REPORTS FROM THE SCIENITFIC EXPEDITION TO THE NORTH-WESTERN PROVINCES OF CHINA UNDER LEADERSHIP OF DR SVEN HEDIN

THE SINO-SWEDISH EXPEDITION
PUBLICATION 37

VI. Vertebrate Palæontology
6

Fossil Reptiles from Mongolia and Kansu

BY

BIRGER BOHLIN

(APPENDIX: DETAILS OF A NEW MOULDING AND CASTING METHOD BY ERIC STÅHL)

(Published also as a Fascicle of Palæontologia Sinica)

STATENS ETNOGRAFISKA MUSEUM
STOCKHOLM 1953

CONTENTS

PART II. CHELONIA

PART III

INTRODUCTION

During the winter and early spring of 1929—1930 the party of the Sino-Swedish Expedition to which the author belonged passed through Inner Mongolia and had a chance to collect some vertebrate remains in badlands of Late Mesozoic age. Later (August 1930 — May 1931) collections were made in three Mesozoic badlands in Western Kansu (fig. 1). Compared with some of the material brought back by the American Expeditions

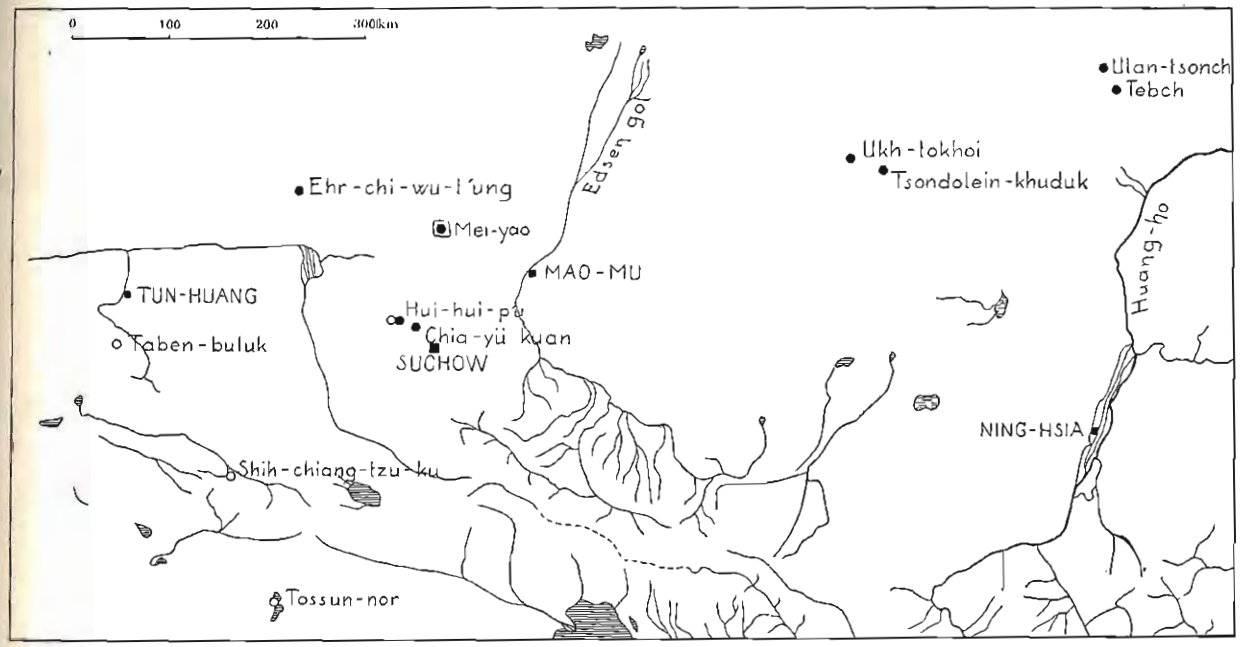


Fig. 1. Map of localities.

ours is rather poor, but a thorough examination has disclosed some fifteen different species of dinosaurs, several of which belong to new interesting species. Further there are some turtles, the Mesozoic ones representing five genera. Of remains of other archosaurs there are only two tooth fragments of crocodiles. As most of the material is too scanty to contribute much to the general knowledge of the larger groups to which it belongs it has been thought preferable to treat the remains from the different localities separately. An exception will be made for the Chelonia, which will be described in a special chapter, together with material from four Tertiary deposits.

The determination of the material is in most cases provisional. It might have been possible to make it more definite if the author had had access to large collections of fossil

reptiles, but circumstances have made it necessary to hasten the work and thus there was no time for travel. Unfortunately for a worker on very fragmentary material, important literature on related forms deals with more or less complete skeletons, and accordingly the descriptions and diagnoses pay more attention to limb proportions, vertebral formulae, number of teeth in the jaws, and so on, than to minute details, and often figures of articulation surfaces and other minor features are lacking. It is therefore impossible to appreciate the diagnostic value of some observations made on the present material. Some characters which have been quite useful for the analysis of this material may therefore fail when a comparison is made with other forms.

The whole material of fossil vertebrates was returned to China.

