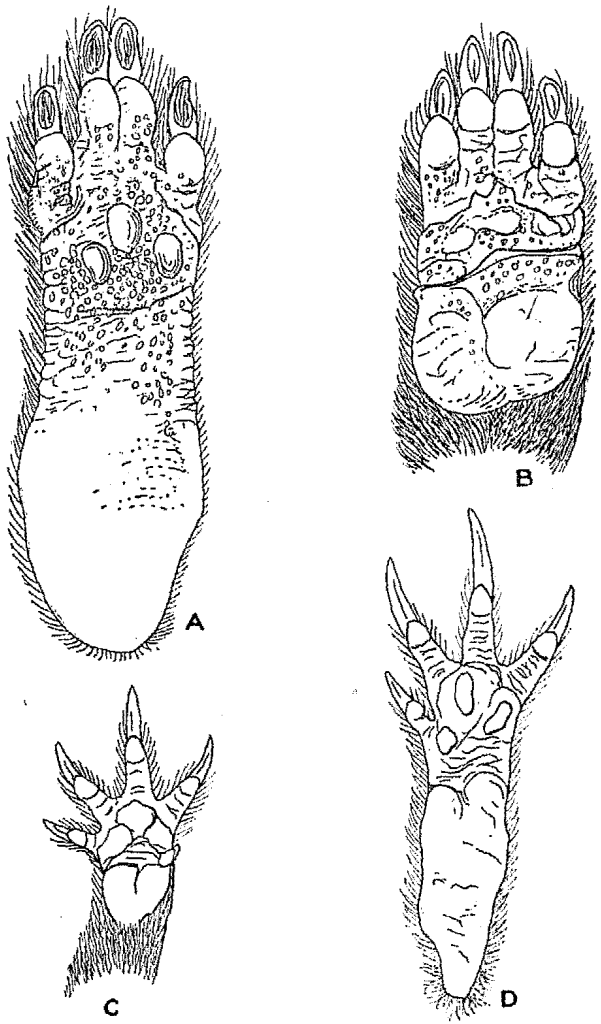
The hind foot is short and wide, and narrows behind to the heel, which like the rest of the lower surface is naked. The four main digits are subequal in length, but thinner than on the fore foot, but otherwise similar, except that the claws are relatively and actually smaller, although that of the 4th is elongated and curved. Digits 2, 3, and 4 are set nearly in a straight line and evenly spaced, but digit 5 is set further back and much more widely separated from 4 than the latter is from 3. Digits 2 and 3 are thickened above for the accommodation of the two superimposed combs of stiff bristles which overhang the claws. Similar bristles, but thinner and less modified, are found on digits 1 and 4, and in the case of the latter the function of combing the fur is no doubt performed by the long curved claw, the point of which reaches as far as the distal end of the bristle-combs on the 2nd and 3rd digits. The plantar pad is almost suppressd, being mainly represented by four small hemispherical tubercles, two in front just behind digits 2, 3, and 4 and one at the base of digits 1 and 5 respectively. The area between these tubercles is wrinkled and irregularly papillate; but the area behind them is smooth and mostly covered by a large callous external metatarsal pad, which terminates anteriorly in a tubercle, and posteriorly falls short of the heel, which, like the inner side of the foot, is covered with thinner skin, the internal metatarsal pad being represented by a tubercle behind the pollical tubercle of the plantar pad. (Text-fig. 18, E, F.)

The feet of *Thrynomys* are not like those of any other genera of the group; both fore and hind are perissodactyle. In the fore foot the pollex is minute. The second, third, and fourth digits are short, thick, and armed with long strong claws, the second and fourth being subequal and shorter than the third, which lies between them. They are free from webbing. The fifth digit is much smaller than the fourth, but set close behind it a little in front of the level of the pollex. The plantar pad is wide, three-lobed, convex in front, and concave behind. The carpal pad, which is separated mesially, at all events, from the plantar pad by a moderately long membranous space, is large and indistinctly divided by a groove and notch in front. (Text-fig. 19, C.)

The hind foot has lost all trace of the hallux externally. Otherwise the digits are similar to those of the fore foot in

number, shape, and disposition, although longer. The plantar pad is well developed and supplied with three smooth, suboval,

Text-figure 19.



A. Right hind foot of *Dinomys branickii*, copied from Peters.
B. „ fore „ „ „ „ „
C. „ fore foot of *Thrynomys swinderianus*, from dried skin. ×⅓.
D. „ hind „ „ „ „ „

isolated, interdigital areas, the innermost, tolerably large, at the base of the second digit, the median equalling it in size behind

the space between the third and fourth, and the outer smaller, rounder, and set further back behind the base of the fifth. The metatarsal area is mostly covered with a smooth horny plate, with bilobed anterior border separated from the plantar pad by a shortish naked area of skin. (Text-fig. 19, D.)

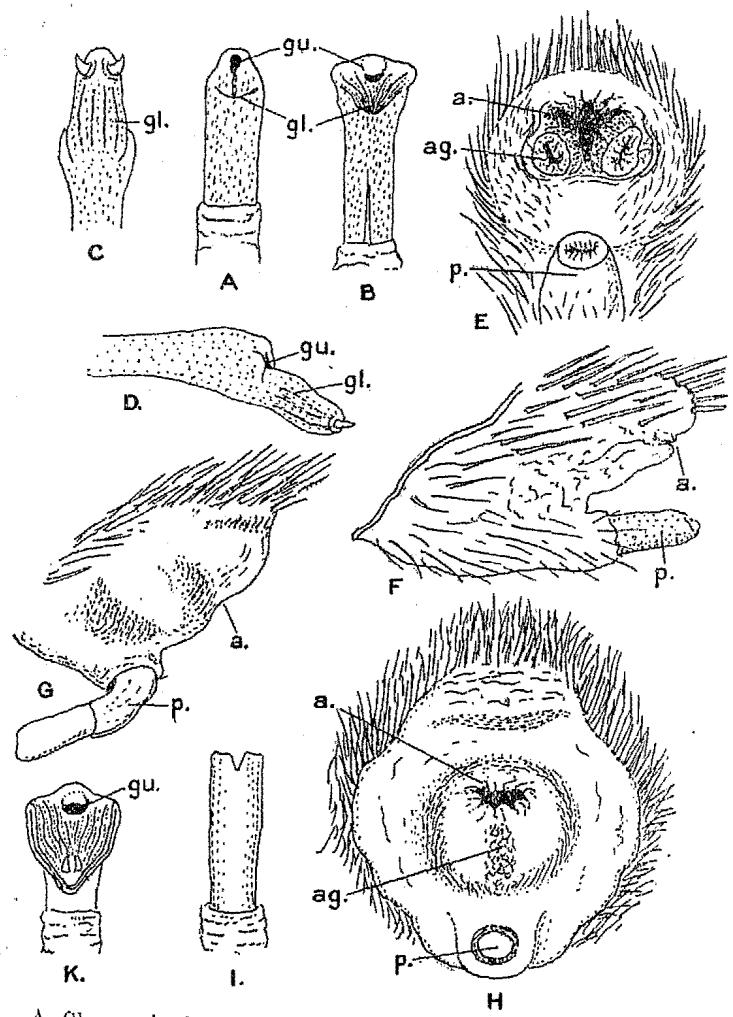
The fore foot of *Ctenodactylus gundi* has only four tolerably long and slender digits, which are subequal in length, subequally spaced, and widely separable. The pollex is absent. The skin of the lower side of the digits is smooth, the digital pads are well developed, and marked in their posterior half by two transverse grooves. The claws are short, sharp, and curved. The plantar pad is very large, markedly three-lobed, and very coarsely areolate. Immediately behind it there are two large smooth carpal pads in contact in the middle line, or nearly so, each longer than wide and the two together as wide as the plantar pad. (Text-fig. 18, A.)

The hind foot has digits similar in number and shape to those of the fore foot, except that they are relatively much longer with reference to the plantar pad, which is in a general way like that of the fore foot in shape and sculpturing. The claws are short, sharp, and curved; and the two inner digits, the 2nd and 3rd, are provided with combs of bristles similar to those of *Ctenomys*, but there are three of them on each digit instead of two. The tips of the remaining digits also have long bristles, but these are much thinner than those of digits 2 and 3. There are two elongated smooth metatarsal pads, separated by a definite area of transversely wrinkled skin from the plantar pad. They are in contact throughout their length, and the outer of the two extends back to the heel. (Text-fig. 18, B, C.)

Genital Organs of the Male.

