MINISTERIE VAN ONDERWIJS, KUNSTEN EN WETENSCHAPPEN

ZOOLOGISCHE MEDEDELINGEN

UITGEGEVEN DOOR HET

RIJKSMUSEUM VAN NATUURLIJKE HISTORIE TE LEIDEN

DEEL XXX, No. 14 6 APRIL 1949

PLEISTOCENE VERTEBRATES FROM CELEBES. IV. ARCHIDISKODON CELEBENSIS NOV. SPEC.

by

Dr. D. A. HOOIJER

(Rijksmuseum van Natuurlijke Historie, Leiden)

(with Plates VIII-IX)

The fossil elephant remains recently discovered in S. Celebes by Mr. H. R. van Heekeren, and entrusted to me by Prof. Dr. A. J. Bernet Kempers, Head of the Archaeological Survey of the Dutch East Indies, belong to a small form of the genus *Archidiskodon*. These specimens, described and figured in the present paper, give the first evidence of the existence of Proboscidea in the island of Celebes. As stated already in earlier notes on the fossils in Mr. Van Heekeren's collection (Hooijer, 1948a, 1948b, 1948c) this elephant is associated with a fauna containing a peculiar suid (*Celebochoerus heekereni* Hooijer), a babirusa (*Babyrousa babyrussa beruensis* Hooijer), an anoa (*Anoa depressicornis* (Smith) subsp.), and a gigantic land-tortoise (*Testudo margae* Hooijer). None of the fossils has been found in situ, but one of the elephant molars was still embedded in the matrix, a note on which is given below because it may help to determine the exact stratigraphical position of the specimen when the geology of the site will have been studied.

The matrix of the unworn right M^2 or M^3 from Sompoh near Tjabengè (Sopeng district), about 100 km N.E. of Macassar was kindly studied by Mr. L. J. Fick and is a river-laid sediment with volcanic material. The rock consists of detrital grains of lateritic sandstone, the interstices partly filled with amorphous limonitic silica and opaque components. There are some pieces of quartz and veins of rhombohedral calcite. The volcanic components consist for the greater part of diopside and a few crystals of alkaline felspar.

Archidiskodon celebensis nov. spec.

Diagnosis: Size small; about one-half as large as *Archidiskodon planifrons* (Falconer et Cautley) and *A. meridionalis* (Nesti) and most closely related to the former species. Upper molars relatively broad and low with well-separated plates tapering to their summits, V-shaped valleys, relatively low ridge-plate formula, thick and superficially plicated enamel, and plentiful cement also on outer sides of plates. Plates sometimes expanded in the median line at the base, giving an imperfectly loxodont sinus when worn.

Holotype: The unworn M^2 or M^3 dext. described and figured in the present paper (specimen A, pl. VIII figs. 1-2).

Paratypes: A worn M^2 or M^3 dext. (specimen B), 2½ plates of left upper M (specimen C), and two isolated plates (D and E). Parts of a right ulna and of a left tibia are also referred to the present species.

Locality: Holotype and molar B, as well as tibia: Sompoh; specimens C-E and ulna: Desa Beru, 12 km S. of Sompoh near Tjabengè (Sopeng district), about 100 km N.E. of Macassar, S. Celebes.

Age: Pleistocene.

The holotype (pl. VIII figs. 1-2) is unworn but incomplete; the roots are entirely missing. It carries a small posterior talon and six ridge-plates or plates; the front end of the specimen has broken off transversely through the summit of the seventh plate from behind. In lateral view the plates are seen to diverge from the root to the crown, indicating that the tooth is of the upper jaw. In crown view the molar shows a definite horizontal curvature of the longitudinal axis; the convex border is the labial one and our specimen proves to be of the right side. The valleys are V-shaped and are for the greater part filled with cement, leaving only a few mm of the crown edges of the plates uncovered. On the labial (convex) side of the molar the cement between the plates does not fill the valleys completely and the labial surface thus presents a wavy outline when seen in crown view. The enamel, wherever exposed, shows a peculiar crimping, a fine and horizontal plication, and the plates taper toward their summits. On the lingual side the cement filling the valleys is on a level with the plates (except between plates I, II, and III from behind) so that the plates do not protrude and the lingual surface is flattened. The basal surface was the only surface of the tooth exposed when I received the specimen, the whole crown being embedded in the matrix. The less resistant dentine is much more weather-worn than the enamel. In the middle portion of the tooth the transverse enamel ridges on the basal surface that represent the bottoms of the valleys are mostly broken, but on either side some of them are still complete.

In the following description of the specimen, designated below as molar A, I pass from the posterior talon on forward along the tooth; the plates are numbered with Roman figures from back to front.

The postero-lingual edge of molar A is missing; of the lingual conelet of plate I only the summit is preserved but its posterior surface, to which doubtless a part of the talon was attached, has broken off. What is left of the talon consists of two median low cusps (up to half of the height of the crown) of which the lingual is the higher. They are flanked at the labial side by a still lower cusp (lingually of the median pair the talon has broken off) and are surmounted by two cusps, one midway above the labial cusp and the median pair, and the other on a slightly higher level just lingually of the median pair and represented only by its tip, the main body being lost. In this small talon we observe the same plan of structure as that in the true plates, and it seems evident that the median pair of lower cusps was flanked on the lingual side by a cusp as well as on the labial; this cusp would have supported the lingual of the two higher talon cusps.

There is but little cement on the talon: we find it only between the upper pair of cusps. The enamel, shown in the broken surface of the lingual conelet of plate I is very thick, 2.5 to 3 mm.

Plate I, apart from the defective state of its lingual conelet, is well preserved, and, which is especially fortunate, the base of the valley separating it from plate II is preserved on either side. The valley is deeper on the labial side than on the lingual as shown by the undamaged enamel protuberances on the basal surface. There is a distinct median swelling at the base of plate I that must have resulted in a lozenge-shaped enamel figure upon wear. The internal or lingual side of the plate is more steep than the labial side and both sides converge toward the summit that bears four conelets and that is only about one-half as wide as the base of the plate. The maximum height of enamel of plate I is 35 mm, and the basal width may have been 40 mm. Of the four conelets making up the summit of plate I the second from the lingual side is the biggest and highest. The lingual conelet is as large as that on the labial side of the main conelet and equally high, while the extreme labial conelet is the smallest. The cement in the valley separating plate I from plate II extends crownward up to the conelets.

At the labial side the plate descends less steeply than at the lingual side; this holds for all of the plates constituting the tooth.

Plate II is higher than plate I (height of enamel 39 mm measured from the base of the valley between plates I and II) and its basal width is 42 mm. The anterior surface is expanded in the middle at the base, giving a loxodont appearance. Instead of four conelets we count five of them; the second conelet from the lingual side is duplicated. The other conelets being equal in size to their homologues in plate I, the width of the crown edge of plate II is somewhat greater than that in plate I, viz., 22 mm against 20 mm. The cement in the valley behind plate II reaches upward to 3 mm below the occlusal surface, while the conelets are completely covered with cement in front.

