Palæontology. — *"Manis Palaejavanica, the Giant Pangolin of the Kendeng Fauna."* By Prof. EUG. DUBOIS.

(Communicated at the meeting of October 30, 1926).

Near Kedung Brubus, 40 km E.S.E. of Trinil, in the same tract of the Kendeng formation from which a piece of a very peculiar human mandible had been obtained, which, on closer consideration, after the discovery of a lower premolar at Trinil, I have ascribed to Pithecanthropus erectus, I found, almost two years later, a number of bones of a gigantic Manis species.[1]) In all I found 28 bones or large pieces of bones, some of them coherent, still in their natural mutual position or only very little dislocated. They all were spread over an area of a few square meters, and as regards form, bear a striking resemblance to the homonymous bones of the present Manidae. They are certainly parts of one skeleton of a Manis species and agree most closely with Manis javanica Desm., with this difference that the dimensions are truly gigantic. The long bones of the hand and the foot are, indeed, more thickly built, comparatively short for their length, which, it seems, must be ascribed to the claws being necessarily relatively stronger in a so much heavier species. But yet from what is available (among which also pieces of vertebrae and of the skull) the total length of the animal may be estimated to have been at least $2^1/_2$ meters, i.e. three times the length of a middle-sized Javanese pangolin, and more than once and a half that of a fairly sized adult existing Giant Pangolin of West Africa. The specimen found was, besides, not even entirely full-grown, as appears from the fact, that the epiphyses of the ulna, the radius, the femur, the tibia, and the calcaneus have not yet entirely united with the body of the bone.

I have called the species Manis palaejavanica[2]), denoting by this name the closer relationship with the Javanese species of to-day, from which it is, however, very well to be distinguished by characters of minor importance.

The available parts of the skeleton[3]) are:

1. A considerable piece of the left *temporal bone* with the processus zygomaticus, in connection with a large part of the *frontal bone* and a

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[1]) Verslag van het Mijnwezen over het 2e Kwartaal 1892. Batavia. Landsdrukkerij. 1892.

[2]) EUG. DUBOIS, Das geologische Alter der Kendeng- oder Trinil-Fauna. Tijdschrift van het Kon. Ned. Aardrijkskundig Genootschap, 2nd Series, Vol. **25**. (1908), p. 1267.

[3]) Belonging to the Collection-DUBOIS of the Leyden University.

small piece of the *parietal bone* with its antero-inferior angle. (Plate, middle row, third figure from the left. Above this a skull of M. javanica).

The breadth of the processus zygomaticus, immediately before the place of the lost tympanicum, is 20.5 mm; the corresponding breadth of the skeleton of Manis gigantea Ill. in the Rijks Museum van Natuurlijke Historie at Leyden (Cat. N^0. 3) is 14.3 mm, and of that of a more than middle-sized Manis javanica Desm., in my possession, 10 mm. [1]) The length of the sutura fronto-temporalis is 25 mm, in the Manis gigantea it is 20 mm, and in the more than middle-sized Manis javanica 14.5 mm. In this it should be considered that from species to species the size of the neurocranium does increase relatively less than the size of the body. The plaster cast of the available part of the endocranial surface shows sharp separation of the lobus olfactorius, very pronounced folding of the pallium, especially in the lobus hippocampi, which is large also here, and in the parts lying before this, to the lobus olfactorius — undoubtedly as a consequence of the large size of the body —, further a very remarkable wide and deep depression, which implies a considerable deficiency of brain mass, round the place where the fossa Sylvii of the Manidae was described. The bone wall of the cranial vault is thickened there to 9.3 mm, on account of local smaller *growth of the brain* (for the outer surface of the skull is smooth, and there is no mechanic cause for this growth of the bone), whereas behind it, at the thinnest place of the fragment, only 5 mm can be measured. An endocranial plaster cast of M. javanica shows a similar condition, only the folding and also the depression of the cerebral surface are not so considerable — no doubt on account of the smaller body size; the depression, especially, is comparatively less wide. The thickness of the bone wall reaches there a maximum of 3.6 mm, and behind it, at the thinnest place, it is scarcely 1 mm.