A peculiarity of the penis of the Hystricomorphs is the presence at the tip of the gland, behind and below the orifice, of a wide slit leading into a sac, with laminated or corrugated walls, which can be evaginated and withdrawn again by the action of a pair of tendons. In some genera, as recorded below, this sac is provided with a pair of horny spikes arising from its floor, as was recorded long ago in the case of *Cavia*, *Cœlogenys*, and *Dasyprocta*. Tullberg's conclusion as to the generic incidence of these spikes does not tally at all with mine. He says they are distinctive of the family Caviidæ, which for him included the genera *Dasyprocta*, *Cœlogenys*, *Cavia*, *Dolichotis*, and *Hydrochœrus*. He does not, however, appear to have seen the penis of *Dolichotis*. Hence his generalization with respect to it must have been merely inferential. The spikes were not present in the example of *Dolichotis* examined by me; they were also absent in two specimens of *Hydrochœrus*, although, according to Tullberg, the penis of this animal resembles that of *Cavia* in essentials. I have also found these spikes well developed in genera which fall

Text-figure 20.



A. Glans penis of *Acanthion longicauda*, from beneath.
B. The same with the orifice of the glandular pouch dilated.
C. The same with the glandular pouch evaginated.
D. The same as C, from the side.
E. Anal area of the same, with anus dilated to show glands.
F. Lateral view of anal area of young *Hystrix africæ-australis*.
G. The same of *Coendu novæ-hispaniæ*, with penis protruded.
H. Posterior view of the same with glans retracted.
I. Lower view of glans of the same.
K. The same with the glandular pouch cut open, showing a pair of short spikes at the bottom.

a, anus *ag*, anal gland; *gl*, glandular pouch; *gu*, genito-urinary orifice; *p*, penis.

outside the limits of the Dasyproctidæ and Caviidæ, namely, in *Octodon* and *Ctenomys*, where they are of large size, and in *Acanthion* and *Erethizon*, where they are short. I do not know what the explanation of these differences may be. Probably, however, these spikes are only fully developed in mature males; but, since my examples of *Dolichotis* and *Hydrochœrus* were fully mature, it also occurs to me as a possibility that they may be broken off during copulation and reproduced subsequently. Also I do not know what their function may be, unless it is to penetrate the orifices of the Fallopian tubes, either to make a passage for the semen or, if shed, to block the orifices after the introduction of the semen. However that may be, one thing is clear, namely, that the presence of these spikes in such widely separated genera as *Acanthion*, *Erethizon*, and *Octodon* does away with their importance as evidence of kinship between such genera as *Dasyprocta*, *Cœlogenys*, and *Cavia*.

One other point to note is that the testes never pass into a scrotum in the Hystricomorpha.

The penis of *Hystrix* and *Acanthion* is retrospective, when at rest, being bent backwards on itself so that the prepuce forms a swelling a little beneath the anus. When erected the penis protrudes a long way from the prepuce and projects forwards. It is furnished with an apical baculum. The orifice, when dilated, reveals two apertures, an upper and smaller one immediately beneath the tip of the baculum and a lower one forming a transverse slit which leads into a tolerably deep glandular pouch, with puckered walls and a pair of small spikes at the bottom. This pouch can be evaginated, and in this condition it projects well beyond the normal tip of the penis. It can be withdrawn by the action of a couple of tendons running backwards along the lower half of the penis beneath the urethral canal. The epithelium of this glandular pouch and of the penis itself is beset with minute spicules, but the epithelium at the bottom of the pouch round the tooth-like spikes is smooth. (Text-fig. 20, A–F.)

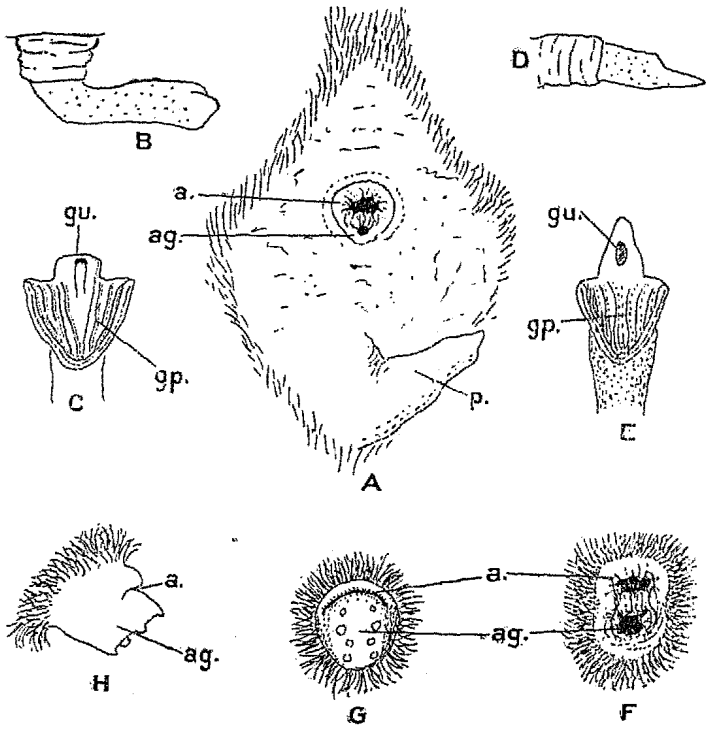
According to Parsons (P. Z. S. 1894, pp. 251–296) the male genitalia of *Atherura* resemble those of *Hystrix*.

In the male of *Coendu novæ-hispaniæ* the penis opens at the lower extremity of the naked area of skin common to it and the anus, as described below (p. 417). When at rest the penis is retrospective and completely withdrawn within a short naked prepuce. The structure of the penis is almost exactly the same as in *Acanthion longicauda*. The orifices of the urethra and of the glandular sac are normally concealed by the epithelium at the tip of the *glans penis*, but when this is spread the orifice of the urethra is exposed just beneath the tip of the baculum, with that of the glandular pouch behind it. This pouch has longitudinally corrugated walls and a pair of small spikes at the bottom. (Text-fig. 20, G–K.)

In *Myocastor* the penis opens retrospectively a little distance below and in front of the anus and is normally entirely

withdrawn, the prepuce being a mere low rim of naked skin. The apex of the penis is attenuated and pointed, with the genito-urinary orifice just behind the tip. The orifice of the glandular pouch is a slit with puckered lips, and the walls of the pouch are longitudinally corrugated, but there is no trace of spikes at

Text-figure 21.



A. Anal and genital area of *Capromys pilorides*.
B. Lateral view of glans penis, projecting backwards, of the same.
C. Lower view of tip of glans penis, with glandular pouch cut open.
D. Tip of glans penis of *Myocastor coypus*, in same position as in B.
E. Lower view of tip of glans penis of the same, with pouch cut open.
F. Anal orifice of the same dilated to show gland beneath.
G. The same from behind with glandular pouch protruded.
H. The same from the side.

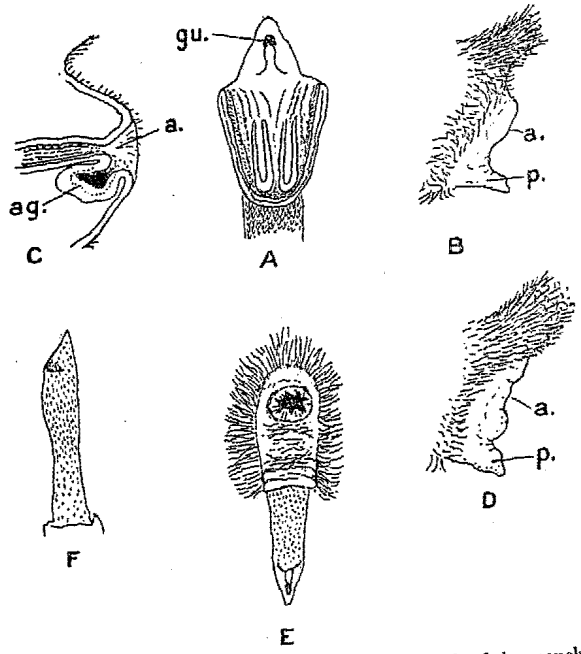
a, anus; *ag*, anal gland; *gp*, glandular pouch; *gu*, genito-urinary orifice.

the bottom of it. Round the region of the pouch the penis is expanded, becoming gradually attenuated to the apex distally and narrowed proximally, the expanded portion being covered with minute recurved spicules. (Text-fig. 21, D, E.)

In *Capromys* the prepuce is long and pendulous and some little distance from the anus. The penis itself is finely spicular,

truncated at the apex, and furnished with a distinct lappet beneath the genito-urinary orifice, between the labia of which it projects as in *Octodon* and *Ctenomys*. The apex of the glans is truncated, a little attenuated from the inferior aspect, but not at all from the lateral view. The glandular pouch is moderately deep, with laminate walls, two of the laminæ extending from

Text-figure 22.