Plate III is higher than plate II but its exact height cannot be determined; measured from the broken lower borders of the valleys on either side the height is 43 mm. The actual height may have been 45 mm, at any rate greater than the basal width which is 42 mm. The base of this plate, again, is expanded in the middle anteriorly. In plate III the second conelet from the lingual side is again undivided as it is in plate I, but its labial neighbour has grown bigger and is almost as high as the former. The lingual conelet is on a slightly lower level and smaller than that in plate II, while the extreme labial conelet is higher and more distinctly marked off when compared to its homologue in plate II. The cement in the valleys behind and in front of plate III leaves only 3-4 mm of the crown edge of the plate uncovered.

In plate IV, which must have been a little, if any, higher than plate III but which is certainly narrower (width at base 40 mm) the two median conelets are of equal height, but the lingual of these two, though smaller than that in plate III, is still the larger. The extreme lingual conelet is a little smaller, and the extreme labial a little larger than its homologue in plate III. The width of the four conelets is the same as that in plate III, viz., 22 mm. The cement covers plate IV up to 5 mm below its summit.

When passing from plate II forward to plate IV we thus noticed the gradual decrease in size of the two lingual conelets and the increase in size of the two labial cusps. In the more anterior plates this gradation is continued, and the four conelets remain of the same width, 22 mm, irrespective of the anterior tapering of the crown.

In plate V, which is lower (height of enamel slightly over 43 mm) than plates IV and III but also narrower (39 mm at the base) the third instead of the second conelet from the lingual side is the biggest, and subdivided into a small labial and a larger lingual portion. It is higher, too, than its lingual neighbour. The extreme lingual conelet is smaller and set on a lower level than that in plate IV, while the extreme labial conelet has increased, and now exceeds the extreme lingual in size. The cement in front of plate V is higher (3-4 mm from the summit) than that behind (5 mm of the edge exposed).

Plates II-IV, when seen in labial view, diverge but slightly toward the crown and are but little concave anteriorly. The crown third of plate V, however, is decidedly bent forward. Plate VI is more obliquely set and diverges crownward at an angle of about 8° from plate IV. Its enamel height is exactly 42 mm; the basal width is 39 mm. The third conelet from the lingual side of plate VI is already twice as large as as the second from the lingual side and consists of two cusps. The extreme labial conelet also is much bigger and higher than the extreme lingual. The summit of plate VI is as well exposed as that of plate V.

Plate VII has broken off transversely through its summit, and thus shows the enamel layer in cross section, which has a thickness of 2.5-3 mm. This plate is again lower (41 mm) and narrower (38 mm) than its neighbour. The configuration of the conelets, which are partly exposed on the broken surface, seems to be essentially the same as that in plate VI, the duplicated third conelet from the lingual side as well as the first and second from the lingual side are observable. Plate VII is again more oblique than plate VI; the angle of divergence between plates VII and VI is about 17°, thus about 9° greater than the angle between plate VI and plate IV.

The distance from the middle of plate II to the middle of plate VI is 57 mm at the occlusal surface, 53 mm at the base of the labial surface, and 48 mm at the base of the lingual surface due to the curvature of the molar both in the vertical and in the horizontal plane. The laminar frequency, that is the number of plates occurring within a space of 100 mm, thus is 7 at the occlusal surface and we may put 8 as the average figure for the laminar frequency at the base of the crown.

Of course the total number of plates is difficult to ascertain, but from the relative size and the obliqueness of the broken anterior plate of the present molar A it would seem improbable that more than one or two plates are missing, making a total of 8-9 plates. The length of the complete molar may be estimated as about 120 mm; the width-length index consequently is approximately 35.

The second specimen (B), originating from the same locality as the holotype described above, viz., Sompoh, consists of a worn right upper molar with six plates completely preserved (pl. VIII fig. 3). The occlusal surface is slightly convex longitudinally as well as transversely and falls off toward the lingual side that is concave in contradistinction to the labial surface which is convex. Cement is again plentiful and conceals the inner and outer edges of the plates with the exception of the posterior, but from cement remnants it is evident that the posterior plates too were covered with cement on the sides. The roots have broken off.

The posterior talon consists of one cusp, which is to the lingual side of the longitudinal axis of the crown. There has been a labial cusp to the talon too, but this one has broken off. The preserved lingual cusp is only about one-half as high as plate I which has just been touched by wear.

Plate I is high (at least 36 mm) and narrow (basal width 31 mm) and has three conelets, the lingual being on a distinctly lower level than the others. The median conelet is produced transversely and is decidedly laid forward, the labial conelet is the smallest and separated from the main conelet by a shallow fissure only. The plate seems to have been covered completely with cement, a few patches of which are preserved on its posterior surface but which still fills the valley separating it from plate II. The enamel surface is finely plicated.

In plate II the three conelets are slightly worn. The enamel figures of the labial and the central conelets are confluent, and present already a narrow transverse strip of dentine. In the lingual conelet the dentine is not yet exposed. The basal width of plate II is 40 mm. The cement in the valley between plates II and III conceals the surface of the plates up to barely 2 mm from the worn edges.

Plate III presents a complete enamel figure. Whereas the posterior border of this enamel figure, apart from a tendency to form wrinkles, is almost straight, the anterior border is produced forward just to the labial side of the median longitudinal axis of the crown, giving an imperfect loxodont appearance to the plate in crown view. The enamel has a thickness of 3 mm. The cement filling the valley between plate III and plate IV is very unequal on both sides. While the labial half of the valley is at the most 4 mm deep due to the presence of a great amount of cement that is polished by friction. lingually of the anterior protuberance of plate III the valley becomes much deeper, up to 7 or 8 mm at the lingual surface. The valley is decidedly narrower antero-posteriorly lingually than at the labial side due to the horizontal curvature of the longitudinal axis of the crown with the concavity toward the lingual side; its antero-posterior width of 5 mm is less than that of any of the worn plates. The presence of but little enamel in this narrow lingual portion of the valley cannot be explained by wear and must be due to some abnormality. The lingual as well as the labial surfaces are coated with cement, as mentioned already above. The cement coating on the labial and lingual sides of plate III is accidentally partly chipped off along a fractural plane that crosses the plate; labially the cement is 1 mm thick, but lingually about 2 mm. The actual width of plate III at the base is 43 mm.

Plate IV is again wider (48 mm, cement included) and more worn than plate III. The enamel is 3-3.5 mm thick. Not only anteriorly but also posteriorly there is a defined projection of the enamel border just to the labial side of the median longitudinal axis of the crown. This axis is marked by sharp grooves in the enamel both at the anterior and at the posterior side of the plate. The posterior projection of the enamel is marked off labially by a groove too and is flanked lingually by a similar but smaller projection. Apart from these projections, however, the posterior border is straight. It is only due to the median expansion of the anterior surface that the imperfect lozenge-shape of the plate is formed. Labially of the median projection the anterior border gradually slopes backward to the labial edge, while lingually, as said above, the projection is marked off by a groove, but to the inner side of this groove the anterior surface slopes gradually backward as well.

