

## 29. The External Characters of the Pangolins (Manidae).

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(Text-figures 6-13.)

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*Introduction.*

Pangolins are seldom imported alive to Europe. During the time I was Superintendent of the Zoological Society's Gardens only one example, a specimen of *Manis tricuspis*, was exhibited. Of the external characters of this animal I made sketches and notes immediately after its death. Otherwise I have seen no fresh material. But in the Natural History Museum, in addition to a large number of dried skins and mounted specimens, there are examples preserved in alcohol of *M. tricuspis*, *M. tetradactyla* (= *longicaudata*), and immature individuals of *M. pentadactyla* (= *aurita*), and *M. javanica*. Through the courtesy of Mr. R. H. Burne I have also had the opportunity of examining the material, including anatomical preparations, in the Museum of the Royal College of Surgeons. This paper is based upon an examination of this material; but I paid no special attention to the shape, number, and disposition of the scales on the body and tail, since these have been already described in systematic papers.

Although Gray\* and Fitzinger† divided the Pangolins into several genera, which will be referred to later, other monographers of the group, like Jentink‡ and Matschie§, assigned all the species to the single genus *Manis*; and their example has been followed, I believe, by all systematic and faunistic writers. This course I propose to adopt in the first part of this paper, leaving to the final part my conclusions respecting the generic subdivisions justified, in my opinion, by the facts established.

\* Proc. Zool. Soc. 1865, pp. 363-371; also Cat. Edentate Mamm. 1869.

† SB. Akad. Wien, lxx. pp. 9-83 (1872).

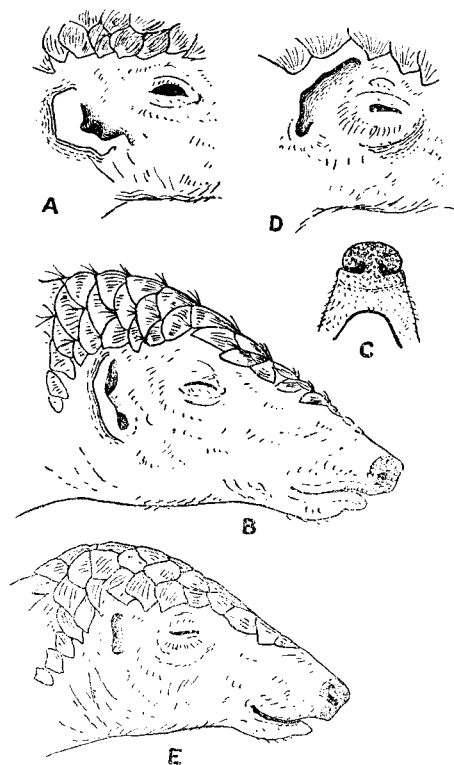
‡ Notes Leyden Mus. 1882, p. 206.

§ SB. Ges. nat. Fr. Berlin, 1894, pp. 1-11.

*The Head and its Sense-Organs.*

The *head* is short and conical, tapering to the snout, which is bluntly truncated. The scales extend nearly to the ears, but leave a deeper area above the eyes and usually fail to reach the rhinarium by a considerable distance, as in *M. tricuspis*, but sometimes, as in *M. javanica*, extend almost to it, although in that case they are small and weakly cornified.

Text-figure 6.



- A. Part of the head and ear of young *Manis pentadactyla* from Nepal.  
 B. Head of young *Manis javanica*.  
 C. Rhinarium of the same.  
 D. Part of the head and ear of adult *Manis tricuspis*.  
 E. Head of newly-born young of the same.

The *eyes* are comparatively small except in *M. tricuspis*, and probably *M. longicaudata*, where they are relatively considerably larger.

The *facial vibrissae*, as in the American Ant-eaters, are reduced to a few short fine hairs on the lips and round the eyes, the supra-orbital, genal, and interramal tufts being aborted.

The *rhinarium* is tolerably well-defined, naked, moist, and areolated. It is without median groove, and the nostrils are narrowly separated in the middle line. They are well developed and normal, being expanded at their antero-internal ends and posteriorly form a narrower curved slit.

The *ears* vary considerably in size, but are always comparatively small. They are largest in *M. pentadactyla* (= *aurita*), where each consists of a well-developed flap standing away from the head. The upper edge does not rise above its point of attachment in front. It forms an abrupt angle with the posterior border, which inferiorly is angled and turns forward running into a slightly sinuous inferior border. The shallow cavity of the ear is defined below and behind by a sinuous ridge parallel in a general way to the external edge. In front it forms a small, possibly "tragal" thickening, and behind this there is a wide shallow angular notch. Above and a little behind the notch is the conspicuously exposed orifice.

In *M. javanica* the postero-inferior rim of the pinna seen in *M. pentadactyla* is reduced to a thickened subvertical ridge of integument with a lightly convex, slightly sinuous posterior edge, and a correspondingly concave, more strongly sinuous anterior edge, with a narrow notch below, within which lies the almost concealed orifice. The ear of *M. crassicaudata* is apparently similar to that of *M. javanica*.