A. Tip of the glans penis of *Octodon degus*, with glandular pouch cut open and the spikes turned to show the two prongs. In the normal position one prong lies behind the other.
B. Side view of anal and genital region of the same.
C. Vertical section of anus of the same, showing median gland.
D. Side view of anal and genital region of *Ctenomys mendocinus*.
E. Anus and penis, with glans protruded, of the same.
F. Side view of glans penis of the same.

Lettering as in text-fig. 21.

the tip of the glans being thick and ridge-like. There is no trace of the horny spikes seen in *Octodon* and *Ctenomys*. (Text-fig. 21, A–C.)

The prepuce of *Octodon* projects backwards a little way below the anus. The penis is cylindrical with a conical apex, which is smooth, the rest being closely covered with spicules. Between the labia of the orifice there is a small soft rounded process underlying the genito-urinary orifice. The pouch has corrugated

walls and is armed at the bottom with two long spikes, but each of these instead of being simple is divided into a pair of subequal branches rising from a common base. There are thus four spikes, a peculiarity not recorded elsewhere in the Hystricomorpha. (Text-fig. 22, A, B.)

The prepuce of *Ctenomys* is closer to the anus than in *Octodon* and the penis itself is thinner, and when viewed from behind or below is seen to be tolerably evenly attenuated to the narrowed apex, but from the side its distal end is a little expanded behind the pointed tip. It is beset with spicules, and the pouch is corrugated and armed with a single pair of long spikes, as in *Dasyprocta*. (Text-fig. 22, D–F.)

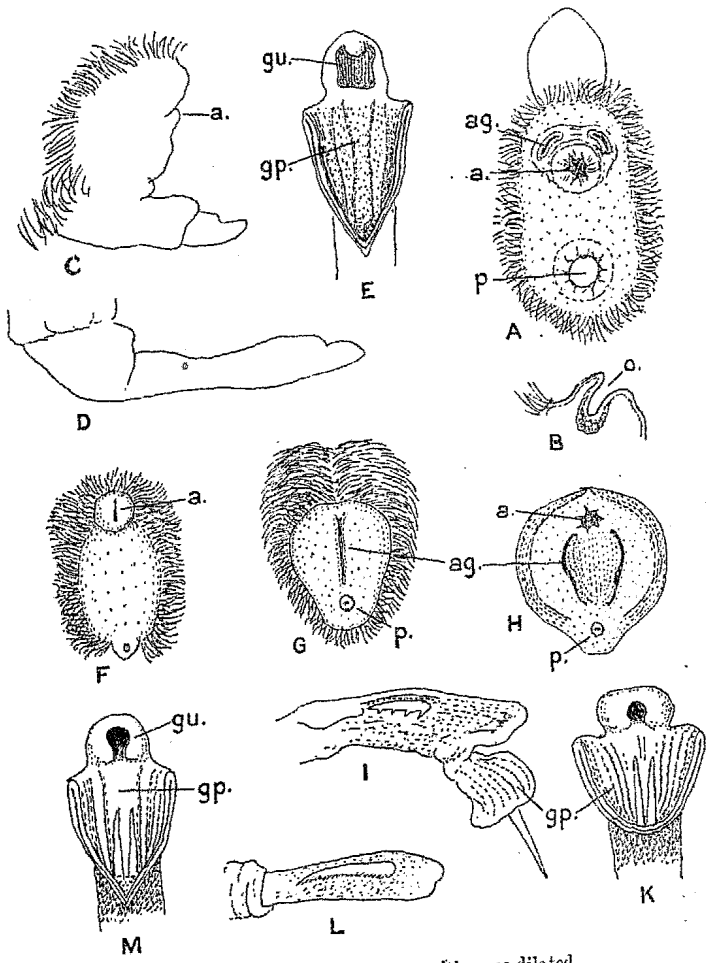
In *Dasyprocta* the glans of the penis, figured by Tullberg, is subcylindrical, with a bluntly rounded apex, and is beset, especially beneath, with minute recurved sharp papillæ; but on each side of it there is a long lustrous horny blade-like lamina, attached by one edge to the epithelium of the glans, the other edge being free and finely serrate. This plate is capable of erection, and in this state the free edge stands away from the glans like a ridge. Presumably its function is to fix temporarily the penis in the vagina during copulation. (Text-fig. 23, L.)

The penis of *Cœlogenys*, described by Owen and others, tolerably closely resembles that of *Dasyprocta*, except that the horny plate is represented by a short, hard, erectile plate, the free edge of which is armed with about five comparatively large, widely-spaced, thorn-like teeth. In both genera there is a pair of long spikes in the glandular pouch. (Text-fig. 23, I, K.)

In *Cavia porcellus* and *Galea littoralis* the prepuce is at the lower extremity of the naked subcaudal tract. The glans penis is subcylindrical and apically rounded. On each side of it towards the apex there is a long narrow flap of epithelium, the edge of which is serrulate with soft papillæ, and above this there are a few shorter smaller flaps. The longer larger flap, no doubt, represents the horny lustrous plate on the penis of *Dasyprocta*, but it is quite soft and pliable, not rigid and horny as in that genus. The glandular pouch is deep and provided with a pair of long spikes lying between two strongly developed ridges on the upper or anterior wall of the pouch. (Text-fig. 23, F–H, M.)

The penis of *Dolichotis* projects backwards from the lower portion of the naked area of skin extending up to the root of the tail. The prepuce is moderately long, but naked. The glans penis is slightly narrowed apically, its surface is reticulated and pitted, and the genito-urinary orifice, just beneath the tip of the baculum, is large. The deep, proximally narrowed, glandular pouch is lined with rows of elongated papillæ representing the laminate ridges of other genera, but there is a pair of low thickened ridges, corresponding to the large ridges of *Cavia* and *Galea*, passing down the anterior or upper wall. No spikes are present and no trace of the erectile papillate lateral ridge seen in *Cavia* and *Dasyprocta* was detected. (Text-fig. 23, A–D.)

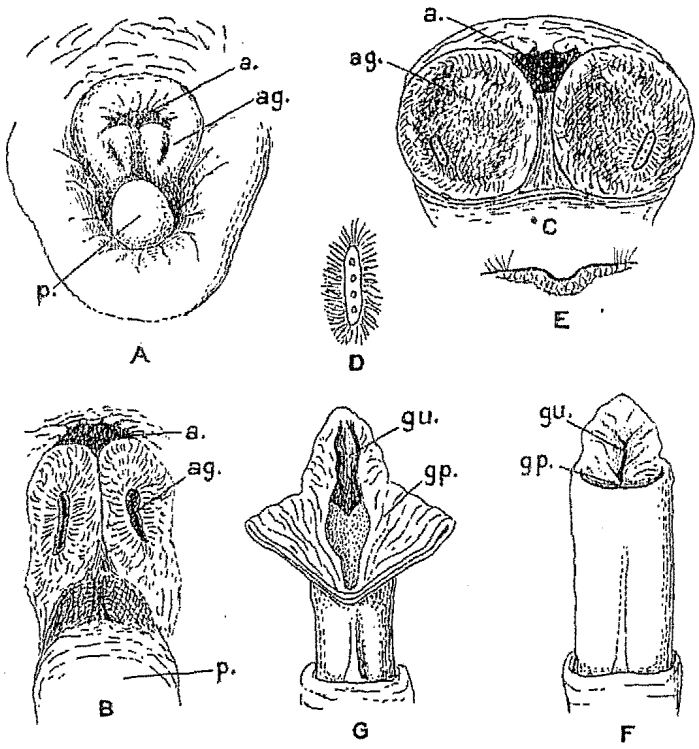
Text-figure 23.



A. Anal region of *Dolichotis patagonica*, with anus dilated.
B. Section of anal gland of the same.
C. Side view of anal region of the same, with penis in natural position.
D. Glans penis of the same from the side.
E. Tip of glans of the same, with glandular pouch cut open.
F. Anal region of *Galea littoralis*.
G. The same of *Cavia porcellus*, with anus concealed in glandular crease.
H. The same with glandular area dilated.
I. Side view of glans penis of *Cœlogenys paca*, with glandular pouch evaginated.
K. Tip of glans penis of the same, with glandular pouch cut open.
L. Side view of glans penis of *Dasyprocta* sp.?
M. Tip of glans penis of *Galea littoralis*, with glandular pouch cut open.
a, anus; *ag*, anal gland; *gp*, glandular pouch; *gu*, genito-urinary orifice; *o*, orifice of anal gland; *p*, penis.

In *Hydrochœrus* the tip of the penis when contracted is retrospective and close below the anus, in contact with the perineal integument between the orifices of the pouches of the anal glands. When distended the base of the penis is seen to arise just below

Text-figure 24.