The valley in front of plate IV, which is obstructed in the middle by the contact of the median projections of plates IV and V, is as irregularly filled with cement as that between plates IV and III. The labial portion is only 4 mm deep; the lingual rapidly deepens as it passes inward, down to 11 mm below the worn surface between the lingual edges of the plates.

Plate V measures 49 mm transversely at the base, inclusive of cement. As the cement coating is at least 2 mm thick, the actual enamel width may have been 47 mm. Its enamel figure is only larger than that of the foregoing plate, and undoubtedly due to the more advanced stage of wear, its anterior enamel protuberance is more blunted and that on the posterior side a little broader than those in plate IV. Both make a contact with the projections on the opposite side of their valleys. The configuration of the valley between plates V and VI is the same as that between plates IV and V, the lingual opening is only slightly less deep: 9 mm below the worn edges.

Plate VI is complete too; the basal width is again 49 mm inclusive of cement. Upon removal of the cement the actual width proved to be only 47 mm at the base. The enamel figure has essentially the same shape as those of plates IV and V and the thickness of the enamel is 3-3.5 mm. The anterior and posterior enamel protuberances have less distinctly developed and the lingual edge is blunted as a result of this plate being more worn down than the preceding. The valley in front of plate VI is again deeper lingually (7 mm at the inner surface) than at the labial side.

Of plate VII only the lingual two-thirds of the posterior border is preserved which is almost straight, the posterior enamel projection having hardly developed.

The present molar B displays a slightly lower laminar frequency at the base than molar A; it contains four plates in 60 mm at the labial side and in 49 mm at the lingual side. The average laminar frequency at the base thus is 7½.

The total number of plates is still more difficult to estimate than in the case of molar A, but I think that we may safely add at least three full-sized plates at the anterior side, which makes up a total number of at least 10 plates, which most probably is even too low a figure. The complete molar thus may have had a length of at least 145 mm, which would give a width-length index of about 32.

Our third specimen (C) is from Beru, and is much less complete than the two Sompoh molars described above. It consists of two plates and a half, the anterior of which is slightly worn, while the posterior has broken off transversely through the summit. Nothing of the roots is preserved (pl. IX fig. 1). That this fragment belongs to an upper molar too is evident from the slightly convex wearing surface of the anterior plate in transverse direction as well as from the fact that the three plates, in side view, are seen to diverge toward the crown. The plates diverge as well in the horizontal plane, and the side on which the edges are most closely approximated must be the lingual side. The wearing surface falls off towards this side, and our specimen must be a left molar.

There is a great amount of cement which fills the valleys completely and which must have concealed the sides of the plates too, where it now has weathered off. The plication of the enamel surface is somewhat more coarse than that in the Sompoh specimens. The plates taper as well antero-posteriorly toward their summits as in molar A.

The configuration of the conelets of the broken posterior plate is perfectly shown on the broken surface. There are five conelets, the lingual of which is the largest and separated from the others by a deep cleft. The three central conelets are equal in size, while the extreme labial is again sharply marked off and is set on a slightly lower level than the extreme lingual. The lingual edge of the plate is straight from above downward and is steeper than the labial edge which is convex. The enamel is not less than 3.5 mm in thickness. The height of the posterior plate, measured from the exposed bottom of the valley in front of it to the unworn summit is 32 mm; the basal width cannot be given exactly because the inferior angles are incomplete. The width taken over the five conelets is 27 mm, a figure that holds for the two plates in front too.

The valley between the posterior and the middle plate is deeper labially than lingually and is completely filled with cement.

The middle of the three plates is unworn, and presents four central conelets instead of three as shown in the posterior plate, the additional conelet being formed by the subdivision of the lingual of the central conelets. The extreme lingual conelet is of the same size as that in the posterior plate, but the extreme labial conelet is bigger and about as high as the central conelets. The basal enamel width of this plate is 42 mm, the height cannot be determined exactly. The inner edge of the plate is straight, the outer convex. The thickness of the enamel, shown in cross section at the base, is 3.5 mm. The bottom of the valley separating it from the anterior plate is incomplete, it is full of partly weathered cement.

In the anterior plate the four central conelets are worn and separated only by fine lines. The two on either side of the median line are the smallest. The extreme labial conelet is again bigger than that in the middle plate and is equal in size to the extreme lingual. The enamel coating of the lower portion of the lingual edge of the anterior plate is missing. The enamel thickness is again 3.5 mm and the basal width must have been about 41 mm. In front of the anterior plate only cement is preserved; the tooth has broken off along the bottom of the valley.

In the present molar fragment C we thus observe a similar increase in size of the labial conelets when passing forward along the plates as that found in molar A. From the fact that the conelet width is greater in specimen C (27 mm) than that in specimen A (22 mm) by the same basal width (42 mm) as well as from the lesser height of specimen C (32 against 45 m) it is evident that molar C is decidedly lower-crowned than specimen A.

The basal antero-posterior diameter of the two complete plates of molar C can be measured and is 26 mm at the lingual side against 28 mm at the labial side. This gives an average figure for the laminar frequency of 7½, the same figure we found for our specimen B. The present Beru fragment is too incomplete to determine its ridge-plate formula with sufficient accuracy.

From Beru we have also two isolated unworn plates broken off at their bases, one evidently representing one of the small terminal plates and the other a full-sized plate. Cement has almost completely gone, and consequently the horizontal crimping or plication of the enamel surface is well shown, especially in the larger specimen D (pl. IX fig. 5) where it is very fine in the basal third especially toward the edges and becomes more coarse near the summit. The plates are as asymmetrically built as those of the molars described above, one of the lateral edges being straight and more steep than the other which is convex.

Specimen D shows seven conelets on the crown edge, which form a gradual curve and have a united width of 30 mm. The biggest conelets are the central and the two lateral, of which that above the straight edge is on a lower level than that above the convex edge. The apices of all conelets are slightly bent toward the straight-edged side of the plate. The enamel is at least 2 mm thick at the inferior edges. The anterior and the posterior surfaces of the plate are unequal, one being convex and the other concave transversely. The plate has a uniform antero-posterior diameter at the base of 13 mm; the basal width is 45 mm, the height 40 mm.

The small specimen E measures only 30 mm transversely and 25 mm vertically and carries two large and two small conelets, the latter being situated near the convex side of the lateral edges. The anterior and posterior surfaces are again unequal; the convex side is weather-worn in contradistinction to the flat side, the latter seems to have been covered by cement much longer than the former since the specimen was washed out of its deposit. The enamel thickness at the base of the convex surface is 2.5 to 3.5 mm, on the other side the specimen seems to have broken off along the base of the valley separating it from another plate. At the base of the big conelet the antero-posterior diameter is 12 mm, 13 mm below the small conelets and 14 mm in the median line due to a median expansion of the plate at the base which is also characteristic of some of the plates of specimen A.