It seems that from the local shortage of brain mass described for M. palaejavanica, it is justifiable to conclude that also this pliocene giant species was covered with scales.

2. A piece of the right half of the *occipital bone*, round the asterion in connection with a piece of the *parietal bone* at its postero-inferior angle, and a piece of the *temporal bone* at its postero-superior angle. The inner side shows the dividing ridge between the pallium and the cerebellum.

3. The right half of the ventral arch of the *atlas*. The distance between the outer edges of the articular surfaces is 36 mm, and must have been at least 37 mm in the perfectly intact bone. The corresponding distance in M. gigantea is 25 mm, in a more than middle-sized M. javanica 15 mm.

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[1]) In the dimensions of the bones I compare the fossil species with Manis javanica, because morphologically it resembles this most closely among all existing species, and with M. gigantea, because this living species comes nearest to it in the size of the body.

4. The left processus articularis superior and some adjacent bone substance of one of the basal *caudal vertebrae*, and the adherent extremity of the processus articularis inferior of the preceding caudal vertebrae. The dimensions are almost $2^1/_2$ times the corresponding ones in the more than middle-sized Manis javanica.

5. The upper end of the right *ulna* (Pl. upper row, fourth figure). The olecranon to the distal edge of the cavitas sigmoidea major and minor; the processus coronoides is broken off. In this articular cavity is a large part of the trochlea and the capitulum of the humerus, somewhat dislocated to the inside. The epiphysis of the olecranon was not yet united with the body of the bone. The length from the beak to the top of the olecranon is 65 mm. The corresponding measure is 33 mm in M. gigantea, 22 mm in the large M. javanica, 20.5 mm in a middle-sized one. Through its length, which is considerable compared with its thickness, the olecranon resembles that of M. javanica very closely; it is only still greater than proportional to the size of the body estimated by the vertebrae. This process is relatively much shorter and broader in M. gigantea.

6. The right *radius*, without the proximal epiphysis. (Pl. upper row, third figure 1). This had got detached, being still separately ossified. Nor are the distal epiphysis and the diaphysis united together. The length is 103 mm, in M. gigantea 69 mm, in a middle-sized M. javanica 53 mm. The smallest (dorso-volar) breadth of the distal epiphysis is 29 mm, and the greatest (at right angles to it) 35 mm, in M. gigantea resp. 19 mm and 25 mm, in a middle-sized M. javanica resp. 11 mm and 13 mm, and in a small one (but also full-grown) 9 and 10 mm The smallest diameter of the collum is 13 mm, in M. gigantea 6.7 mm, and in a large M. javanica 4.5 mm.

7. The proximal extremity of the left *radius* (Pl., upper row, second figure). The epiphysis is slightly dislocated. Its smallest breadth (dorso-volar) is 19.3 mm, its greatest breadth (at right angles to the latter) 32.2 mm. In M. gigantea these measures are resp. 13.6 mm and 20 mm, in a middle-sized M. javanica 9 mm and 13 mm, in a small adult M. javanica 6.5 mm and 11 mm.

The total length of the radius (with the two epiphyses) may be estimated at about 115 mm. In the M. gigantea (also with epiphyses not yet joined by bone) it is 73 mm, in a middle-sized M. javanica 57 mm, and in the small adult 45.5 mm.

In relation to its length the bone is, compared with that of M. javanica, particularly thick and strong.

8. The *metacarpal bone* of the left *middle finger* (Pl., bottom row, fifth figure). Against the proximal articular surface a piece of the os capitatum. Length 37 mm, breadth in the middle 16.5 mm, in a large M. javanica resp. 15.5 and 5.5 mm. Accordingly the bone in the fossil species is thicker in relation to its length than that of the living species.

9 and *10*. The *metacarpal bone* of the right *middle finger*, connected with the somewhat defect *first phalanx* (Pl., bottom row, second figure).