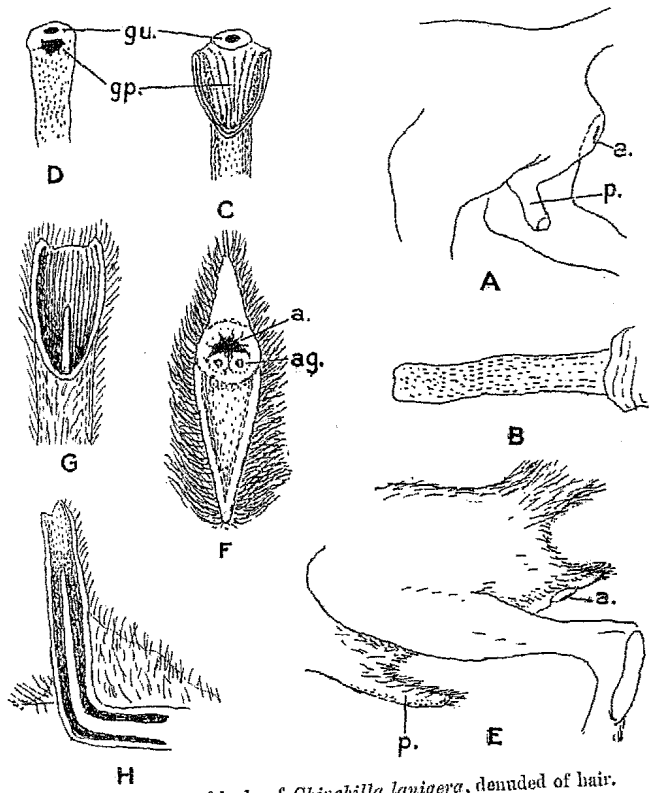
A. Anal and genital region of *Hydrochœrus capybara*, with penis retracted.
B. The same showing the base of the penis extended and the orifices of the anal pouches partially opened.
C. The same with penis omitted and the anal pouches distended.
D. Secreting area at the bottom of anal pouch.
E. Transverse section through one of the pores of the glandular area.
F. Lower view of glans penis.
G. The same with glandular pouch cut open.

a, anus; *ag*, anal gland; *gu*, genito-urinary orifice; *gp*, glandular pouch; *p*, penis.

those orifices in a position similar to that of the vulva (p. 418). The penis is large, smooth, and cylindrical, with a narrowed apex, beneath which lies the large genito-urinary orifice in the form of a longitudinal slit when undilated. Behind this is the wide,

transverse slit-like aperture of the glandular pouch, which is rather shallow, narrowed at the bottom with weakly ridged or

Text-figure 25.



A. Posterior region of body of *Chinchilla lanigera*, denuded of hair.
B. Lateral view of glans penis of the same, projecting forwards.
C. Tip of glans penis of the same, with glandular pouch cut open.
D. The same with glandular pouch entire.
E. Posterior region of body of *Lagostomus trichodactylus*.
F. Anal area of the same.
G. End of penis of the same from below, with prepuce slit to show tip of slender glans.
H. Penis of the same, dissected to show long, slender glans lying in preputial sheath.

a, anus; *ag*, anal gland; *gp*, glandular pouch; *gu*, genito-urinary orifice; *p*, penis.

wrinkled lateral and inferior walls, but without the spikes present in *Cavia*, *Dasyprocta*, *Cœlogenys*, and others. (Text-fig. 24, A, G, F.)

In *Chinchilla* the penis lies some distance in front of and below the anus on the pubic area between the hind legs, and is represented externally by a long hairy prepuce projecting downwards and slightly backwards. When extended from the prepuce it is seen to be subcylindrical, with a slightly expanded, truncated extremity and with the epithelium beset with minute spicules. The genito-urinary orifice is terminal, and immediately beneath it is the larger orifice of the glandular pouch, which has longitudinally laminate walls but no spikes at the bottom. Thus, apart from its elongated prepuce, projecting freely from the pubic integument, the penis of *Chinchilla* structurally resembles that of typical Hystricomorph Rodents. (Text-fig. 25, A–D.)

The penis of *Lagostomus*, however, differs in one very important point, and is unique so far as my observations go. As in *Chinchilla*, it is represented externally by a long, pendulous, hairy prepuce, which, however, is abdominal in position, being set much further forwards than in *Chinchilla*. But the penis itself, sheathed in the prepuce, is an exceedingly long and slender rod, apically attenuated so as to be almost filiform at the tip and much thinner than the lumen of the preputial sheath. The pouch at the tip of the penis appears to have aborted. (Text-fig. 25, E–H.)

Tullberg described the glans of the penis in a young example as "dünn und stark zugespitz, fast lanzettenförmig."

The following tabulation, setting forth the principal variations in the structure of the penis, is based entirely upon my own observations. In many respects it would differ materially from a table based upon the recorded observations of Tullberg:—

a. Glans of penis exceedingly long and slender, without glandular pouch; elongated prepuce situated far forwards on the abdomen ..... *Lagostomus.*
a'. Glans of penis comparatively short and stout, with glandular pouch; prepuce long or short, but pelvic in position and comparatively near the anus.
b. Glandular pouch with a pair of spikes at the bottom.
c. Spikes very short ..... *Acanthion, Erethizon.*
c'. Spikes very long.
d. Spikes biramous ..... *Octodon.*
d'. Spikes simple, undivided.
e. Spiniform papillæ on penis not arranged in definite rows; a soft pointed lappet below urino-genital orifice, as in *Octodon* ..... *Ctenomys.*
e'. At least one long row of spiniform papillæ on an erectile ridge on side of penis; no lappet below orifice of penis.
f. The erectile ridge with its papillæ quite soft and uncornified ..... *Galea, Cavia.*
f'. The erectile ridge and its papillæ forming a hard horny plate.
g. Horny plate long with serrulate free edge ..... *Dasyprocta.*
g'. Horny plate short, with about five larger spines on its free edge ..... *Cœlogenys.*
b'. No spikes at bottom of pouch.
h. Prepuce, when penis is contracted, withdrawn into sac, involving the anus ..... *Hydrochœrus.*

h'. Prepuce not withdrawn into common integumental sac with anus, but remote from that orifice.
j. A small pointed soft lappet in the middle line below the urino-genital orifice and projecting between its labia, as in *Octodon* and *Ctenomys* ..... *Capromys.*
j'. No lappet below the urino-genital orifice.
k. Walls of glandular pouch spicular, not distinctly laminated, with merely two low rounded ridges running down the anterior wall ..... *Dolichotis.*
k'. Walls of glandular pouch with numerous compressed ridge-like laminæ.
l. Apex of glans broad and truncated ..... *Chinchilla.*
l'. Apex of glans attenuated ..... *Myocastor.*

The Genital Organs of the Female.

The genital apparatus in the female *Hystrix* and *Acanthion* appears externally as a large triangular prominence, marked on its posterior surface by a longitudinal slit. Separation of the labia of the slit reveals the orifice of the vulva above, and just beneath the latter the orifice of the urethral canal. Some distance beneath the urethra and near the apex of the integumental prominence is a trilobed clitoris, with a shallow glandular depression above or in front of its apex. The lateral lobes can be folded over so as to meet each other in the middle line and form a partial tube for the passage of the urine. In the unpaired female only one orifice is superficially detectable above the clitoris. The condition is very similar in *Atherura*, except that the clitoris has a simple conical apex with the orifice of the urethra near its tip, and therefore farther from the vulva than in *Hystrix*. (Text-fig. 26, A, D, E.)

In *Erethizon* and *Coendu* the anal and genital area of the female is bordered on each side by a ridge of integument running from the root of the tail to the clitoris. The vulva is a tolerably large orifice situated a little below the anus, and the urethra is a smaller orifice beneath the vulva and above the tip of the clitoris, which has a glandular pouch just below and in front of it, and the clitoris is protected by a short projection of hairy integument corresponding to the prepuce of the male. The condition is thus very much the same as that of *Hystrix* and *Atherura*. In *Coendu* the integument round the urino-genital orifices is naked, whereas in *Erethizon* there is a considerable quantity of hair round the orifices. (Text-fig. 26, F, G.)