The larger of the two unworn Beru specimens is intermediate in width between the largest plates of specimens A and B. In its antero-posterior diameter at the base, which is 13 mm and which would give a laminar frequency of 7½ it is equal to specimens B and C. The conelet width of plate D (30 mm) exceeds both that of specimen A (22 mm) and that of molar C (27 mm), but in the relation of the width and the height it is intermediate between molars A and C. I cannot decide whether specimens D and E belong to upper jaw or to lower jaw molars.

Our knowledge of the Pleistocene Celebes elephant does not rest upon these molar fragments alone. Mr. Van Heekeren collected also two portions of limb bones referable to the elephant, one in either of the two localities where the molars were found. Fortunately both belonged to adult individuals since the epiphyses are fused. One is the distal portion of a right ulna found at Beru, the other the proximal portion of a left tibia from Sompoh. They will be described below.

The preserved portion of the right ulna (pl. IX fig. 2) is 21 cm long. The shaft is four-sided and each of its surfaces increases in width distally except the anterior surface that remains of equal width down to the epiphysis and which is slightly concave transversely. The lateral surface stands at an angle of 90° to the anterior surface and is flat transversely. At the broken upper end of the bone it is narrower than the anterior surface, but at the lower border of the shaft it is wider. Like the anterior surface the lateral surface of the shaft is straight from above downward, and thus the antero-lateral edge of the shaft is perfectly straight.

The postero-lateral edge of the shaft is much more rounded off than the antero-lateral edge, and becomes more prominent as it passes downward. The posterior surface is the widest of the four surfaces and stands at an angle of 54° on the lateral surface above, which angle increases to 66° just above the epiphysis due to the posterior surface being very slightly spirally curved. The posterior surface is slightly convex transversely above but slightly concave below. The medial surface that has been in contact with the radius is rough and well marked off from the anterior and posterior surfaces. It increases most distinctly in transverse diameters distally but is the narrowest of the four surfaces.

The distal epiphysis of the ulna is damaged postero-medially and some parts of the articular facet for the cuneiform are missing too, but the borders of this facet are well shown. It is concave transversely behind and convex from before backward, but it flattens as it decreases in width in front. Its lateral portion forms a convexity; it is the most prominent part of the cuneiform facet and is situated just below and slightly behind the tuberosity for the lateral ligament of the carpal joint. The latter forms a huge vertically elongated prominence at the base of the postero-lateral edge of the shaft. The groove for the common extensor tendon in front of it has well developed too, and separates it from the broad anterior prominence which is highest laterally and flattens toward the radial surface. The latter presents a depression surmounted by a prominence. The measurements are given in table 1.

Four recent ulnae of *Elephas maximus* L. used for comparison vary considerably among themselves, partly due to male or female sex and partly individual, and the only constant differences from the Celebean ulna are:

1. Their decidedly larger size (see measurements).
2. The postero-lateral edge of the shaft is flattened instead of prominent above the lateral tuberosity but becomes more marked proximally than is the case in the Celebes ulna. The postero-lateral edge of the ulna passes upward into the olecranon, and this ridge is decidedly less marked in the fossil

ulna than on the corresponding levels in the recent. It would seem that we are justified to infer from this fact that the olecranon has less developed in the fossil ulna than in the recent.

3. The cuneiform facet, however variable in *E. maximus*, is less concave transversely behind than that in the fossil ulna from Celebes.

Of the portion of the left tibia (pl. IX figs. 3-4) the proximal extremity is complete except for the posterior border of its medial condyle, while the latero-posterior angle is injured. The medial condyle is the higher and presents a large rounded concavity but occupies slightly less than one-half of the width of the proximal surface. The lateral condyle is broader than the medial but much shorter antero-posteriorly. The intercondyloid eminence is formed anteriorly by the edge of the medial condyle and posteriorly by that of the lateral condyle; between them is a narrow antero-posterior fossa that widens behind. The surface in front of the condyle is a rough triangular prominence with a median depression for the patellar ligament. It is continued downward as a crest, the crista tibiae, which has broken off. The medial surface of the three-sided shaft is convex anteriorly and damaged above but presents a large vertically elongated muscular depression below the overhanging inner margin of the medial condyle. The lateral surface is concave and more smooth than the likewise concave posterior surface. The lateral and medial borders of the shaft have broken off a few cm below the proximal epiphysis. The measurements are given in table 1.

I have been unable to find structural differences between the fossil and the recent tibiae beyond the marked difference in size. In *E. maximus* the medial condyle is the wider instead of the lateral, but this does not seem to be a matter of great moment.

The distal end of the ulna and the proximal end of the tibia of recent *Loxodonta africana* (Blumenbach) present no tangible differences from those of *Elephas maximus* L. Adams (1877-81, p. 157) remarks that the distal articular surface of the ulna "varies so much in the convexity and configuration of the cuneiform aspect in the Mammoth and Asiatic [elephant] as to appear to me of little value as a means of diagnosis". Pohlig (1911, p. 211) states that of the proboscidean tibia especially the proximal condyles and eminences are very variable individually and their characters can hardly be used for specific or generic discrimination.

The Celebes bones, upon comparison with the corresponding bones of two male and two female skeletons of recent *Elephas maximus* L. in the Leiden Museum, prove to be 30 % smaller than the male, and 17 % smaller

TABLE I

Measurements of ulna and tibia of *Archidiskodon celebensis* nov. spec. and of *Elephas maximus* L.

	A. celebensis nov. spec.	*Elephas maximus* L. males		females	
ULNA					
Distal width of anterior surface of shaft	50	80	70	65	60
Id. of lateral surface	77	132	114	105	100
Id. of posterior surface	90	125	135	99	109
Distal antero-posterior diameter over anterior tuberosity and cuneiform facet	120	218	170	164	160
Greater diameter of cuneiform facet	79	107	101	87	92
Smaller diameter of id.	51	84	83	72	66
Cuneiform facet index	76	79	83	83	72
TIBIA					
Transverse diameter of proximal extremity	124	195	194	159	166
Id. of medial condyle	58	94	96	81	78
Id. of lateral condyle	68	90	95	79	76
Antero-posterior diameter of id.	60	84	82	69	67

than the female. The average figures for the ulna are 31 % and 19 % respectively, and those of the tibia 29 % and 15 %, the two bones thus are very nearly of the same relative size as compared to *E. maximus.*

Though the present bone fragments are not of value for the identification of the genus to which they belong, they are highly important for the establishment of the actual size of the species. The head of the Sompoh tibia measures 124 mm transversely, which is intermediate between that of the tibia of *Elephas melitensis* Falconer (110 mm) and that of *Elephas mnaidriensis* Adams (143-145 mm), two of the well-known Pleistocene dwarfed elephants of the Mediterranean islands (Vaufrey, 1929, pp. 83 and 138).