11 and *12*. The connected *first* and *second phalanx* of the left *middle finger*. (Pl., bottom row, fourth figure). Length of the first phalanx in the middle of the side surfaces, on the medial side 15.5 mm, on the lateral side 16 mm. Thickness in the middle 22 mm. In the large M. javanica these measures are 8.5 mm, 8.7 mm, and 6 mm. Hence the fossil bone is relatively to its length much thicker. Measured in the same way the length of the second phalanx is on the medial side 22 mm, on the lateral-side 22.5 mm, the breadth at the base 21 mm. In the large M. javanica the corresponding measures are 9 mm, 9 mm, and 6.3 mm. Also this fossil bone is, therefore, thicker relatively to its length than that of M, javanica.

The second phalanx of a middle finger in the Indian Museum at Calcutta, ascribed originally (1880) by LYDEKKER to a Manis sindiensis, and considered later (1886) to belong to Macrotherium, and then again (1891) assigned to Chalicotherium, is, as regards length, measured as above, and as regards dorso-volar dimension of the trochlea, in good agreement with M. palaejavanica, but the throchlea is broader on the volar side, and the base differs greatly in form; the latter lacks the long dorsal point, and the very broad volar rim ending knobby on every side in the pliocene and the recent species of Java.

13. The third or *nail phalanx* of the left *middle finger* (Pl., bottom row, third figure). Of this cleft phalanx the ulnar point has broken off and has got lost, probably over a third part of the total length of the bone. Likewise the radial point is absent, which is broken off still about $1^1/_2$ cm nearer the base. The length of what remains is 53 mm, and that of the whole bone may be estimated at 80 mm by comparison with the homonymous bone of other species of Manis, especially M. javanica, which the fossil bone resembles most closely. The thickness, between the dorsal and the volar edge of the base, is 27 mm, the breadth at the base 17.5 mm. In M. gigantea the last three measures are: 53 mm, 18 mm, and 11.5 mm. In M. javanica I find mostly 26 mm (as maximum 27 mm), 8,5 mm, and 6.2 mm in more than middle-sized specimens. In the plistocene M. Lydekkeri of India (cave deposits in the Presidency of Madras)[1]), only known through the homonymous bone, the length is 57 mm and the width 12.5 mm. The cleaving begins dorsally in M. palaejavanica at 17 mm distance from the transversely truncated base, i.e. about $^1/_5$ of the total length of the phalanx, in M. gigantea at 17 mm from the rounded base point, or about $^1/_3$ of the total length, in M.

[1]) Tijdschr. Kon. Ned. Aardrijksk. Genootschap, loc. cit. p. 1268. The characters mentioned here, and besides the pointed form of the volar process of the base, sharply distinguish the Indian plistocene species from the M. gigantea. It is certainly also different from M. palaejavanica; I was able to establish this in the Indian Museum at Calcutta, where this fossil is preserved.

Lydekkeri at 10 mm distance from the truncated base or little more than $^1/_6$ of the total length, and in M. javanica at 10.5 mm or $^2/_5$ of the total length. Apart from this more proximal cleaving in M. palaejavanica, there exists the closest similarity in the shape of this bone with M. javanica. Both species are distinguished by the possession of small bars of bone, bounding the volar entrances to the vascular furrows on both sides. On the fossil bone they are broken off, but surfaces of fracture clearly betray their former presence. Besides, only the existing M. javanica has the sharp, antler-like ramified vascular furrows on the side surfaces of the nail phalanges in common with M. palaejavanica.

14. The *metacarpal bone* of the right *fourth finger* (Pl., bottom row, last figure). Length 33.5 mm. Breadth in the middle 9.5 mm. In M. javanica length 14 mm, breadth in the middle 3 mm; the bone is, accordingly, much slenderer. In M. gigantea, on the other hand, the metacarpal IV is still relatively thicker than in M. palaejavanica, for the length is 17.5 mm and the breadth in the middle 6.5 mm.