In *M. tricuspis* the thickened rim seen in *M. javanica* and *crassicaudata* has entirely disappeared, the posterior border of the slit of the ear which contains the orifice in its lower portion being flush with the skin of the head behind it. In the remaining African species the pinna is said to be similarly absent. No trace of it is detectable on dried skins.

#### *The Fore Foot.*

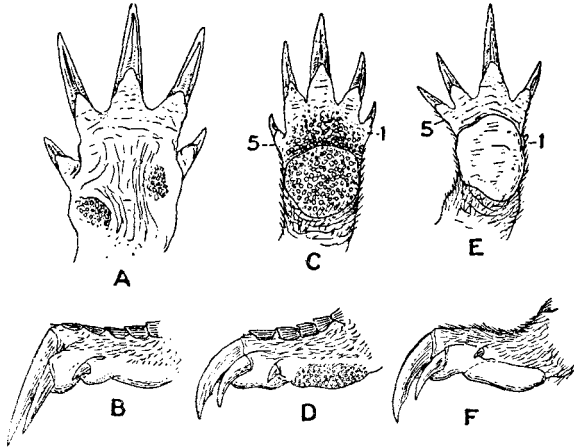
The fore foot has five digits, of which the 3rd is always the largest, and the 2nd and 4th larger than the 1st and 5th, the 2nd, 3rd, and 4th carrying the falcate fossorial claws.

In a newly born young, preserved in alcohol, of *M. pentadactyla* Linn., the arrangement of the digits is nearly symmetrical. They are tolerably evenly spaced. The 1st and 5th are small and subequal, and are set almost on the same level on the inner and outer sides of the foot respectively, the 1st being only slightly in advance of the 5th. The 2nd and 4th are much larger, and approximately equal in size, and are armed with long pointed, slightly curved claws. The 3rd, in the centre of the foot, is considerably longer and stronger than the 2nd or 4th. The upper surface of the foot is covered with scales down to the base of the claws. The lower surface is quite naked and is covered for the

most part with smooth wrinkled skin, but towards the outer and inner sides of the sole, behind the 5th and 1st digits respectively, there is an ill-defined granular pad, the pad on the outer side behind the 5th digit being set a little farther back than the one on the inner side behind the pollex.

In the young of *M. javanica* the fore foot agrees in the scaling of its upper side and in the relative lengths and disposition of its digits with that of *M. pentadactyla*; but the claws of the 2nd, 3rd, and 4th are more curved and relatively much shorter, and the sole of the foot is granularly corrugated all over and carries a

Text-figure 7.



- A. Right fore foot of young *Manis pentadactyla* from below.  
 B. The same from the inner side.  
 C. Right fore foot of *M. javanica* from below.  
 D. The same from the inner side.  
 E. Right fore foot of *M. tricuspis* from below.  
 F. The same from the inner side.

1 and 5 first and fifth digits.

(Drawn from specimens preserved in spirit.)

single large pad, as wide as the foot, which represents the plantar or carpal pad, or both combined, of the normal mammalian foot.

Of the third Asiatic species, *M. crassicaudata*, of peninsular India and Ceylon, I have seen only dried skins, in which the soles of the fore feet are too shrivelled for accurate interpretation of the pads; but the digits appear to be quite like those of *M. pentadactyla* and *M. javanica*, although the claws are long as in the former, being, as in that species, much longer than those of the hind feet.

Of the two big terrestrial African species, *M. gigantea* and

*M. temminckii*, I have also seen only dried skins; but in these I can detect no structural points suggesting any difference of moment from the feet of the three Asiatic species.

But in the two small arboreal African species, *M. longicaudata* and *M. tricuspis*, the fore feet present well-marked differences from those of the other forms of the genus. In the first place, as other observers have noticed, the upper side of the foot is hairy and not scaly. But there are also distinct differences in the digits. The 1st or pollex is minute and represented by little more than a small functionless claw behind the base of the 2nd. The arrangement and relative lengths of the 2nd, 3rd, and 4th are as in the other species, with the claws strongly curved and sharp. But the 5th digit is considerably larger than the 1st, is set far in advance of it and rises from the base of the 4th, to which it is tolerably closely united, more closely than the 2nd is to the 3rd, in a manner indeed suggesting incipient syndactylism. The sole of the foot is quite smooth and carries a well-developed pad similar to that of *M. javanica*, but better defined.

#### *The Hind Foot.*

The relative length and disposition of the digits of the hind foot of *M. pentadactyla* and *M. javanica* are nearly the same as in the fore foot in the sense that the 2nd, 3rd, and 4th are the largest and the 1st and 5th the smallest of the five. But in the two young examples of these species examined there are some noticeable differences in their feet. In *M. pentadactyla* the sole is longer and narrowed towards the heel, which is covered with naked wrinkled skin. The anterior part is padded and granular and extends forwards between the 1st and 5th digits, encroaching upon the underside of the 2nd, 3rd, and 4th, up to the level of their fusion, and the 3rd is only a little longer than the 2nd or 4th, the claws and digits being much shorter than in the fore foot.