The characters of the molars from Beru and Sompoh point to their belonging to the genus *Archidiskodon.* The two best known species of *Archidiskodon,* viz., *A. meridionalis* (Nesti) and *A. planifrons* (Falconer et Cautley) agree with that of the small Celebes remains in the molars having well-separated plates tapering to the summit, V-shaped valleys, thick and superficially plicated enamel, plentiful cement that extends beyond the outer borders of the plates, and sometimes imperfectly lozenge-shaped enamel figures. In the sum of its characters the Celebes form is closer to *A. planifrons* than to *A. meridionalis,* as will be noted below.

A. planifrons from the Upper Siwaliks of India and the Lower Villafranchian of Europe is connected by a series of ascending mutations with

A. meridionalis from the Upper Villafranchian and Saint Prestian of Europe. The ridge-plate formula of *A. planifrons* (Lydekker, 1880, p. 277) is:

$$\text{pd2}\ \frac{3}{3}\ \text{pd3}\ \frac{5\text{—}6}{6}\ \text{pd4}\ \frac{6\text{—}7}{7\text{—}9}\ \text{M1}\ \frac{7}{7}\ \text{M2}\ \frac{8\text{—}9}{8\text{—}11}\ \text{M3}\ \frac{10\text{—}11}{10\text{—}13}$$

while the typical formula of *A. meridionalis* is:

$$\text{pd2}\ \frac{3}{3}\ \text{pd3}\ \frac{6}{6}\ \text{pd4}\ \frac{7}{7\text{—}8}\ \text{M1}\ \frac{9}{8\text{—}10}\ \text{M2}\ \frac{9\text{—}10}{9\text{—}11}\ \text{M3}\ \frac{11\text{—}13}{11\text{—}14}.$$

The Saint Prestian form of *A. meridionalis* has often 1-2 additional plates on M1, M2 and especially on M3 which attains the formula $\frac{12\text{–}15}{12\text{–}16}$ besides the talons (Mayet and Roman, 1923, p. 12).

It will be seen that the difference in total number of plates in pd3-M2 is very small, and isolated specimens must be difficult to classify unless there are other characters by which it is possible to separate them. There are not many distinguishing characters, however; the width, besides the observed or estimated ridge-plate formula is the character most relied upon by the authors in determining the serial position of a given specimen. In some cases even the distinction between undamaged specimens of M2 and M3 remains doubtful, namely when the molar has lost too many plates by wear in front so that the actual number of plates is uncertain. The absence of a posterior pressure-scar characterizes the hindmost molar, but this character is somewhat difficult to handle since it appears only upon a certain stage of wear.

In keeping with the increasing number of plates when passing along the series from before backward the molars become longer, but also broader and higher. The width-length index of the molar, however, tends to decrease in the posterior molars, as is evident from tables 2 and 3. In table 2 I give the data of the upper jaw specimens of *A. planifrons* from the Upper Siwaliks described by Falconer (1868) and those of the Barnum Brown collection (Osborn, 1942, pp. 949 and 954). The same data for *A. meridionalis* from the Upper Villafranchian and Saint Prestian of Europe, derived from the works of Falconer (1868), Adams (1877-81), Pohlig (1888-91), Weithofer (1890) and Depéret and Mayet (1923) are given in table 3.

These tables show astonishingly wide variation ranges of the various

TABLE 2

Archidiskodon planifrons (Falconer et Cautley)

	greatest length	greatest width	width-length index	greatest height	height-width index
pd^4	102	61	60	—	—
M^1	132-172	71-90	44-58	65-107	74-134
M^2	191-221	77-94	37-43	ca. 66-ca. 71	ca. 70
M^3	201-279	63-123	34-47	63-123	71-115

TABLE 3

Archidiskodon meridionalis (Nesti)

	greatest length	greatest width	width-length index	greatest height	height-width index
pd^2	19-23	15-18	65-79	—	—
pd^3	60-67	38-41	57-66	35	88
pd^4	100-116	36-63	32-56	45-63	73-117
M^1	141-173	62-88	39-55	83-97	94-142
M^2	178-240	75-97	33-49	100-140	130-169
M^3	208-320	75-125	30-45	110-140	103-140

dimensions and indices, and now the difficult question as to the serial position of our fragmentary molars from Celebes comes in.

The essential data of our specimens are given in table 4. The two Sompoh molars (A and B in table 4) have a ridge-plate formula that classes them

TABLE 4

Archidiskodon celebensis nov. spec.

	ridge-plate formula	greatest length	greatest width	width-length index	greatest height	height-width index	laminar frequency
A	$\frac{\times\ 1-2}{\quad} 7\times$	? 120	42	? 35	45	107	8
B	$\frac{\times\ 3+}{\quad} 7\times$	? 145	47	? 32	—	—	7½
C	$\frac{?}{\quad} 3 \frac{?}{\quad}$	—	42	—	32	76	7½
D	—	—	45	—	40	89	7½

with the true molars M^1-M^3; of specimens C and D not enough is preserved to establish their actual numbers of plates with any degree of certainty.

The worn Sompoh molar (B) is broader than the unworn (A) and has apparently more plates, indicating that it may have occupied a more posterior position in the maxillary. The possibility is even not excluded that it represents the last upper molar, for there is no trace of a posterior pressure-scar. It has the posterior plate still entire, and the penultimate slightly worn. A right M^2 of *A. meridionalis* described by Adams (1877-81, p. 193) is in a less advanced stage of wear, the posterior two plates not yet being touched by wear, and has a well-marked pressure-scar on the heel. In another (Adams, l.c., p. 194) none of the conelets are worn out, and even this specimen presents a posterior pressure-scar. There remains some doubt, however, for I cannot see why Depéret and Mayet (1923, p. 150, pl. VIII fig. 4) are uncertain whether an upper molar with worn (but not yet confluent) conelets on the posterior two plates is M^2 or M^3 unless they consider its stage of wear not sufficiently advanced to show a posterior pressure-scar, if any. This molar indeed is not typically a last one, being neither especially broad (as is, e.g., that of Depéret and Mayet, 1923, p. 151, pl. VIII fig. 1) nor markedly tapering posteriorly (cf. l.c., p. 151, pl. VIII fig 6).

In size our molars A and B are nearest to the pd^4 and M^1 of *A. planifrons* and *A. meridionalis*, but it is improbable that they represent these elements for the following reasons:

1. It is a well-known fact that in contradistinction to the anterior molars and milk molars the M2 and M3 are most frequently met with in collections. These larger specimens have a far greater chance of being preserved also because of their belonging to the adult dentition, and added to that they are more easily found by the collectors. The specimens from S. Celebes have a greatest width of 42-47 mm, and it would seem very improbable that they represent only the narrowest molars of the species.