15 and *16.* The *phalanx prima* and *phalanx secunda* of the right fourth finger connected in their natural mutual position (Pl., bottom row, sixth figure). The length of the first bone, in the middle of the radial side, is 15 mm, in the middle of the ulnar side 14 mm, the breadth at the base 17 mm. The length of the second bone is 15 mm on the radial side and 19 mm on the ulnar side, the breadth at the base 15 mm. Accordingly the capitulum of this phalanx points very obliquely to the middle finger, as it does in M. javanica, which proves, that also M. palaejavanica supported itself, in its walk, on the outside edge of the forefeet (hands), turning its fingers inwards.

In M. javanica both phalanges are much slenderer. The corresponding lengths are 6.3 mm, 6 mm and 6 mm, 7.4 mm, the corresponding breadths 5 mm and 4.7 mm. In M. gigantea the first phalanx is as short and thick as in the fossil species of Java, but the second somewhat less.

17, 18, 19, 20. The *metacarpal bone* and the *three phalanges* of the left *fourth finger* (Pl., bottom row, first figure). Somewhat dislocated from their natural mutual position; on the ulnar side of the capitulum of the metacarpal bone, a *sesamoid bone*. The nail phalanx, broken off at 45 mm length, was probably as a whole 65 mm long. As in M. javanica and M. gigantea, it is somewhat obliquely flattened sidelong. The base measures from the back side to the palm side 23.5 mm, transverse 12.5 mm. The radial half is slightly defect, probably as a consequence of a morbid process during life. For the rest this phalanx has many characters in common with the nail phalanx of the middle finger.

21. The medial half of the upper end of the right *femur* with almost the entire caput and the trochanter minor; the lateral half is broken off. (Pl., middle row, fifth figure). The epiphysis of the caput and that of the trochanter minor were not yet united by bone with the body of the femur. Length of the fragment 86 mm; diameter of the caput,

measured from the front backward, 40 mm; in a middle-sized M. javanica 15.5 mm, in M. gigantea 28 mm. Thickness of the diaphysis, measured in the same way, 27 mm, in the other two species 9 mm and 18 mm. Distance from the top of the trochanter minor to the top of the caput 52 mm resp. 24 mm and 40 mm. In comparison with those two living species the thickness of the caput and of the diaphysis and also the length of the collum is about proportional to the body length estimated.

22. The upper half of the left *tibia.* (Pl., upper row, first figure). The epiphysis is not yet united together with the shaft. Length of the fragment 122 mm. The length of the whole tibia was probably about 245 mm. The antero-posterior dimension of the epiphyses from the tuberositas to the middle of the concavity on the back side, is about 44 mm; the transverse dimension 64 mm, and the circumference of the diaphysis, measured at the fragment as low as possible, about at the thinnest place of the tibia, is 73 mm. These three dimensions are in a middle-sized M. javanica 15 mm, 24 mm, and 25 mm; in the M. gigantea 26 mm, 43 mm, and 40 mm. The tibia of the last is apparently not entirely full-grown.

23. The left *calcaneus.* (Pl., middle row, first figure and Fig. 1 *Ca.* In this figure, accurate outlines of a photograph, four tarsal bones are placed in their natural position). The total length is 72 mm, that of the part behind the articular surface for the astragalus, i.e. the length of the collum and the tuberositas (the epiphysis of which is not united by bone), is 39 mm or 55 % of the total length, the width of the collum at its narrowest is 15 mm, the height idem 25 mm. In a middle-sized M. javanica these measures are resp. 28 mm, 15 mm, 5 mm, and 9,5 mm; the posterior part occupies 53,6 % of the total length.

In M. gigantea the measures are resp. 44 mm, 19 mm, 14 mm, and 19 mm; the posterior part occupies 43.2 % of the total length. The form of the calcaneus of M. palaejavanica presents a striking resemblance to that of M. javanica; especially on the lower side it is to be seen that, as regards body size, both are equally long, narrow, and high. On the other hand the calcaneus of M. gigantea is short, and at the bottom in its front half, not narrow and angular, but broad and flatter. The processus (in man "spina") peronealis is relatively smaller than in M. javanica.