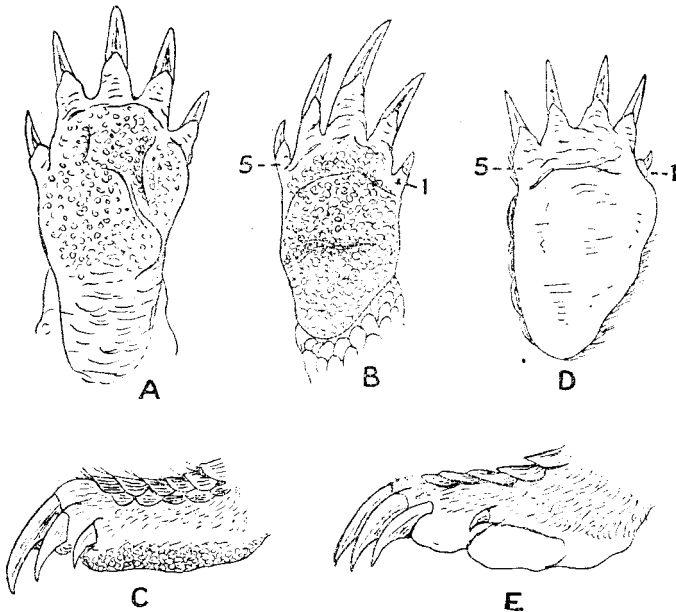
In *M. javanica*, on the contrary, the pad which, like the area in front of it, is granularly roughened, does not extend forwards between the 1st and 5th digits, but leaves the lower sides of digits 2 to 5 uncovered for some distance behind their point of union. It is quite sharply defined from the scaly skin of the tarsus behind, its posterior third being narrowed, and in front its anterior edge is also more sharply defined than in *M. pentadactyla*, and the 3rd digit is larger as compared with the 2nd and 4th than in that species.

On dried skins of adult and young examples of these two species the most noticeable difference in the hind foot lies in the claws, which are longer, sharper, and more curved in *javanica* than in *pentadactyla*. As others have observed, they are nearly as long in *javanica* as those of the fore foot and are no doubt scansorial in function. In *pentadactyla* they are sometimes tolerably sharp and long, at other times blunt and short, owing

to wear. In one example of this species from Amoy the pad behind the base of the digits is subdivided by radiating grooves into five distinct areas, four of which, forming the curved distal edge of the pad, suggest the four combined lobes of the plantar pad characteristic of many mammals; but considering the dried condition of the specimen it would be unwise to assume that homology.

In dried skins of the common Indian and Ceylonese species, *M. crassicaudata*, the hind foot differs very markedly from that

Text-figure 8.



- A. Right hind foot of young *Manis pentadactyla* from below.  
 B. The same of young *M. javanica*.  
 C. The same from below.  
 D. Right hind foot of *M. tricuspis* from below.  
 E. The same from the inner side.

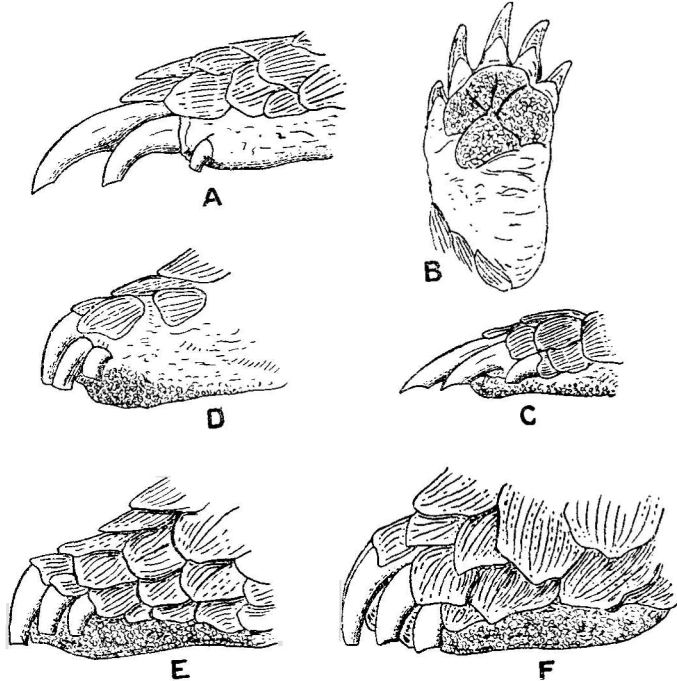
1 and 5 first and fifth digits.

(Drawn from specimens preserved in spirit.)

of *M. javanica*, less so from that of *M. pentadactyla*, which is almost intermediate. It is compact and short and stumpy, the coarsely granular pad extending up to the base of the claws, which are quite short, blunt, slightly curved and depressed over the anterior edge of the pad. Although this foot, judging from its shape, seems designed for walking on the ground, we have the testimony of Sir Emerson Tennant to prove that this *Manis* is able to climb.

Judging from dried skins and mounted specimens, the hind feet of the large African terrestrial species, *M. gigantea* and *M. temminckii*, are short and stumpy and covered with a continuous pad up to the tips of the short, curved, blunted claws which rest on its anterior extremity, scarcely or not reaching the ground. The claws form an evenly curved line, and there is no

Text-figure 9.