2. The bones found in association with the molars point definitely to animals of much smaller dimensions than *A. meridionalis* (and *A. planifrons* which is only slightly inferior in dimensions to the former). The cuneiform facet of an ulna of *A. meridionalis* measures 178 by 140 mm (Adams, 1877-81, p. 217) which is more than twice as large as that of our Beru ulna (79 by 51 mm). The transverse diameters of the proximal extremity of three tibiae of *A. meridionalis* vary from 203 to 305 mm (Adams, l.c., p. 225); that of the Sompoh tibia measures only 124 mm, which gives about the same mean estimate of the size ratio.

If our molars A and B represent M^2 or M^3, and the above mentioned facts seem to favour this view, they are about two-fifths to three-fifths less in width than the average widths of these molars in *A. meridionalis* (82 and 104 mm respectively). This is a difference in size of the same magnitude as that found for the bones.

The lengths of our molars A and B can only be estimated, and the width-length indices based on the actual greatest width and the estimated length of these specimens are to the lower side of the variation ranges in this respect in *A. planifrons* and *A. meridionalis,* which means that the molars of *A. celebensis* nov. spec. are apparently narrower-crowned than the averages of those of the former species. In either of the two species narrow-crowned and broad-crowned varieties have been distinguished. The narrow-crowned molars of *A. planifrons* have been referred to a new genus and species, "*Leith-Adamsia siwalikiensis*" Matsumoto (1927; types figured in Falconer and Cautley, 1845, pl. 11 fig. 4, 1846, pl. 14 fig. 8). Matsumoto considers them to represent probably a form that stands at the starting point of the entire phylum of the "loxodontine" elephants, an opinion not shared by Osborn (1942, p. 959). On the other hand Depéret and Mayet (1923. p. 157/58) have established a series of mutations from *A. planifrons* up to *A. meridionalis* in which the molars become progressively narrower and more hypsodont.

The greatest height of molar A exceeds its greatest width, and this in all probability is also true for molar B. Plate I of the latter molar only is almost unworn and presents a height-width index of $\frac{36+}{31} \times 100$ or 116+. Molar B seems to have been even more hypsodont than molar A in which plates I and II are still wider than high. Molar fragment C as well as plate D have much lower height-width indices (76 and 89 respectively), that fall outside the variation limits of the true molars of *A. meridionalis* but are well within those of *A. planifrons.* As no ridge-plate formulae of these specimens can be given, I prefer to leave their serial position provisionally undetermined.

Our Celebes molars agree very well in their laminar frequency, which is 7½ or 8. In the above mentioned series of ascending mutations from *A. planifrons* to *A. meridionalis* the laminar frequency increases from 3½ to 6 (Osborn, 1942, p. 954) and even reaches 6½ in *A. meridionalis cromerensis* Depéret et Mayet (1923, p. 152/53) from the Cromer Forest Bed. These figures for the laminar frequency are considered to be of great importance in determining the evolutionary stage of the forms (Depéret and Mayet, 1923, p. 157/58; Hopwood, 1935, p. 90; Osborn, 1942, p. 982). However, it must be kept in mind that the numbers of plates contained in 100 mm are comparable only when based on molars of individuals of approximately the same size. It is evident that a small form of elephant that has the same ridge-plate formula of its molars as a larger form must have a higher laminar frequency than the latter. There is a beautiful example already in the genus *Archidiskodon,* viz., the dwarfed insular form of *A. imperator*

(Leidy) from the Pleistocene Santa Rosa island, California, first described by Stock and Furlong (1928) as *Elephas exilis*. It is only about one-half as large as *A. imperator*. The upper and lower M3 figured by Osborn (1942, p. 1030) have a laminar frequency of 8½ and 7½ respectively (as measured from the figures) while the laminar frequency of *A. imperator* is only 3-5½ (Osborn, l.c., p. 1012/13).

The genus *Archidiskodon* ranges from the Middle(?) Pliocene to the Upper Pleistocene. According to Osborn (l.c., pp. 934, 946, 1581, pl. XXI) the most primitive species are *A. proplanifrons* Osborn and *A. subplanifrons* Osborn, both from South Africa and supposed to be Middle Pliocene in age. We find *A. planifrons* (Falconer et Cautley) both in the Lower Villafranchian of Europe (succeeded by *A. meridionalis* (Nesti) in the Upper Villafranchian and Saint Prestian) and N. Africa, and in the Upper Siwaliks of India. Thence the archidiskodonts migrated to North America where they attained gigantic dimensions (*A. imperator maibeni* (Barbour) of the Upper Pleistocene of Nebraska).

Hopwood (1935, p. 88, pl. VIII fig. 1) described an M^3 from the Lower Pleistocene of Shansi in N. China as *Archidiskodon* cf. *planifrons* (Falconer et Cautley). This find was the first to fill the gap in the known distribution of the genus between India and N. America. Previously Van der Maarel (1932, p. 173, pl. XVII figs. 1-2) had described an M^1 from the Upper Pliocene or Lower Pleistocene of Bumiaju in Java as *A. planifrons*, but according to Osborn and Dietrich the Javan form is related to *Palaeoloxodon namadicus* (Falconer et Cautley) (Ter Haar, 1935, p. 37/38). On the other hand, Osborn (1942, p. 892) regards the fragment of lower molar from the Pleistocene of Mindanao, Philippine Islands, described as *Stegodon mindanensis* Naumann as probably referable to *Archidiskodon*. In the opinion of the same author (Osborn, l.c., p. 903) it may possibly represent a progressive stegodon too. It is difficult to compare this form, based on an incomplete lower molar of uncertain serial position, with *A. celebensis* nov. spec. From the figures (Naumann, 1887, pl. I figs. 1-2) it would seem clear that the Mindanao form has more compressed, less tapering and more closely set plates which carry a greater number of conelets. It is Matsumoto (1924) again who created a new genus for the inclusion of this form: *Parastegodon*.

In my opinion there are several points of resemblance between *Archidiskodon celebensis* nov. spec. and *A. planifrons* rather than *A. meridionalis*, and I hold the view that our small Celebes *Archidiskodon* may very well constitute a dwarfed *A. planifrons.* The arguments are the following:

1. In *A. planifrons* the molars are typically lower-crowned than those of *A. meridionalis,* and the range of variation of the height-width index in *A. celebensis* nov. spec. (76-116+) is well in accord with that found in *A. planifrons* in contradistinction to that of *A. meridionalis* (tables 2 and 3).

2. The low ridge-plate formula of *A. celebensis* nov. spec. points to *A. planifrons* rather than to a more progressive species.