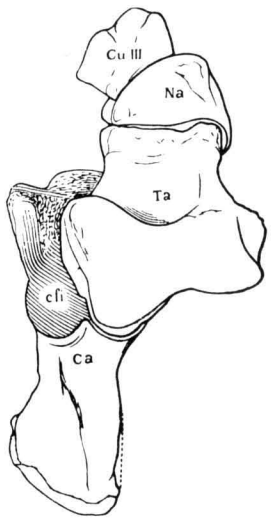

Fig. 1.
2/3 nat. size.

A very important difference between M. palaejavanica and M. javanica on one side, and M. gigantea on the other side, consists in this that the calcaneus of the two first-mentioned species does not articulate only with the astragalus but in a surface forming a lateral continuation of the articulating surface for the astragalus, the

width of which is $^2/_3$ of that of the last-mentioned (fig. 1, the hatched part *c f i*), also with the lower border of the maleolus of the fibula, and chiefly with the back part of that lower border. This articular surface slopes down to the outside, that for the astragalus, with which it, however, forms a whole, to the inside. It is absent in the African species M. gigantea and M. temmincki Smuts, and also in the Asiatic M. pentadactyla L. en M. aurita Hodgs, but it *is* found in the African species M. tetradactyla L. and M. tricuspis Rafin. Through this particular articulation with the fibula the foot obtains the guidance and the firm support which it requires in its outwardly-turned (somewhat supine) position, especially when its claws, which in these particular species are distinguished by their large size, are active. All this — it also appears from other parts of the skeleton of the foot — applied undoubtedly also to the M. palaejavanica.

24. The left *talus* or astragalus (Pl., middle row, fourth figure and Fig. 1 *Ta*). The length measured normal to the tangent on the backside of the trochlea, is 44 mm, the greatest breadth is 42 mm. In a middle-sized M. javanica the length, measured in the same way, is 14.5 mm, in the M. gigantea 26 mm. The collum is relatively much narrower than in M. javanica, and does not point so obliquely inward. As in all Manidae, the caput is for the greater part concave, only near the inner edge convex to about the middle.

25. The left *navicular bone* (Pl., middle row, second figure. With the dislocated ectocuneiform bone, and Fig. 1, *Na*). Breadth, total 30 mm; in a middle-sized M. javanica 11 mm, and in the M. gigantea 19 mm. Length of the free dorsal surface 13 mm; in M. javanica 4,5 mm, in M. gigantea 8 mm.

26. The left *ectocuneiform bone* (Pl., middle row, second figure, and Fig. 1, *Cu III*). Breadth 22 mm. Length of the free dorsal surface 11 mm; in M. javanica 4.5 mm, in M. gigantea 6.5 mm. The anterior articular surface is, as in M. javanica, somewhat saddle-shaped, but on account of the strong outward turned, position of the articulating-surface with the navicular bone, turned also much more outward. The metatarsal of the middle toe and the toe itself was, however, not pointing much more outwards, as its base must have been very oblique to the axis of the bone, for the extant fourth metatarsal possesses such a very oblique basal plane.

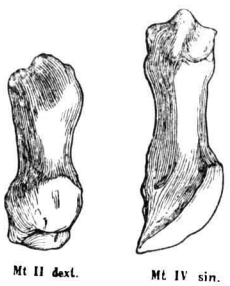

Fig. 2.
$^2/_3$ nat. size.

27. The *metatarsal* of the right *second toe* (Fig. 2, *Mt II dext.* The outlines of these figures, too, are accurate photographic ones). Though this bone is slightly weathered at the surface, yet it is to be recognized with certainty as such, inter alia by the characteristic excavation of the base at the outside. The length measured in the direction of the axis,

dorsally to the large plantar process of the base, is 38 mm, (the total length, with that plantar process, is 40.5 mm), the breadth of the diaphysis at its narrowest is 10.5 mm. In a middle-sized M. javanica the length is 16 mm and the breadth 3.2 mm.