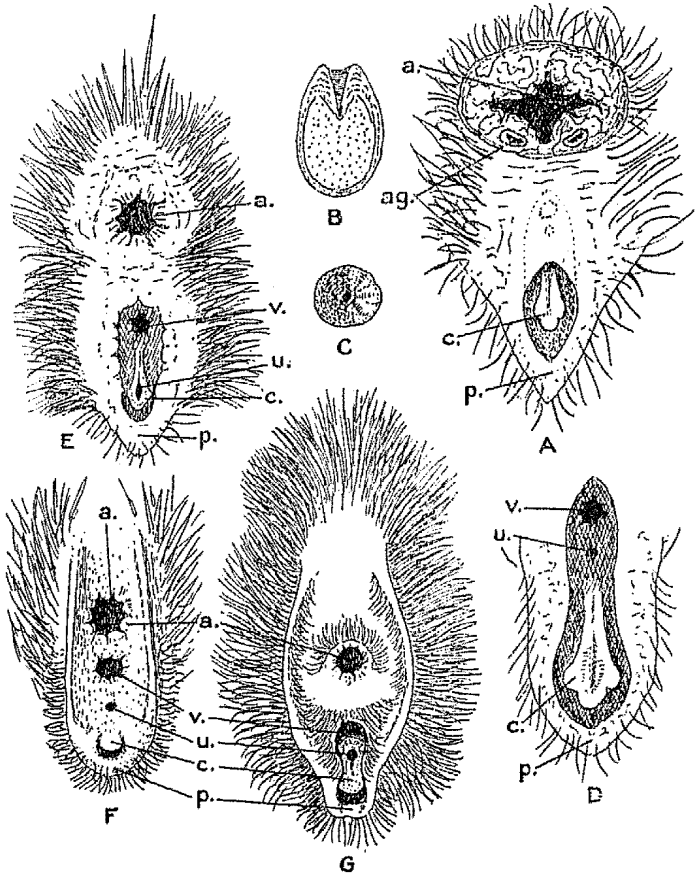
In *Myocastor* the vulva is an arched transverse orifice close beneath the anus in the middle of the naked area above described. A little way beneath it is the short, conical, slightly hairy clitoris, which is perforated at the tip by the orifice of the urethra. (Text-fig. 27, A, B.)

In *Capromys* the vulva is a little way beneath the anus, and below it the prepuce of the clitoris, which is long in the adult. projects downwards and backwards. It has a few hairs at the tip, which bears a large bilabiate orifice. (Text-fig. 27, C, D.)

In *Octodon* the vulva is a large transverse orifice close beneath

the anus, and the prepuce is a short conical projection, perforated at the tip, beneath it. (Text-fig. 27, E.)

Text-figure 26.



A. Anal and genital area of *Acanthion longicauda*, ♀ (unpaired), with the orifices of the urethra and vagina, dotted in, covered with integument.
B. Section of anal gland of the same.
C. Orifice of the anal gland of the same, distended.
D. Genital area of *Hystrix africæ-australis*, ♀ ad.
E. Anal and genital area of *Atherura africana*, ♀ ad.
F. The same of *Coendu prehensilis*, ♀ ad.
G. The same of *Erethizon dorsatum*.

a, anus; *ag*, anal gland; *c*, clitoris; *p*, prepuce; *u*, urethra; *v*, vulva.

The vulva of *Cœlogenys* and *Dasyprocta* is a large wide orifice a little beneath the anus. From it a wide inferiorly narrowing

groove extends downwards to the apex of the short, but projecting, hairy prepuce, just above the tip of which posteriorly may be seen the urinary orifice. (Text-fig. 28, D.)

In a female *Dolichotis* there is a single small genito-urinary orifice in the lower half of the naked subcaudal area, and there is no external sign of clitoris or projecting preputial integument. This is the normal condition presented by immature or unpaired female Hystricomorphs. Possibly the vulva is closed by membrane out of the breeding season. In the present instance its orifice lay, no doubt, beneath the skin between the anus above and the genito-urinary aperture mentioned above. (Text-fig. 28, C.)

In *Cavia porcellus* and *aperea* the vulva is near the centre of the naked glandular anal area and separated from the anus by the depression of the glandular sac. The very short prepuce of the clitoris is situated some distance below the vulva. Before pairing takes place, or out of the breeding season, the vulva is covered with thin membrane, which easily ruptures when stretched. (Text-fig. 28, B.)

In the female *Hydrochœrus*, as stated below (p. 419), the vulva is situated a short way beneath the anus, near the lower border of the ano-genital area. It is a large, transversely extended, dilatable orifice, containing and concealing a large, soft, fleshy, linguiform clitoris on its ventral or anterior wall, and the orifice of the urethra is some little distance away from the tip of this clitoris. (Text-fig. 28, A.)

In *Ctenodactylus* the vulva is situated a little below the anus, and the prepuce is elongated and perforated at the top. (Text-fig. 28, E.) (See also pp. 419–420.)

a. Orifices of genital and urinary organs visible externally as separate apertures; the prepuce and clitoris not involved in a sphincter embracing also the anus.
  b. Urinary orifice visible beneath the vulva, not concealed within a tubular prepuce.
    c. Orifice close beneath the vulva, remote from the tip of the prepuce ..... *Hystrix, Erethizon, Coendu.*
    c'. Orifice not close beneath vulva, but nearer to the tip of the prepuce ..... *Atherura.*
  b'. Urinary orifice at apex of closed prepuce. *Octodon, Capromys, Dasyprocta, Cœlogenys, Cavia, Kerodon, Ctenodactylus.*
a'. Orifices of genital and urinary organs involved in a common integumental fold, so that externally there is a single large urino-genital aperture, and this is involved in a sphincter embracing the anus ..... *Hydrochœrus.*

According to Tullberg, *Thrynomys* by this table falls under *b'*.

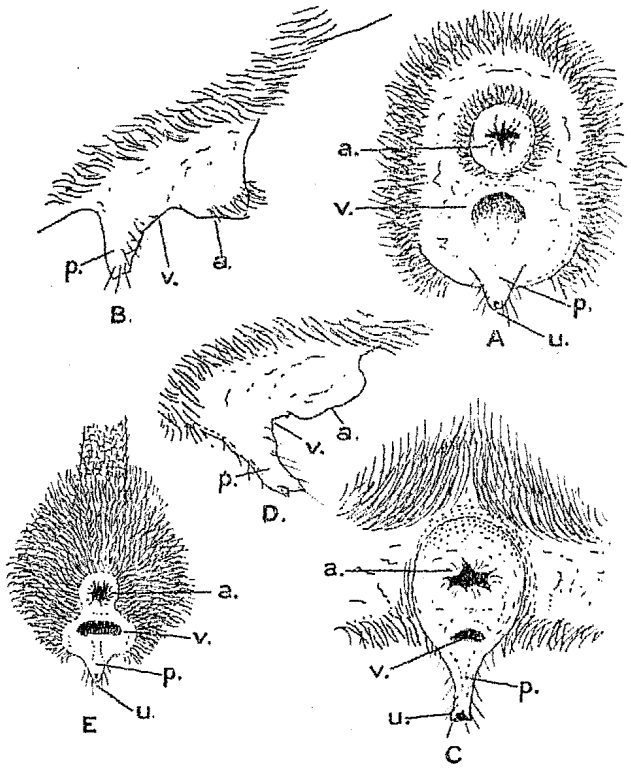
The Anus.

The anus in *Hystrix* and *Atherura* opens in the middle of a naked area, surrounded laterally and above by hairs and spines, and inferiorly reaching to the genital orifice. There is a pair of large, solid, anal glands opening by a slit-like orifice just within the anal aperture, but below the termination of the rectum. The

orifice, which has puckered lips, leads into a short narrow duct into which the secretion of the gland is poured. These glands appear to be equally well developed in the male and the female. (Text-figs. 20, E, F; 26, A–C, E.)

The anus in the female of *Coendu* and *Erethizon* opens near the centre of an area, common to it and the genito-urinary

Text-figure 27.



A. Anal and genital area of *Myocastor coypus*, ♀ ad.
B. The same from the side.
C. Anal and genital area of *Capromys pilorides*, ♀ ad.
D. The same from the side.
E. Anal and genital area of *Octodon degus*, ♀ ad.

a, anus; *p*, prepuce; *u*, urethra; *v*, vulva.

orifices and defined on each side by a ridge of integument. The area above the anus is naked in *Coendu*, but laterally hairy in *Erethizon*; and in the latter there is in addition a half-circle of hairs just above the orifice. I did not examine fresh specimens for the anal glands; but failed to distinguish them, if present,

in spirit-preserved material. In a male of *Coendu novæ-hispaniæ*, however, in which the anus opens near the centre of a very large naked area, without integumental ridges, and with the penis at its lower extremity, there appeared to be a median longitudinal mass of glandular tissue, without definite orifice, showing through the skin of the longish perineal area between the anus and the penis. Possibly this represents the coalesced and partially aborted paired glands of *Hystrix*. (Text-figs. 20, G, H; 26, G. F.)

In *Myocastor* the anus, with a few hairs round the orifice, forms a projection in the centre of a naked area a little distance below the root of the tail. In the female this naked area is continued round the genito-urinary region; but in the male the long perineal area is hairy. The anal glands in both sexes form a solid median mass, opening by four pairs of small papillate orifices into a sac which can be extruded by evagination just beneath the anus. (Text-figs. 21, F–H; 27, A, B.)