3. Taking into consideration that the Celebes molars are only about one-half as large as those of *A. planifrons* and *A. meridionalis,* they would correspond to an evolutionary stage in the *A. planifrons-A. meridionalis* line with a laminar frequency of 4, which is indeed the figure found for *A. planifrons* in the Lower Villafranchian of Europe (3½-4) while the archaic form of *E. meridionalis* (Upper Villafranchian) has already 4½ and the species finally reaches 6½ in the Saint Prestian (Mayet and Roman, 1923, p. 14; Depéret and Mayet, 1923, p. 157/58). Osborn (1942, p. 954) has shown that the Upper Siwalik *A. planifrons* attains a laminar frequency of 5½-6 too, and he attributes this variation to progressive evolution or to ascending mutations ranging into higher geologic levels. Unfortunately, however, the Barnum Brown collection on which Osborn's studies of *A. planifrons* are based lacks stratigraphical data (Osborn, l.c., p. 950). Colbert (in Osborn, 1942, p. 1448) assigns *A. planifrons* to the Pinjor zone of the Siwaliks, which is correlated with the European Villafranchian as a whole by Pilgrim (1944, p. 36). However this may be, our Celebes *Archidiskodon,* again, agrees with the primitive stage exemplified by *A. planifrons.*

4. The enamel of our Celebes molars is comparatively very thick, up to 3-3½ mm, which corresponds to 6-7 mm in the two times larger molars of *A. planifrons* and *A. meridionalis.* Actually, the enamel is thicker in *A. planifrons* than in *A. meridionalis.* In the former species the thickness of the enamel certainly reaches 6-7 mm (Falconer and Cautley, 1845, pl. 2 fig. 5a, pl. 11 figs. 1 and 4, 1846, pl. 14 fig. 8; Mayet and Roman, 1923, figs. 3-4; Depéret and Mayet, 1923, fig. 4; Osborn, 1942, p. 952 fig. 827).

Consequently in its relatively low crown and ridge-plate formula as well as in the low laminar frequency and great enamel thickness our diminutive Celebes *Archidiskodon* is evidently more closely related to *A. planifrons* than to *A. meridionalis.*

As far as the above evidence goes, it may thus be concluded that *Archidiskodon celebensis* nov. spec. is representative of a Lower Pleistocene rather than of a Middle or an Upper Pleistocene stage of development in the genus *Archidiskodon.* There are no exact data as yet as to the geologic age of the Celebes fossils. As I stated in my first paper on Mr. Van Heekeren's collection the fauna is associated with stone-flakes identical to those of the uppermost Middle or Upper Pleistocene of Sangiran in Java (Hooijer, 1948a). The fossil Celebes fauna, however, is totally different from that of the Pleistocene of Java, and it may be added that the entry of Asiatic terrestrial animals into Celebes must have been by way of the Philippines, the only acceptable land connection between Celebes and the Asiatic continent.

It has now been established, I think, that *Archidiskodon celebensis* nov. spec. is most probably the stranded decendant of *A. planifrons* (Falconer et Cautley) which roamed great parts of southern and eastern Asia in the early Pleistocene. Consequently we may date the time of arrival of the elephant in the island of Celebes as far back as the Lower Pleistocene. Since then the elephant of Celebes underwent a diminution in size, thereby preserving its archaic characters. The association of *Archidiskodon* with *Babyrousa* and *Celebochoerus* in the fossil fauna of Beru and Sompoh indicates that the length of time has sufficed even for generic differentiation unless the suids are earlier immigrants; close fossil relatives of both of these endemic genera are still unknown.

The accidental finds of Mr. Van Heekeren at Beru and Sompoh in S. Celebes described and to be described in the present series of papers give us a first glimpse of the ancient fauna of Celebes, and some remarkable forms have already come to light. With the march of our knowledge the Pleistocene Vertebrate fauna of Celebes is likely to become as rich and varied as, e.g., that of Java though widely different from the latter. The existence of fossil Man in Celebes is indicated already by the stone-flakes referred to above. In all probability there have been various invasions of animals into Celebes through a great length of time, one of which was that of the forerunner of *Archidiskodon celebensis* nov. spec. in Lower Pleistocene times.

LITERATURE

ADAMS, A. L., 1877-81. Monograph of the British Fossil Elephants. Palaeontographical Society, London, 265 pp., 28 pls.

DEPÉRET, CH., and L. MAYET, 1923. Les Eléphants Pliocènes. Part 2. Monographie des Eléphants Pliocènes de l'Europe et de l'Afrique du Nord. Ann. Univ. Lyon, n.s., I Sciences, Médecine, fasc. 42, pp. 89-224, pls. IV-XI, 33 figs.

FALCONER, H., 1868. Palaeontological memoirs and notes of the late —. With a biographical sketch of the author, compiled and edited by C. Murchison. London, vol. I, Fauna Antiqua Sivalensis, LVI + 590 pp., 34 pls.; vol. II, Mastodon, Elephant, Rhinoceros, ossiferous caves, primeval Man and his cotemporaries, XIV + 675 pp., 9 figs., 38 pls.

——, and P. T. CAUTLEY, 1845-1849. Fauna Antiqua Sivalensis, being the fossil zoology of the Sewalik Hills, in the North of India. London, pls. 1-12, 1845; pls. 13-24, 1846; pls. 25-80, 1847; pls. 81-92, 1849.

HAAR, C. TER, 1935. Geologische kaart van Java. Schaal 1 : 100.000. Toelichting bij blad 58 (Boemiajoe). Dienst van den Mijnbouw in Ned. Indië, 65 pp., 17 figs.

HOOIJER, D. A., 1948a. Pleistocene Vertebrates from Celebes. I. Celebochoerus heekereni nov. gen. nov. spec. Proc. Kon. Ned. Akad. Wet. Amst., vol. 51, pp. 1024-1032, 1 pl., 1 fig.

——, 1948 b. Pleistocene Vertebrates from Celebes. II. Testudo margae nov. spec. Ibid., vol. 51, pp. 1169-1182, 1 pl.

——, 1948 c. Pleistocene Vertebrates from Celebes. III. Anoa depressicornis (Smith) subsp., and Babyrousa babyrussa beruensis nov. subsp. Ibid., vol. 51, pp. 1322-1330, 1 pl.

HOPWOOD, A. T., 1935. Fossil Proboscidea from China. Pal. Sinica, ser. C, vol. 9, fasc. 3, 108 pp., 8 pls.

LYDEKKER, R., 1880. Siwalik and Narbada Proboscidea. Mem. Geol. Surv. Ind., ser. 10, vol. 1, part 5, pp. 182-294, pls. XXIX-XLVI.

MAAREL, F. H. VAN DER, 1932. Contribution to the knowledge of the fossil Mammalian fauna of Java. Wet. Med. Dienst Mijnb. Ned. Ind., no. 15, 208 pp., 20 pls., 29 figs.

MATSUMOTO, H., 1924. [Preliminary note on fossil elephants in Japan]. Journ. Geol. Soc. Tokyo, vol. 31, pp. 255-272.

——, 1927. On Leith-Adamsia siwalikiensis, a new generic and specific name of archetypal elephants. Jap. Journ. Geol. Geogr., vol. 5, no. 4, art. 12, 1 p.