- A. Right hind foot of adult *Manis javanica* from the inner side.  
 B. Right hind foot of adult *M. pentadactyla* from Amoy, from below, showing lobate pad.  
 C. The same from the outer side.  
 D. Right hind foot of adult *M. crassicaudata* from inner side.  
 E. Left hind foot of the same from outer side.  
 F. Left hind foot of adult *M. gigantea* from the outer side.

(Drawn from dried skins.)

indication of division between the distal ends of the digits. The hind feet of these two species do not appear to differ in any characters of moment from those of the common Indian species, *M. crassicaudata*, and it may be noted that this type of foot seems to be correlated with a rather short but powerful tail.

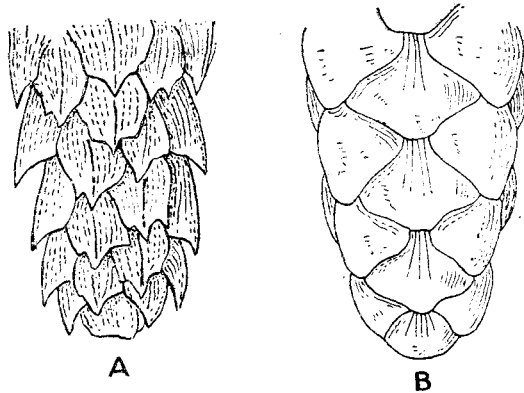
In *M. longicaudata* and *tricuspis*, the African arboreal species,  
 Proc. Zool. Soc.—1924, No. XLVII.

the feet are more like those of *M. javanica*, but, as in the case of the fore feet, differ from those of all other Pangolins in the reduction of the hallux, or 1st digit, to an excrescence bearing a very small claw and set behind the base of the 2nd and a long way behind the 5th. The 5th, moreover, is as large as the 4th, 3rd, and 2nd, the four being approximately equal, nearly on a level, and having subequal, sharp, curved claws. The whole of the underside of the foot is smooth and carries a large flat pad which extends from the level of the 1st digit to the heel and has a conspicuous bulge on its inner side behind the hallux.

#### The Tail.

The tail is always well developed and powerful, and approximately as wide at the base as the anal region; but its well-known variation in length and breadth relatively to the body is very considerable, the extremes being met with in the two African species, *M. longicaudata* and *M. temminckii*. The number and shape of the scales have been described by various authors, and

Text-figure 10.



- A. Upper side of end of tail of *Manis tricuspis*, showing the irregular arrangement of the scales.  
 B. The same of *M. pentadactyla*, showing the regular arrangement of the scales and bristles projecting beneath the median series.

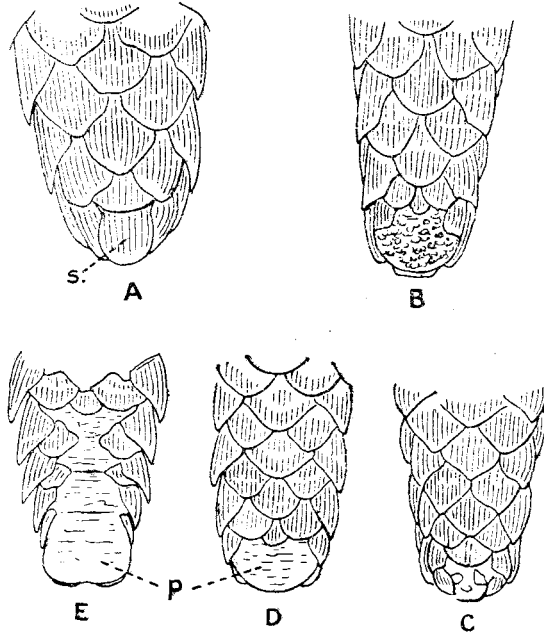
many systematists have recorded the puzzling difference between the four African species and the three Asiatic species in the arrangement of the scales at the tip of the dorsal side of the tail. In the Asiatic species the arrangement is almost always\* symmetrical, the median series of scales being continued uninterruptedly to the tip, whereas in the African species the median row is represented by two rows of asymmetrically disposed scales at the distal extremity of the organ.

\* Shown to be variable in *M. crassicaudata* by Anthony (Bull. Mus. Paris, xxv. pp. 17, 18, 1919).



The presence or absence of a naked cutaneous pad at the tip of the tail beneath has also been described. It attains its highest development in the two West African arboreal species, *M. longicaudata* and *M. tricuspis*, where it is comparatively wide and truncated and indistinctly bilobed at its distal end. Proximally to it there is a median area of skin left naked by the absence of two median and two lateral scales. In the newly-born

Text-figure 11.



- A. Lower side of end of tail of adult *Manis crassicaudata*, showing the terminal scale (*s*).
- B. The same of adult *M. pentadactyla* from Upper Burma, showing the granular terminal pad.
- C. The same of a young specimen from Nepal.
- D. The same of *M. javanica*, showing the naked terminal pad (*p*).
- E. The same of *M. tricuspis*, showing the naked terminal pad (*p*) and the naked skin above it.
- (A and B from dried skins; C, D, E from spirit specimens.)

young example of *M. javanica* the pad is also present, but it is shorter and relatively narrower than in the two species just described and has an evenly convex edge. There is also no median area of naked skin proximally to it, the median and lateral scales mentioned above being present. In dried skins of adult examples of *M. javanica* the pad is as well developed as that of the young and similar to it.