In *Capromys* the anus is on an eminence a little way below the base of the tail in the upper half of a naked area of skin which extends downwards to the prepuce of the penis or clitoris. When it is dilated the single orifice of the anal gland may be seen immediately beneath it within the sphincter. This orifice leads into a small pocket filled with the secretion of the gland which lies mainly behind the pocket. The gland seems to resemble in all respects that of *Octodon*, and differs from that of *Myocastor* in being much smaller, apparently unprovided with papillæ and also incapable of evagination. (Text-figs. 21, A; 27, C, D.)

In *Octodon* the anus also opens on a prominence a little way below the base of the tail and about the same distance above the prepuce in both sexes, the perineal region and the area round the prepuce being naked. The anal gland is a median mass with a small sac opening just beneath the anus by a median orifice, but concealed from view unless the latter is distended. (Text-figs. 22, B, C; 27, E.)

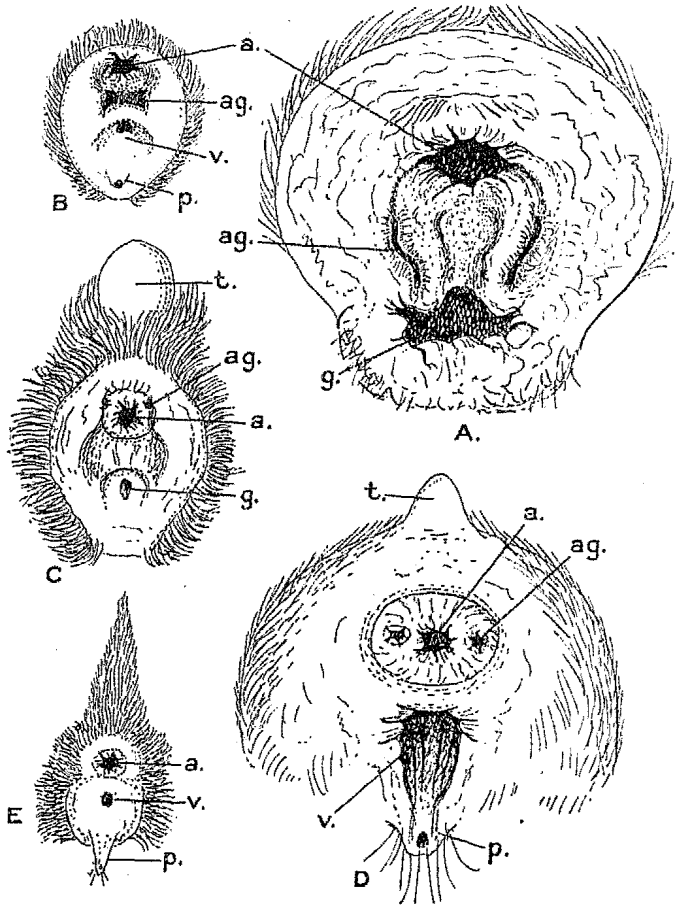
In *Ctenomys* the anus is more dilated than in *Octodon*, and its walls inside are symmetrically wrinkled; but in the single male example examined I was unable to satisfy myself as to the presence of a gland such as is seen in *Octodon*. According to Tullberg, however, a gland similar in position and structure to that of *Octodon* is found in *Ctenomys*, *Echimys*, *Nelomys*, *Cannabateomys*, and *Abrocoma*. (Text-fig. 22, E, D.)

In *Lagostomus* the anus lies just beneath a hairy excrescence some distance below the root of the tail. Just within the sphincter may be seen the apertures of the anal glands opening just below the orifice. From each side of the subcircular anus a ridge of skin runs downwards, forwards, and obliquely inwards to meet its fellow of the opposite side in a point, the two forming the lateral margins of an acutely angled glandular area covered with short hair. (Text-fig. 25, E. F.)

In *Chinchilla* the anus also forms a marked projection some

distance below the tail, but it is not overlapped by a projecting flap of integument. The anal glands were not detected in the single spirit-preserved example examined; but, according to Tullberg, the gland resembles that of *Octodon*. (Text-fig. 25, A.)

Text-figure 28.



A. Anal region of *Hydrochœrus capybara*, ♀, with the orifices of the anus, anal glands, and genital organs pulled apart.
B. The same of *Cavia porcellus*, ♀.
C. The same of *Dolichotis patagonica*, ♀ (? immature and unpaired).
D. The same of *Cœlogenys paca*, ♀ ad.
E. The same of *Ctenodactylus gundi*, ♀ ad.

a, anus; *ag*, anal gland; *g*, common genito-urinary orifice; *p*, prepuce with urinary orifice; *t*, tail; *v*, vulva.

In *Cœlogenys* the anus forms a large prominence near the middle of a naked area of skin which extends in front of the tail above and of the penis or clitoris below. The anal glands are represented externally by a pair of small pouches opening one on each side of the termination of the rectum within the sphincter of the anus. (Text-fig. 28, D.)

Dasyprocta seems to resemble *Cœlogenys* in having paired lateral anal glands.

The anus in both sexes of *Dolichotis* is in the upper half of an area of naked skin which extends inferiorly beneath the genito-urinary organs, and is separated from the tail above by a fringe of hairs. When the anus is opened the orifices of the anal glands appear as a pair of oblique slits set one on each side *above* the termination of the rectum. The orifice leads into a shallow hair-lined pouch. (Text-figs. 23, A, B; 28, C.)

In *Cavia porcellus* the anus is situated near the summit of a large naked area which extends downwards to the prepuce in both sexes; but it is normally concealed from view by being folded into a depression common to it and the anal glands. This depression appears superficially as a median groove. When this is dilated it resolves itself in the female into a pair of pits separated by a low partition, and situated between the anus and the vulva. In the male the pits are much larger and longer and when distended to the fullest extent appear as a single capacious pouch owing to the depression of the partition between them. When partially closed the floor of the pouch rises to form a low partition between the pouches. A female *C. aperea* resembles *C. porcellus* in the features mentioned above. But a male example of *Galea littoralis* differs very considerably from the male of *C. porcellus*. The anus is at the summit of a large naked or nearly naked area extending down to the penis; but this area, overlying the testes, shows no trace of glandular depression, the anus being exposed, as in *Dasyprocta* and other genera. I failed to find the anal glands in a spirit-preserved specimen. *Kerodon* apparently resembles *Cavia* in the structure of the anal region, but I have seen no fresh material. (Text-figs. 23, F–H; 28, B.)

In both sexes of *Hydrochœrus* the anus and external genitalia are packed closely together, as if contained by a common sphincter, upon a nearly naked prominence, some distance beneath the tail. Between the anus and the penis or vulva there is a short perineal area, hairier in the male than in the female, and on each side of this lies a long vertical slit which leads into a large pouch, lined with hair, which projects from the orifice, and filled with secretion. At the bottom of each of these pouches there is a strip of naked skin with a row of four or five little pits, and beneath this strip the dermis is thickened and glandular. (Text-figs. 24, A, E; 28, A.)

In *Ctenodactylus* the anus opens just beneath the root of the short, tapering, uniformly hairy tail, at the summit of an

elongated area of naked skin, from the lower half of which the clitoris projects. The clitoris is a closed tube perforated by the urethra. When cut open in an unmated female the orifice of the vagina may be seen to lie a little below the anus, and a little lower down is the urinary orifice. (Text-fig. 28, E.)

The following table shows the variation in position of the apertures of the anal glands, and other points connected with them, in the genera in which I have detected them :—

a. Apertures or aperture of anal glands concealed within the sphincter of the anus.
  b. A pair of moderately widely separated apertures above the anal orifice ..... *Dolichotis*.
  b'. Apertures not above the anus.
    c. Aperture on each side of the anus ..... *Dasyprocta*, *Cœlogenys*.
    c'. Aperture or apertures beneath the anus.
      d. Two apertures, one on each side of middle line ... *Hystrix*, *Lagostomus*.
      d'. A single median aperture.
        e. Anal gland small, incapable of evagination ..... *Octodon*, *Capromys*.
        e'. Anal gland large, capable of evagination and provided with four pairs of papillæ ..... *Myocastor*.
a'. Apertures of anal glands forming a pair of elongated slits outside the sphincter of the anus and extending down the perineal area. *Cavia*, *Kerodon*, *Hydrochœrus*.

The interesting point to note in connection with this table is the difference between *Dolichotis* and *Cavia*+*Hydrochœrus* with respect to the glands.

According to Tullberg's descriptions, *Thrynomys* falls by this table with *Cavia* and *Hydrochœrus* under *a'* and *Ctenodactylus* with *Dasyprocta* and *Cœlogenys* under *c*.

The Tail.