28. The *metatarsal bone* of the left *fourth toe* (Pl. above the end of the top row, and Fig. 2, *Mt IV sin.*) The length, measured dorsally to the large plantar process of the base (here at the same time the greatest length), is 49 mm, the breadth of the diaphysis at its narrowest 10 mm; in a middle-sized M. javanica the length is 20,7 mm and the breadth 3,2 mm. The slightly convex basal articular surface is much *more obliquely turned outward* than in M. javanica, through which the base possesses a very sharp edge as outer rim, and the dorsal free surface presents a much acuter angle than ever occurs in M. javanica.

The *much more considerable length of the fourth* than of the second metatarsal bone the extinct giant pangolin of Java has in common only with M. javanica among all the existing Manis species. Except the existing Javanese pangolin all the recent species have these two metatarsalia of about the same length. This similarity in structure of the foot of the pliocene and of the living Manis of Java renders it already probable that also the pliocene Manis had large claws on its hind-feet as well as on its fore-feet, which implies similarity in the function of scratching open termite-hills or ant-dwellings. The outer border of the foot is turned somewhat downward, so that the animal throws the unearthed termites and ants under it, and not behind it. This resemblance in construction and function of the foot is corroborated by a peculiarity in the construction of the foot, which *distinguishes* M. palaejavanica from M. javanica. In the extinct giant pangolin the metatarsal of the fourth toe and also the metatarsal of the middle toe and the navicular bone were evidently at the same time particularly adapted to offer resistance to strong pressures exerted by the anterior part of the outer border of the foot — it is to be seen in the articular surfaces — in contrast with the homonymous bones of M. javanica. It may be inferred from this that by turning both the hind claws and the fore-claws under its feet, M. palaejavanica walked permanently on the outside also of its hind-feet, not only "sometimes", as is stated of M. javanica[1]). But this permanent mode of walking is, at the same time, a sure indication of the possession of large claws also on the hind-feet.

It may, therefore, be assumed that in both species the two pairs of extremities were less specialized than in the other Manidae; moreover the recent species of Java lives chiefly on the ground, but it does also climb. For climbing the extinct giant pangolin will undoubtedly have been too heavy, certainly even more so than the existing African M. gigantea.

[1]) By W. T. BLANFORD, according to Tickell, in "The Fauna of British India. Mammalia", p. 600. London 1891.

Although constituting a true (natural) genus, the existing Manidae are devided into two tribes, further they are differently specialized.

Of the four existing African species, which as appears from the common possession of certain distinguishing characters (as the form of the xiphisternum and the arrangement of the scales on the tail) certainly belong to one tribe, whereas the three Asiatic species classified according to these peculiarities, form another tribe, two species are adapted exclusively to a life on the ground, through specialisation of their fore- and hind limbs. They find their food on the ground: termites and ants, chiefly termites, and the hills of these latter mostly reaching considerable heights in Africa, the closely allied M. temmincki Smuts and Manis gigantea Ill. have assumed to a certain extent bipede locomotion. The first-mentioned species, which inhabits the steppes and savannas of South Africa, north of the Vaal-river, and East-Africa to 17° N.L., even walks almost exclusively on its hind-legs, the heavy, broad tail being used not as a support, but to keep its balance. As in the plantigrade mammals their hind feet are provided with toes and claws differing comparatively little in size inter se, whereas on the fore-feet the three middle ones, especially the middle toe and claw, have grown to gigantic dimensions. Standing on their hind feet more or less erect, they use there fore-fect like pickaxes to scratch, or rather hew, open very hard termite-hills, often some meters high. Also M. temmincki is of considerable size, and can therefore reach high with its fore-claws.