In the young example of *M. pentadactyla*, of approximately the same age as the young *javanica*, there is no true pad, the tail being scaly to the end beneath, although the scales at the extreme tip are much smaller and less distinctly horny than the rest and separated by naked skin. But in dried skins of adults a pad similar in shape to that of *javanica* is present; it does not, however, consist of smooth skin as in that species but is beset with minute scale-like roughnesses.

In some dried skins of young examples of *M. crassicaudata* the tip of the tail beneath is like that of the young example of *pentadactyla*, there being no true pad, but in adult examples the pad is absent, its place being taken by a median horny scale, as hard and compact as the other scales. Thus Matschie's statement that this species has a caudal pad is erroneous, as Anthony has shown (Bull. Mus. Paris, xxv. p. 20, 1919). The two large African species, *M. gigantea* and *M. temminckii*, have no pad, according to Matschie and Anthony. In most of the dried skins I have been able to see the scaling at the tip of the tail has been destroyed by the skinning; but my observations confirm Matschie's statement on that head.

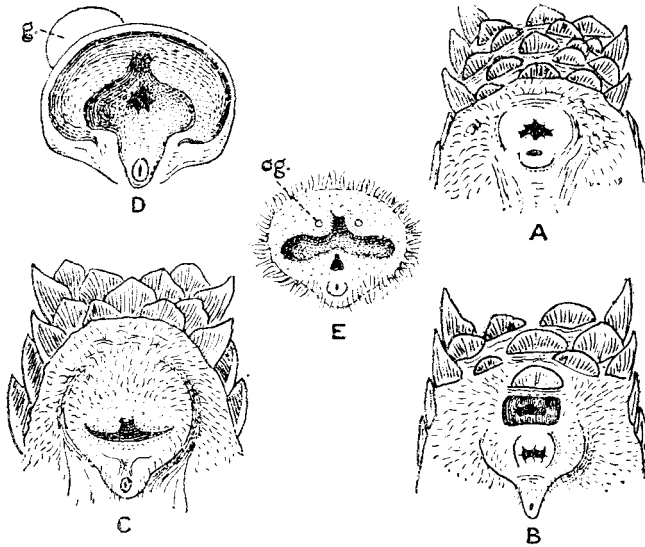
There are some interesting facts to record in connection with the length and breadth of the tail. In *M. longicaudata* and *tricuspis* this organ is comparatively narrow and exceedingly long, longer indeed than the head and body combined, sometimes nearly twice as long. In the other species it is shorter than the head and body, although only slightly so sometimes in *M. javanica*. Thus in the length of the tail, as in the presence of the unscaly terminal pad, and the structure of the hind feet, *M. javanica* comes nearer to the long-tailed African forms than do the others. *M. pentadactyla* has a shorter tail and a less well-developed terminal pad than *M. javanica*; but whereas in the latter the sides of the tail gradually converge from the base to the tip, in *M. pentadactyla* the even convergence of the sides ceases before the extreme end, which is almost parallel-sided and more subcylindrical, suggesting greater prehensile skill. *M. crassicaudata*, generally at all events, has a shorter and broader tail than *M. pentadactyla* without a pad, but its sides evenly converge to the tip as in *javanica*. In the structure of the tail and of the hind feet it comes nearer the large African species, in one of which, *M. temminckii*, the tail is so broad as to have been described as paddle-like.

#### *The Anal and Genital Area.*

In examples of the species examined the anus opens in the centre of a well-defined eminence, and in adults and sub-adults it is sunk within a depression formed by the overfolded edges of the circumanal area. This eminence is mainly due to the presence of a pair of large anal glands, opening at the sides of the anus well within the depression, which probably acts as a

reservoir for their secretion. A strong repulsive odour which I noticed in a living example of *M. tricuspis* probably emanated from these glands. The external genital organs both of the male and female are situated on the anterior part of the anal eminence.

Text-figure 12.



- A. Anal and genital area of female *Manis javanica*.  
 B. The same of young male *M. pentadactyla* from Nepal, showing especially the oblong, probably glandular, depression behind the anal eminence and the disarrangement of the scales on the base of the tail.  
 C. The same of adult male *M. tricuspis*, showing the wide orifice of the anal sac.  
 D. Anal sac of the same species dilated to show the insunk anus and one of the anal glands (*g*) dissected.  
 E. Anal sac of female *M. tricuspis* expanded to show the orifices of the anal glands (*og*) and below the sac the vulva and clitoris.

In *M. tricuspis* the anal depression is well defined both in the male and the female, and when closed its orifice forms a transverse cleft. There is no depression on the hairy integumental area between the eminence and the base of the tail: and the first row of scales on the latter forms an evenly curved transverse line. The penis is a short, conical process projecting from the fore part of the eminence, and the orifice of the small glands may be seen surrounded by the prepuce. The perineal area is short.

In the female the vulva opens just in front of the anal depression, and beneath it there is a small bilobed clitoris. In this sex also the perinæum is short.