MAYET, L., and F. ROMAN, 1923. Les Eléphants Pliocènes. Part 1. Elephas planifrons Falconer des sables de Chagny et faunes de Mammifères d'âge Villafranchien-Saint-Prestien. Ann. Univ. Lyon, n.s., I Sciences, Médecine, fasc. 42, pp. 1-88 + I-IX, pls. I-III, 15 figs.

NAUMANN, E., 1887. Fossile Elephantenreste von Mindanao, Sumatra und Malakka. Abh. Ber. Zool. Anthrop.-Ethn. Mus. Dresden 1886/87, no. 6, 11 pp., 1 pl.

OSBORN, H. F., 1942. Proboscidea. A Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World. Vol. II, Stegodontoidea, Elephantoidea. New York, pp. 805-1675 + I-XXVII, pls. XIII-XXX, figs. 681-1224.

PILGRIM, G. E., 1944. The Lower Limit of the Pleistocene in Europe and Asia. Geol. Mag., vol. 81, pp. 28-38.

POHLIG, H., 1888-91. Dentition und Kranologie des Elephas antiquus Falc. mit Beiträgen über Elephas primigenius Blum. und Elephas meridionalis Nesti. Nova Acta Leop.-Carol. Akad., vol. 53, pp. 1-282, 10 pls., 107 figs. (1888), vol. 57, pp. 283-466, 7 pls., 42 figs. (1891).

——, 1911. Zur Osteologie von Stegodon, in: L. SELENKA and M. BLANCKENHORN, Die Pithecanthropus-Schichten auf Java. Leipzig, pp. 196-213, pls. XXVI, XXVII, figs. 1-6.

STOCK, CH., and E. L. FURLONG, 1928. The Pleistocene elephants of Santa Rosa Island, California. Science, vol. 68, no. 1754, pp. 140-141.

VAUFREY, R., 1929. Les Eléphants nains des Iles méditerranéennes et la question des isthmes pléistocènes. Arch. Inst. Pal. Humaine, Mém. 6, 220 pp., 9 pls., 45 figs.

WEITHOFER, K. A., 1890. Die fossilen Proboscidier des Arnothales in Toskana. Beitr. Pal. Österr.-Ung., vol. 8, pp. 107-240, pls. I-XV.

EXPLANATION OF THE PLATES

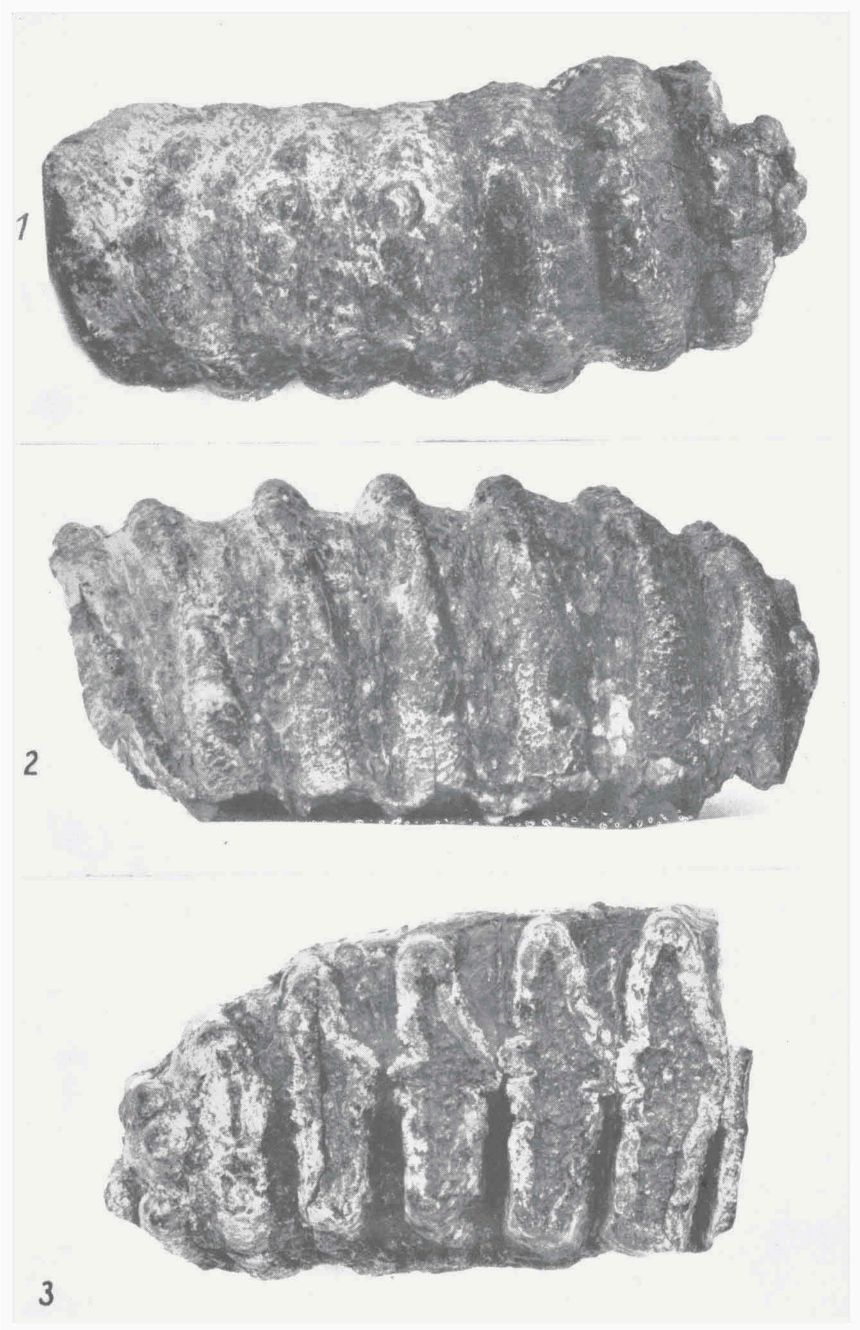
Plate VIII

Figs. 1-3, *Archidiskodon celebensis* nov. spec.; figs. 1-2, M^2 or M^3 dext. (holotype), Sompoh, S. Celebes; fig. 1, crown view; fig. 2, labial view; fig. 3, M^2 or M^3 dext. (specimen B), Sompoh, S. Celebes, crown view. All figures natural size.

Plate IX

Figs. 1-5, *Archidiskodon celebensis* nov. spec.; fig. 1, fragment of left upper M (specimen C), Desa Beru, S. Celebes, crown view; fig. 2, distal portion of right ulna, Desa Beru, S. Celebes, anterior view; figs. 3-4, proximal portion of left tibia, Sompoh, S. Celebes; fig. 3, anterior view; fig. 4, proximal view; fig. 5, isolated plate of molar (specimen D), Desa Beru, S. Celebes.

Figs. 1 and 5, natural size; figs. 2-4, one-half natural size.


1
2
3