The tail supplies useful systematic characters. If, as is probable, a long cylindrical tapering tail covered with scales and short hairs is the primitive type, that type is prevalent in the Octodontidæ, occurring in many of the mouse-like genera. Within the family, however, variations in the length of the tail, in adaptation to habit, and in growth of the hairs are numerous. In *Octodon*, for example, although the organ is longish, the hairs in the distal portion are developed to form an elongated tuft. In *Ctenomys* it is shorter, but thicker and somewhat compressed with a very distinct crest of short hairs extending along the posterior two-thirds of the upper edge.

In *Thrynomys* the tail is of the primitive type, but comparatively short, and the same applies to *Capromys*, but in this scansorial genus the hairs on the underside are stiffened to aid in climbing, a variation foreshadowing that which is seen in a much more marked degree in *Coendu* and *Chætomys* described below. In one species (*C. prehensilis*) the tip of the organ is said to be prehensile, but I am not aware whether the tip is curled downwards over a branch or upwards as in the so-called arboreal Porcupines. In *Myocastor* the tail is moderately long, cylindrical, and rather stout, but shows no modifications

subservient to aquatic life. It is used mainly as a rudder, hardly as a propeller, in swimming.

In the Hystricidæ the tail is always provided with a sounding-organ formed of modified hairs. In the most primitive type *Trichys*, in which the armature of the body-skin consists of a coating of very coarse sharp bristles, nearly uniform in length, the tail is long and cylindrical, and covered, except at the root and tip, with scales and short hairs; and the sounding-organ or rattle at the tip consists of a brush of long flattened hairs or spines somewhat resembling dried blades of grass. In *Atherura* the tail, although still scaly and hairy, is much shorter, and each of the constituent parts of the terminal brush consists of a filiform axis expanding along its course into a series of compressed but hollow fusiform swellings, from two to seven or eight in number, according to the length of the blade. These swellings vary in size, but the one at the end is always much larger than the next of the series.

In *Thecurus*, *Acanthion*, and *Hystrix*, in which the spine-armature reaches its maximum of development, the tail is quite short and thick and without scales and hairs; but twenty or more of its terminal quills are expanded into hollow flattened laminæ or cylinders, for the most part open at the end. This is the most highly specialised rattle in the group.

The so-called arboreal Porcupines of America (Erethizontidæ) fall into two sharply defined groups by their tails. In the North American genus *Erethizon* this organ is quite short and armed throughout with spines resembling those on the body. By swinging it to right and left, the animal uses it as a weapon of defence. In the tropical American genera *Coendu* and *Chætomys* the tail is long, subcylindrical, tapering, and covered with spines and hairs and distally with scales, although the extremity, which is upcurled and prehensile, is naked above. The underside at the base is thickly covered with close-set, stiff, sharp bristles, the function of which, as Waterhouse rightly supposed, is to help in the ascent of vertical or steeply sloping branches, and to give support to the body when the animal is at rest. They are functionally comparable to the caudal scales of the Anomaluridæ.

In the three genera assigned to the Chinchillidæ, namely *Chinchilla*, *Lagidium*, and *Lagostomus*, the tail is also characteristic. It is moderately long, covered with hairs, which are comparatively short and soft all along the underside, but on the upperside are coarse and very long—forming, as it were, a brush.

In the Dasyproctidæ and Caviidæ the tail is reduced. In *Myoprocta* it is at most a few inches long, but quite slender. In *Dasyprocta* it is only about an inch or less. In *Cœlogenys* it is about the same. In *Dolichotis* it is also quite short, but constricted at the base and oval in outline from above or below. In *Hydrochœrus* it is at most a short conical excrescence as it is in *Cavia*, *Galea*, and *Kerodon*, and is sometimes absent.

Notes on the Families and Subfamilies.

Family Hystricidæ.

Since Lyon (Proc. U.S. Nat. Mus. xxxii. p. 576, 1907) has comparatively recently classified the Hystricidæ into the two subfamilies Atherurinæ (*Atherurus*, *Trichys*) and Hystricinæ (*Thecurus*, *Acanthion*, *Hystrix*), mainly by the structure of the tail, I need not refer to these animals further beyond expressing my complete concurrence with his opinion as to the systematic value of the characters he uses as a basis for the separation of the two subfamilies.

Family Erethizontidæ.

By their external characters the three genera (*Chætomys*, *Coendu*, *Erethizon*) composing this well-marked family fall into two groups, the first represented by *Erethizon*, the second by *Coendu* and *Chætomys*. By cranial and dental characters, however, Mr. Thomas separated *Chætomys* from the others as representing a special subfamily Chætomyinæ, and assigned *Coendu* and *Erethizon* to the Erethizontinæ. Adopting the separation of *Chætomys* from *Coendu*, I think the latter should be similarly separated from *Erethizon* and the family divided into three subfamilies, which may be diagnosed as follows *:—

a. Tail long, cylindrical, comparatively slender, and prehensile; hind feet with a large movable lobe on the inner side and minute hallux; fore feet also expanded on the inner side; nostrils widely separated; ear specialised, with large antitragus.
  a'. Body covered with flexible spine-like waved bristles; skull with small orbit circumscribed by frontal and jugal post-orbital processes; jugal arch very deep; palate, tooth-rows, and symphysis of mandible long ..... *Chætomyinæ*.
  b'. Body armed with comparatively stout unwaved spines; orbit large, no postorbital processes; jugal arch not deep; palate, tooth-rows, and mandibular symphysis much shorter ..... *Coendinæ*.
b. Tail short, thick, not prehensile; hind foot with at most a small inner lobe, but with well-developed hallux; fore feet without expansion on inner side; nostrils with narrow septum; ear simple ..... *Erethizontinæ*.

At present each of these subfamilies contains a single genus; but it seems to me to be probable that the first modern systematist who has adequate material of *Coendu*, and the time to devote to the study, will find characters justifying the separation of that genus into two or more genera. There appear to me to be no good reasons for thinking the Erethizontidæ especially related to the Hystricidæ—a conclusion to which other authors have come. The Erethizontidæ are, I think, probably very

* The external characters, apart from the ear, here made use of were long ago pointed out by Waterhouse. It is, however, merely a guess on my part that the nostrils and ears of *Chætomys* are like those of *Coendu*.

specialised descendants of forms akin, or belonging, to the Octodontidæ, whereas the Hystricidæ do not seem to be specially related to any of the South-American groups. In that case the resemblances between the Porcupines of the Old and New Worlds which have led to their affiliation must be due to convergence or to the common inheritance of ancestral characters. In their spine-armature, for instance, it may be noted that in the two genera which appear to me to be the most primitive of the two families respectively—namely, *Chætomys* and *Trichys*—the spines are little more than very stiff bristles. It must be remembered, however, that there is one character, not previously recorded apparently, in which the two families are alike and differ from other Hystricomorphs—the prepuce in the female does not form a closed tube, the orifice of the urethra being exposed beneath the genital aperture.

Families Octodontidæ, Petromyidæ, and Ctenodactylidæ.

I have seen too few examples of the Octodontidæ to offer any opinion as to its subdivision into subfamilies. *Petromys*, too, I have not seen, and I do not know whether it should be referred to the Octodontidæ, where it was originally placed, or, in accordance with Tullberg's views, made the type of a special family. Probably the latter is the better way of regarding it for the present, in view of the differences of opinion that prevail concerning its status. The structure of the ear alone seems to me to justify its separation from *Ctenodactylus*, with which Thomas associated it. The claims of *Ctenodactylus*, indeed, to a place in the Hystricomorphs seem to me to be more than questionable.

Families Capromyidæ and Myocastoridæ, nov.

The family-name Capromyidæ may be restricted to *Capromys* and related genera, like *Procapromys*, *Geocapromys*, and, I presume, *Plagiodontia*.

Myocastor, formerly associated with these genera, may, I think, be regarded as representing a family by itself, Myocastoridæ. This course, however, merely amounts to giving greater systematic value to the characters used by Tullberg when he established the subfamily Myopotamini.

Family Thrynomyidæ, nom. nov.
(=Aulacodidæ of Tullberg).

The genus *Thrynomys*, formerly classified with the Octodontidæ, and later with the Capromyidæ, was separated as the representative of a special family Aulacodidæ by Tullberg, who employed its old name *Aulacodus*. Agreeing with this decision, I adopt Thrynomyidæ as the family-title.

Judging from dried skins, the genus is distinguished by the cleavage of the upper lip by the rhinarium, the valvular supratragus—a character repeated in the Caviinæ,—and the structure of the feet. The affinities of the family appear to me to be quite doubtful.

Family Dinomyidæ.

I can give no opinion about *Dinomys* beyond expressing my conviction that it is not in any way nearly related, as Peters thought, to the Dasyproctidæ, Chinchillidæ, or Caviidæ in the sense in which he understood those terms. It must remain as the sole representative of a well-marked family.