In a young male of *M. pentadactyla* there is also a distinct anal eminence with the anus opening upon it; and just in front of the anus there is a short projecting penis, which, however, is much slenderer than in the specimen of *M. tricuspis* examined. Just behind the anal eminence there is a very distinct transversely oblong pit, about half the width of the eminence and showing a marked depression in its centre. This is probably glandular\*. The scales at the root of the tail do not form an evenly curved line owing to the forward shifting of the median scale of the first row out of line with the two adjoining scales, so that it lies just behind the pit above mentioned and probably acts as a lid to it when the tail is lowered.

In a sub-adult male of *M. javanica* from Chantaboon, Siam (*S. S. Flower*), the anal eminence is very pronounced, and the anus itself is sunk in a deep depression formed by a thick muscular projecting ridge arising from the circumanal area. The orifice of this depression when close forms a transverse cleft, suggesting a very large anal orifice. From the anterior end of the margin of this depression depends the short simple penis. The anal eminence is defined behind by a transverse externally curved groove; but there is no depression behind it such as is seen in the young example of *M. pentadactyla*. The first row of scales at the base of the underside of the tail forms an evenly-curved series.

In a young female example of *M. javanica*, there is a comparatively low anal eminence; the anus in its centre is not insunk and the vulva, a transverse slit, lies just in front of it. There is no pit behind the anus, and the first row of scales of the tail forms an evenly curved line defining the postanal area.

The observations above recorded, especially those relating to the probably glandular postanal pit and the disarrangement of the scales of the first row on the tail in *M. pentadactyla*, call for further examination of the anal and genital regions on fresh material, not only of the species here described but of *M. crassicaudata*, *M. temminckii*, and *M. gigantea*.

#### *The Classification and Generic Nomenclature of the Pangolins.*

From the preceding account it will be seen that the nature of the variations in the external characters of the Manidæ are in many cases of greater than specific value according to modern standards.

1. The small, long-tailed West African species, *M. longicaudata* and *tricuspis*, differ from the rest in the structure of their front and hind feet. There are minor differences as well, such as the great length of the tail, the development of its terminal pad, etc., associated no doubt with the essentially arboreal habits of the animals. But the structure of the feet alone is quite sufficient

\* Traces of this pit are observable in some dried skins of adult and young males of this species.

to justify their separation from the rest. The two species in question are, moreover, so different from each other in scale-armature that they were given subgeneric rank by Gray, and full generic rank by Fitzinger.

2. In general form, appearance, and habits, as well as in the structure of their feet, the species mentioned in the last paragraph are strikingly distinct from the two large, heavily-built terrestrial species, *M. temminckii* and *M. gigantea*, of the same continent. Nevertheless, the four African species resemble each other, and differ from the Asiatic species in four characters, which compel the belief that they belong to the same stock. These characters are:—(1) the prodigious elongation of the xiphisternum into two branches extending backwards to the posterior ribs\*; (2) the duplication of the median line of scales on the upper surface of the tail; (3) the absence of bristles protruding between the scales; (4) the total suppression of the pinna of the ear. Of these characters those supplied by the xiphisternum will appeal most strongly to anatomists as evidence of kinship; but the seemingly functionless arrangement of the caudal scales is a specialization perhaps as cogent on that head as any.

In the Asiatic species, on the contrary, the xiphisternum is comparatively short, and ends in an expanded plate shaped something like the blade of a spade, the median line of scales is typically continued uninterruptedly to the end of the tail, there are bristles projecting beneath the scales†, and the pinna of the ear is retained either as a definite ridge, or a comparatively large flap. It is perhaps needless to point out that in these characters the Oriental species form the more primitive group, and this points to Asia, and not Africa, as the original home of the order.

3. In the case of the three Asiatic species, although *M. pentadactyla* is in some respects intermediate between *M. crassicaudata* and *M. javanica*, it differs from both in the large size of the pinna; and, apparently, in the presence, in the male at least, of the postanal glandular depression, not to mention the peculiar narrowing of the distal end of the tail. Setting this species on one side, *M. crassicaudata* and *javanica* differ considerably from one another in habits, general form, in the structure of the hind foot, and in the absence in the former, and the presence in the latter, of the caudal pad; and since it may be confidently anticipated that other differences between these three Asiatic species will be revealed when properly preserved material in alcohol is available for examination, I propose to assign them to three distinct genera.

It remains now to be seen what names are available for the genera I propose to admit.

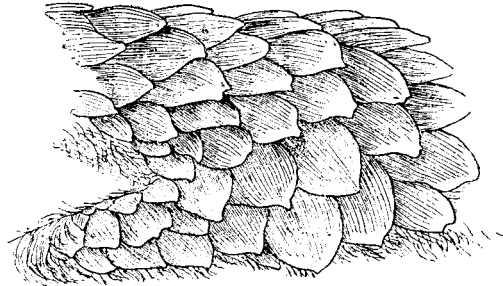
\* Max Weber, Zool. Ergebn. einer Reise Nederl. Ost-Ind. ii. pp. 79-86, pl. ix. figs. 63-66. In the explanation of this plate, fig. 64 is labelled by error *macrura* instead of *crassicaudata*, *macrura* being a synonym of *longicaudata*.