The two other African species: M. tricuspis Rafin. and M. tetradactyla L. (M. longicaudata Briss), which, with M. gigantea, inhabit West Africa between the Gambia and the Kunene, are small, possess a long prehensile tail, which in its functions exceeds the tail of M. javanica no less than the admirably perfect prehensile tail of Ateles that of Mycetes, and live chiefly in the trees, where they, being excellent climbers, seek termites (which build there round nests, the size of a mans head, on the branches out of their own excrements) and ants. They have long middle toes, both on the hind- and on the fore-feet, but since they do not, or only rarely, use their hind feet to scratch open termite- or antnests on the ground, their fourth metatarsal is not longer, or longer only in an insignificant degree than the second. Their calcaneus, however, does resemble that of M. javanica somewhat.

Of the three existing Asiatic species, M. javanica, which inhabits besides the Great Sunda Islands, also the continental area east from the Bay of Bengal and south from the habitat of M. aurita, has not to do with very high termite hills; those in Java, at least, are hardly higher than a meter. This species chiefly lives on the ground, and does not climb very nimbly. The fore-feet and the hind-feet, both provided with large claws, are used for scratching open the low termite-hills and ant-dwellings, which moreover are not so very hard. M. pentadactyla L. of India and Ceylon, and M. aurita Hodgs of Nepal, Assam and South China, Hainan and

Formosa, have, on the other hand, again to deal with high termite hills; as far as I have been able to ascertain they climb seldomer than M. javanica, live more exclusively on the ground. The three middle claws of their hind feet have scarcely half the length of those of the fore-feet [1]). It is known at least of M. pentadactyla that it habitually stands on its hind-feet. They have their extremities already more specialized than M. javanica and M. palaejavanica. Accordingly these two species are really to be considered as the least specialized of all the Manidae known. This finds a striking confirmation in the fact that the cephalisation of M. javanica is only as high (the volume of the brain calculated for the same body weight, half as great) as that of M. gigantea and M. tetradactyla. Wanting data on the body weight, I had no opportunity to examine the cephalisation of M. temmincki and M. tricuspis properly, nor of M. pentadactyla and M. aurita; apparently the two first-mentioned may be considered equal to the two other African species of which I was able to calculate the cephalisation of specimens in the Rijks-Museum van Natuurlijke Historie at Leyden. Among the Asiatic species, M. pentadactyla and M. aurita on the other hand, do not rise above M. javanica, judging from the few available data.

The species arose by adaptation to the different particular conditions of life, imposed on the animal by the world in which it had to live, especially with regard to the regional character of the termite nests, which contain their principal food, and the circumstances of life in the original home of the Asiatic tribe of the genus must actually have differed little from those which exist to-day in the habitat of M. javanica.

Probably these were more favourable to that tribe in the Pliocene time than they are at present, and this time coincides with its flourishing period in that region, as may be deduced from the occurrence of the giant form. As all the Manis species live in open and comparatively dry regions, it may be assured, that the then climate of what is now Java, was still somewhat drier. This corroborates what was already to be inferred from the continental character of the Kendeng-fauna as a whole, viz. that Java at the time of its existence constituted a part of the Asiatic continent, and formed, with the other Great Sunda Islands an appendage to the present continental area east from the Bay of Bengal, of which geographical condition a climate less humid than at present was a necessary consequence.