Families Dasyproctidæ and Cœlogenyidæ, nov.

So far as I am aware, no suggestion has been made to break up the family Dasyproctidæ as understood by earlier authors. The tendency rather has been to merge it with the Caviidæ, as was done by Winge, Tullberg, and Weber. Three genera are now admitted—*Dasyprocta*, *Myoprocta*, and *Cœlogenys*. The first two are closely related; but it appears to me that the value of the well-known distinctive features of *Cœlogenys* have been greatly underrated. I propose to erect it to the rank of a family, which may be distinguished from the Dasyproctidæ (s. s.) as follows:—

a. Antemolar portion of palate broad and nearly flat; preorbital foramen, zygomatic arch, and orbit without special modifications; nasals as long as frontals or nearly so; postorbital part of skull comparatively long and narrow; occipital crest irregularly semi-elliptical. No cheek-pouches. Feet long and slender; fore foot nearly perissodactyle, with fifth digit tolerably widely separated from fourth; plantar pad bilobate, the outer lobe, if represented, indicated merely by a small circular scale at the base of the fifth digit and remote from the rest of the pad. Hind foot with only three toes and a small plantar pad ..... Dasyproctidæ.

a'. Antemolar portion of palate strongly compressed, forming a median ridge deeply grooved and bicarinate almost to the incisors; the whole zygomatic arch profoundly modified mainly by the outgrowth from its maxillary and malar portion of a great bony lamina forming a cheek-plate extending downwards to overlap and conceal the greater part of the mandible; the maxillary portion of the arch is deeply hollowed beneath and is continued forwards as far as the premaxillary suture, the roof of the hollow forming the floor of the preorbital foramen which is converted into a long deep channel in front of the orbit, and the orbit itself is reduced in dimensions by the upgrowth of its inferior edge and looks obliquely outwards and upwards; nasals much shorter than frontals, postorbital portion of skull wide and short, occipital crest nearly semicircular. Large cheek-pouches present. Feet short and robust, fore foot nearly artiodactyle, with four main digits evenly spaced, the plantar pad large with outer lobe well developed and confluent with median; hind foot with five digits ..... Cœlogenyidæ.

So far as the feet are concerned, *Cœlogenys* is a much more primitive type than *Dasyprocta*, and might be regarded as

ancestral to the latter genus; but with respect to the modifications of the skull *Cœlogenys* is extraordinarily specialised and absolutely isolated, nothing approaching an intermediate type between it and *Dasyprocta* being known.

Family Chinchillidæ.

In all the classifications quoted above this family contains the three genera *Chinchilla*, *Lagidium*, and *Lagostomus*. Of these *Chinchilla* and *Lagostomus* are the only ones I have been able to examine in a fresh state, *Lagidium* being known to me solely from a dried skin, a skull, and the descriptions of other authors, which possibly from want of material do not contain the points I want. But, judging from the cranium and the teeth and the external characters revealed by the dried skin, *Lagidium* is more nearly related to *Chinchilla* than it is to *Lagostomus*—that is to say, the family may be divided into two groups or subfamilies, one containing *Lagostomus* alone, the other *Chinchilla* and *Lagidium*. In using the external genitalia of the male as perhaps the most important difference between these subfamilies, I assume provisionally that *Lagidium* will be found to agree with *Chinchilla*. The characters may be tabulated as follows:—

a. Penis normal in position and structure, glans stout and moderately long, with well-developed glandular pouch. Fore feet with trilobed plantar, bilobed carpal pads, and compressed digital pads; hind foot with fifth digit retained, with a large pad on the sole of the foot at its base, digital pads compressed; principal digital brush on the second digit. Root of ear raised externally so as to stand high above auditory aperture. No coarse vibrissæ on cheek. Molar teeth trilaminate. Postorbital area of skull sloping backwards so that the weak occipital ridge is approximately on a level with the middle of the orbit; naso-premaxillary region not downcurved; "prepalatine foramina" long and "Steno's foramen" not remote from incisors ..... *Chinchillinæ*.

a'. Penis very abnormally placed, the prepuce being abdominal in position; glans exceedingly long and slender, with pouch apparently undeveloped. Fore feet with indistinctly lobed plantar and carpal pads and digital pads not compressed; hind foot without fifth digit and no trace of isolated pad on the sole. An immense digital brush on the third digit. Root of ear not raised so as to conceal auditory orifice. A mat of coarse vibrissæ on the cheek; normal genal vibrissæ stout. Molar teeth bilaminate. Postorbital area of skull not sloping backwards, the very strong occipital crest as high as the summit of the orbit; naso-premaxillary region arched downwards; "prepalatine foramina" comparatively short and "Steno's foramen" remote from the incisors ..... *Lagostominæ*.

Families Caviidæ and Hydrochœridæ, nov.

In the current text-books the Caviidæ contain the three genera *Cavia*, *Dolichotis*, and *Hydrochœrus*; but the comparatively recent severance of *Cavia* into some half-dozen genera—*Cavia*, *Caviella*, *Monticavia*, *Galea*, and *Kerodon*—enhances the value of the

characters which distinguish *Dolichotis* from *Cavia* in the old sense, and *Hydrochœrus* from both. In the first place, *Hydrochœrus* clearly differs from *Dolichotis* and *Cavia* much more than these two differ from each other. As set forth in the table that follows, *Dolichotis* also in certain well-defined particulars stands aside from all the genera into which *Cavia* has been split up. I propose to express these differences by severing *Hydrochœrus* as the representative of a distinct family * from the Caviidæ, and to divide the latter into two subfamilies Dolichotinæ and Caviinæ. The distinguishing characters of these groups may be briefly stated as follows:—

a. Last upper molar longer than the three others taken together; palate long, its median line about twice its width, the palatine bones not deeply excised by short mesopterygoid fossa. Feet webbed up to ill-defined digital pads, which with the claw form a hoof-like termination to the digits; digits of fore foot unevenly spaced, the fifth set high above the fourth and carrying a reduced and separate interdigital element of the plantar pad; the third digit markedly larger than the second or fourth and submedian; no additional ridge on ear ..... HYDROCHŒRIDÆ.

b. Last upper molar much shorter than the combined length of the others; palatine bones so deeply excised by the mesopterygoid fossa that the median length of the palate is at most about equal to the width between the last molars. Feet not webbed; digital pads well defined and distinct from the compressed claws; digits of fore foot tolerably evenly spaced; third and fourth digits nearly evenly paired, subequal, the third not markedly larger than second and fourth; plantar pad with external lobe confluent with median lobe; a strong ridge beneath the supratragus in the ear ..... CAVIIDÆ.

*a*². Skull with nasals narrowed and strongly convex in front, the distal edge deeply excised; the interorbital region very wide owing to an expansion, notched anteriorly and defined by a notch behind, overhanging the orbits; upper edge of malar geniculate, paroccipital processes long. Ear long, with simple supratragus. Nostrils expanded. A single pair of widely separated anal glands above the anus. Digits short, legs long, with area behind plantar pads overlapped by hairs; plantar pads very large, projecting behind; carpal pad very small; a distinct tail ..... *Dolichotinæ*.

*b*². Skull with nasals nearly parallel-sided, not strongly convex in front, and distal edge with shallow excision; no appreciable bony growth roofing the orbit, upper edge of malar not geniculate; paroccipital processes comparatively short. Ear short, with valvular supratragus. Nostrils not expanded. Anal glands, where known, opening beneath the anus. Digits more elongated, legs short, naked beneath, plantar pads not projecting behind; carpal pad large; no tail ..... *Caviinæ*.

Other differentiating characters might have been added to those given above. But these must suffice.

* I submit that the characters upon which *Hydrochœrus* may be separated as a family from the Caviidæ are of higher systematic value than those upon which *Castor* has been separated as a distinct family from the Sciuridæ (see Miller, Mamm. of Western Europe, p. 947, 1912).

Mainly by characters supplied by the skulls and teeth, Thomas, in the paper quoted above, showed how the genera of Caviinæ might be distinguished. The three of which I know the external characters may be differentiated as follows:—

a. Ridge of ear beneath supratragus simple, not valvular; interramal vibrissæ consisting of two pairs of long setæ set on the posterior border of a large nearly naked area behind the chin; anus exposed at the summit of a naked or nearly naked area of skin which lies over the testes and shows no trace of glandular depression; penis projecting from lower end of this area ..... *Galea*.

a'. Above-mentioned ridge valvular; interramal vibrissæ absent or at all events typically indistinguishable; anus concealed in the subjacent glandular area.

b. Claws elongated; digital pads flat or lightly convex; a single carpal pad ..... *Cavia*.

b'. Claws quite short; digital pads compressed; carpal pad double... *Kerodon*.