† Often rubbed off or shed in old specimens.

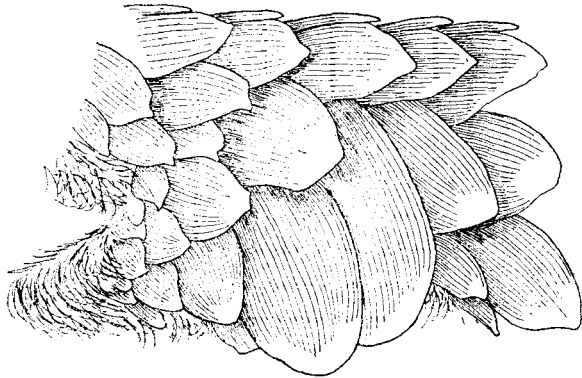
The two earliest names are *Manis* Linn. (Syst. Nat. ed. 10, p. 36, 1758), based upon *pentadactyla*\* and *Pholidotus* Brisson (Regn. An. iii. Quadr. p. 19, 1762), comprising *pentadactyla*, cited by reference, and *longicaudata*, a new species.

*Longicaudata* was subsequently renamed *tetradactyla* by Linnæus (Syst. Nat. ed. 12, p. 53, 1766). I do not know why

Text-figure 13.



A



B

- A. Side view of shoulder and part of the neck and fore leg of *M. tricuspis*, showing the comparatively small, numerous scales.
- B. The same of *M. longicaudata*, showing the enlargement and reduction in number of the scales.

Matschie and Trouessart adopted Linnæus's name instead of Brisson's, which has four years' priority.

Two new subgeneric names were introduced by Rafinesque in

\* Shown by Thomas (Proc. Zool. Soc. 1911, p. 133) to be the same as the Chinese and North Indian form, better known as *awila*, and not, as was supposed, the same as the species of Peninsular India and Ceylon, which now takes the name *crossicaudata*.

1821 (Ann. Sci. Phys. Brux. vii. pp. 214-215\*). With a clear perception of the value of the distinguishing characters between the five-toed and four-toed species, he subdivided *Manis* into two subgenera, *Pangolinus* for *pentadactyla* Linn. and *brachyura*, and *Phataginus* for *tricuspis* and *ceoyne*, two alleged new species, although *ceoyne* from the reference to its large scales is evidently a synonym of *longicaudata* Briss. These two subgenera he designated also by the trivial names Pangolin and Phatagin.

An advance in the classification was made by Sundevall in 1843 (K. Vet.-Akad. Handl. lxiii. pp. 245-281), when he divided the known species of *Manis* into three subgenera, restricting *Manis* to *longicaudata* and *tricuspis*, *Pholidotus* to *aspera* (= *javanica*), *javanica*, and *dalmanni* (= *pentadactyla*), and proposing the new name *Phatages* for *laticauda* (= *crassicaudata*) and *temminckii*.

With certain additions and emendations Gray's classifications of 1865, 1869, and 1873 were amplifications of the systems of Brisson, Linnaeus, Rafinesque, and Sundevall. He divided the family into two main sections typified respectively by the manifestly five-toed and the apparently four-toed species after the manner of Brisson, Linnaeus, and Rafinesque; and, following Sundevall, he restricted *Manis* to the four-toed forms, comprising *longicaudata* (= *tetradactyla*) and *tricuspis*; and *Pholidotus*, broadly speaking, to the five-toed species, including of course *pentadactyla*, giving full generic rank to them. In this he was followed by Fitzinger in 1872, and, in effect, by Trouessart in 1899 and 1905, although the latter regarded the two groups as of subgeneric value.

There are two cardinal points to notice in these classifications:—(1) the allocation of the name *Manis* to the four-toed species was clearly inadmissible, since that name was based in 1758 upon *M. pentadactyla* alone; (2) as regards *Pholidotus*, Sundevall (and following him Gray, Fitzinger, and Trouessart) was acting quite within his rights in applying it to the first of the five-toed species assigned to it by Brisson. His action in so doing was tantamount to selecting *pentadactyla* as its type. But the actual and verbal selection of *pentadactyla* as the type of *Pholidotus* was apparently left to Trouessart in 1905†. To the further subdivision of the five-toed species I shall return presently.

Reverting to the four-toed group, Gray, appreciating the differences between the two admitted species *longicaudata* and

\* A rare work to which few systematists apparently have had access. The volume bears the date 1820; but, according to Mr. C. D. Sherborn, it was not published until a year later.

† It is true that in 1901 (Fauna of S. Africa; Mammals, ii. p. 216), W. L. Sclater selected *tetradactyla* as the type of *Pholidotus*. But herein he ignored the previous restriction by Sundevall and others of that name to *pentadactyla* and its allies. Moreover, he assigned *Pholidotus* to Storr 1780, not to Brisson 1762; but since Storr quoted no specific name under that title, neither *tetradactyla* nor any other species can be its type, assigning the name to him. On all counts, therefore, Sclater's action may be dismissed as invalid.