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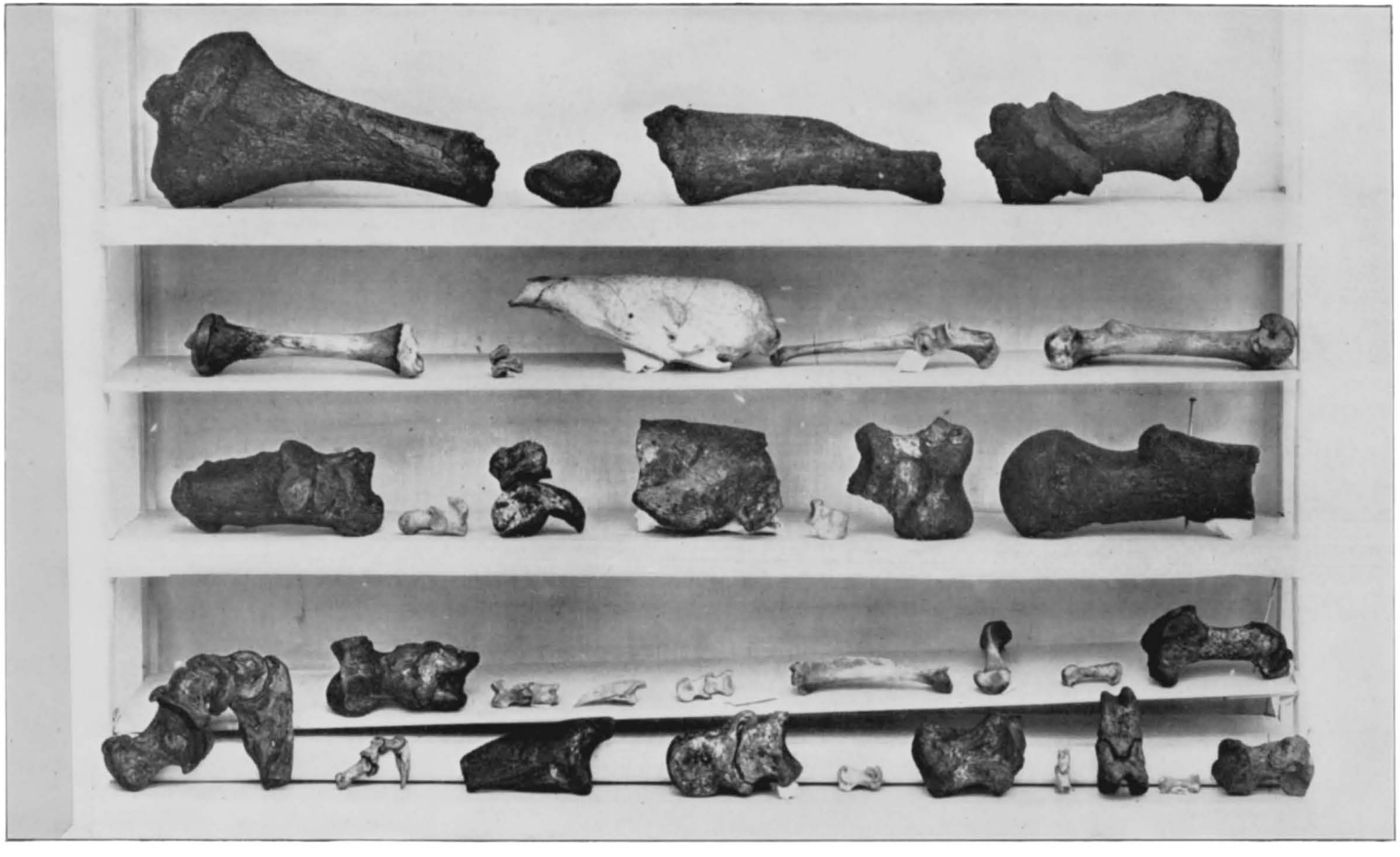
[1]) The significance of the relative length of the fore- and hind claws for the systematization of the Manidae had already been realized by F. A. JENTINK („Revision of the Manidae in the Leyden Museum". Notes from the Leyden Museum. Vol. IV, p. 193—209. 1882) and P. MATSCHIE („Die natürliche Verwandtschaft und die Verbreitung der Manis-Arten". Sitzungs-Berichte der Gesellschaft naturforschender Freunde zu Berlin, Jahrgang 1894, p. 1—11).



Manis palaejavanica Dubois and *Manis javanica* Desm. (Somewhat more than $^2/_5$ nat. size).

EXPLANATION OF THE PLATE.

Photographic figures of 24 (of the 28 collected) bones of *Manis palaejavanica* and the homonymous bones of *Manis javanica*, mostly near each other; the radii of the former species, however, lie in the upper row, of the latter in the lower row. Partly the bones were found connected in their natural mutual position, some slightly, the ectocuneiform bone considerably, dislocated. The corresponding bones of *Manis javanica* are connected with each other in the same way as in the fossil bones found.