*tricuspis*, although referring both to the genus *Manis*, restricted the latter term in a subgeneric sense to *longicaudata*, and adopted as a subgenus for *tricuspis*, *Phatagin* of Rafinesque, taking, with characteristic perversity, that author's French rendering of the title *Phataginus*. Fitzinger also perceived the striking differences between these two forms, and while following Gray in assigning *longicaudata* to *Manis*, introduced the new name *Triglochinelophis* as a substitute for *Phataginus*.

Thus of the two long-tailed arboreal W. African forms, the small-scaled species *tricuspis* has three names—*Phataginus* Raf. 1821, *Phatagin* Gray 1865, and *Triglochinelophis* Fitz. 1872, whereas the large-scaled species, *longicaudata*, is without generic or subgeneric title, *Manis* being inadmissible for it. Since this form appears to me to deserve generic rank, I propose *Uromanis* for it.

To the five-toed species a considerable number of generic or subgeneric names have been applied.

*Manis* Linn., with type *pentadactyla*, takes *Pholidotus* Eriss. as a synonym; and to this may be added *Pangolinus* Raf. with the same type, and *Pangolin* Gray with type *dalmanni* (= *pentadactyla*).

*Phatages* Sundevall contained the Indian species *laticauda*, and the African species *temminckii* as stated on p. 258 of his treatise; but on p. 273 Sundevall definitely cited *laticauda* as its type. An older name for this species is *crassicaudata* Geoff. St. Hilaire. To the synonymy of *Phatages* must be added *Phatagenus* supplied by Sundevall as an alternative.

Thus two of the admitted Asiatic species are already suited with names. But since there appears to be no available title for the third, *javanica*, I propose *Paramanis* for it.

*Smutsia* was applied by Gray in 1865 to *temminckii*, one of the two large African forms; and since the other, *gigantea*, appears to be congeneric with it, I assign both to that genus.

Thus the generic names with their synonymy and type-species will apparently be as follows:—

1. *Manis* Linn. Type *pentadactyla*.  
     Syn. *Pholidotus* Brisson. Type *pentadactyla*.  
     „ *Pangolinus* Raf. Type *pentadactyla*.  
     „ *Pangolin* Gray. Type *pentadactyla*.
2. *Phatages* Sund. Type *crassicaudata* (= *laticauda*).  
     Syn. *Phatagenus* Sund. (Proposed as an alternative.)
3. *Paramanis*, nov. Type *javanica*.
4. *Smutsia* Gray. Type *temminckii*.  
     This genus also includes *gigantea*.
5. *Phataginus* Raf. Type *tricuspis*.  
     Syn. *Phatagin* Gray. Type *tricuspis*.  
     „ *Triglochinelophis* Fitz. Type *tricuspis*.
6. *Uromanis*, nov. Type *longicaudata*.



The characters of these genera may be tabulated as follows:—

- a.* Xiphisternum short, spade-like, the blade with convex posterior edge and forwardly directed spiniform anterior angles; typically with a single median series of scales on upper side of posterior end of tail; hairs projecting between the scales of the head, body, and limbs, except in old animals; pinna of ear at least represented by a thickened rim of integument. Subfam. *Maniinae*.
- l.* Pinna of ear represented by a well-developed flap of flexible integument; a definitely circumscribed deep, probably glandular, depression behind anus in male..... *Manis*.
- l'.* Pinna of ear represented by a rim of thick skin; no definite pit above anus in male.
- c.* No terminal membranous pad at apex of tail beneath; fore foot with pad poorly developed, its claws very long; hind foot with claws short and blunt, projecting to a comparatively slight extent beyond the pad..... *Phatagis*.
- c'.* A terminal membranous pad on apex of tail beneath; fore foot with well-developed pad, its claws shorter; hind foot with claws comparatively long, about as long as those of the fore foot and projecting well beyond the pad..... *Paramanis*.
- a'.* Xiphisternum produced into two long rods running back to the posterior ribs; scales on upper side of apex of tail irregularly paired; no hairs projecting between scales; pinna of ear absent.
- d.* Digit 1 of fore and hind foot as large as digit 5 and approximately on a level with it, digit 5 much smaller than digit 4; hind foot without expansion of sole behind digit 1, its claws short and blunt; upper side of fore foot scaly to the claws; body heavy, tail short, without terminal pad. (Terrestrial species.) Subfam. *Smutsiinae*. *Smutsia*.
- d'.* Digit 1 of fore and hind foot very small, set far behind level of digit 5, which is much larger than it and approximately in line with digits 4, 3, 2; hind foot with distinct expansion of sole behind digit 1, its claws long and sharp; upper side of fore foot without scales; body light, tail very long, with well-developed terminal pad beneath. (Arboreal species.) Subfam. *Uromaninae*.
- e.* Scales small and numerous, the two inferior post-scapulars not markedly enlarged..... *Phataginus*.
- e'.* Scales very large and comparatively few in number, the two inferior post-scapulars enormously large, markedly larger than the next\*..... *Uromanis*.

\* The elevation of the submarginal scales would seemingly increase to a considerable extent the width of the body in this Pangolin. Hence in the event of a fall from the tree-tops they might act like a patagium. The two large inferior post-scapular scales would be particularly efficacious in this respect.