The work has been carried out at the paleontological institution at Uppsala where everything possible was made to facilitate it. Special thanks are due to Professor PER THORSLUND for granting the use of the modern outfit of the institution, to Mr NILS HJORT for taking all the photographs, and to Mr ERIC STÅHL for preparing some of the drawings.

PART II. CHELONIA

The bulk of the material described below derives from Mesozoic and Tertiary formations mainly in Western Kansu. In Mongolia a few fragments were found at Ug-tokhoi (Late Mesozoic); and in Ching-hai (Kuku-nor) one specimen was found in the Shargaltein valley (Upper Oligocene) and one near Tossun-nor (Pliocene).

MESOZOIC FORMS

Most of the specimens are from the small sediment area N. of Chia-yü-kuan, where groups of disconnected plates were found in fairly great number. Most groups were mixed; either there were remains of more than one species, or there were individuals of different sizes of the same species. In no case a complete specimen could be pieced together; but of one of the species a fairly reliable picture could be obtained and of the others enough is known to make a determination possible. A good find was made in the Ehr chia-wu-tung badlands which yielded a nearly complete plastron, great parts of the carapace, and several skeletal bones of the same individual.

It has been impossible on account of a time limit set for the dealing with the whole material of fossil reptiles from the Sino-Swedish expedition to devote much time to the literature on fossil turtles. The author has chiefly made use of various papers by HAY and of earlier descriptions of fossil turtles from China and Mongolia by WIMAN and GILMORE. In one of his papers WIMAN has mentioned the remains of turtles under designations as "Schildkröte A", "Testudo A" etc. and these designations are retained in his final work when the material was too scanty for the foundation of a species. The author has considered a similar course and followed it in the description of the Tertiary forms, but in other cases it was thought more convenient to name several species in spite of the risk that the species might be already known and thus other names shall have priority. The drawings primarily served as a method of investigation, and more attention was paid to details in the structure than to the scale. Therefore this is not exactly the same in all figures—but the deviation from the scale given in the explanation of the figures is negligable in comparison with the variation in size within the species, and it was thought waste of time to redraw the figures to obtain a scale of exactly 1:1 instead of, say, 19:20 when the size of the smallest specimen is 3/4 or even only 2/3 of the largest one.

GENUS OSTEOPYGIS COPE

Perusing HAY's large monograph of 1908 and his later supplements the author was not able to find any North American form that is identical with any of the turtles from Chia-yü-kuan. It is even doubtful if these turtles can be referred to North American genera. Some of them show a resemblance to the species of *Osteopygis*; if they differ from one of the species of this genus, the difference may be less obvious when they are compared with others, and as long as the vertebrals, costals, and the plastron are very imperfectly known a diagnosis distinguishing the material from *Osteopygis* cannot be given. All the American species described by HAY are at least twice as large as those from Kansu, further they must have been flatter as is evident from the section through peripherals 4—6, but in this respect the North American forms seem to vary within rather wide limits.

The diagnosis of the genus *Osteopygis* reads (the characters observable in the Kansu material spaced):

Carapace including 8 pairs of costal plates and 11 pairs of peripherals, with all or only a part of the peripherals suturally articulated with the costals and the suprapygals. All the costals sending their ribs into pits of the corresponding peripherals. Five vertebral and 4 pairs of costal scutes. The nuchal scute much wider than long. Plastron relatively small; its connection with the peripherals extensive, reaching from the second to the eighth peripherals, not by closed sutures. Bridge relatively narrow. Fontanels in the midline and at the ends of the hyohypoplastral suture. Inframarginal scutes present. Lower jaw with a broad and flat crushing surface; not beaked. (HAY 1908 p. 127).

Osteopygis kansuensis n. sp.

(Pl. VI, fig. 1; textfig. 43)

Type: A specimen from Ta-ts'ao-t'an (Chia-yü-kuan) marked "46 B". The find comprises the peripherals 1, 2, 4—11 from the left side, and from the right 1—3, 5—10. The length of the specimen was estimated at 25 cm, the width at 20 cm.

Additional material: Peripherals, fragments of costals, a vertebral plate, and fragments of the plastron of several individuals.

From the anterior half of the seventh peripheral forwards, the free border of the peripherals is thick and strongly turned upwards. Posteriorly the border is sharp-edged and more or less flattened. The border articulating with the costals might be damaged in some of the peripherals, but it is evident that there was a sutural articulation from the nuchal plate to at least the third peripheral and from the 8. to the pygal. In the 4.—6. peripheral of the type the border is somewhat unclear, but in all it shows an indent at the rib pit which one would not expect if the border in its present state was determined by a fracture. The 7. peripheral extended inside the internal border of the marginal scutes, but

its border towards the costals forms a sharp edge that is deeply notched at the rib pit (fig. 43: 4). In the plates which had sutural articulation with the costals this border is jagged; in peripherals 8—10 it has a deep notch at the rib pit as in the seventh. In his key to the species of *Osteopygis* HAY distinguishes between forms with all the peripherals sutured to the costals and such in which the "3 to 10 inclusive" are free. In *O. kansuen-*

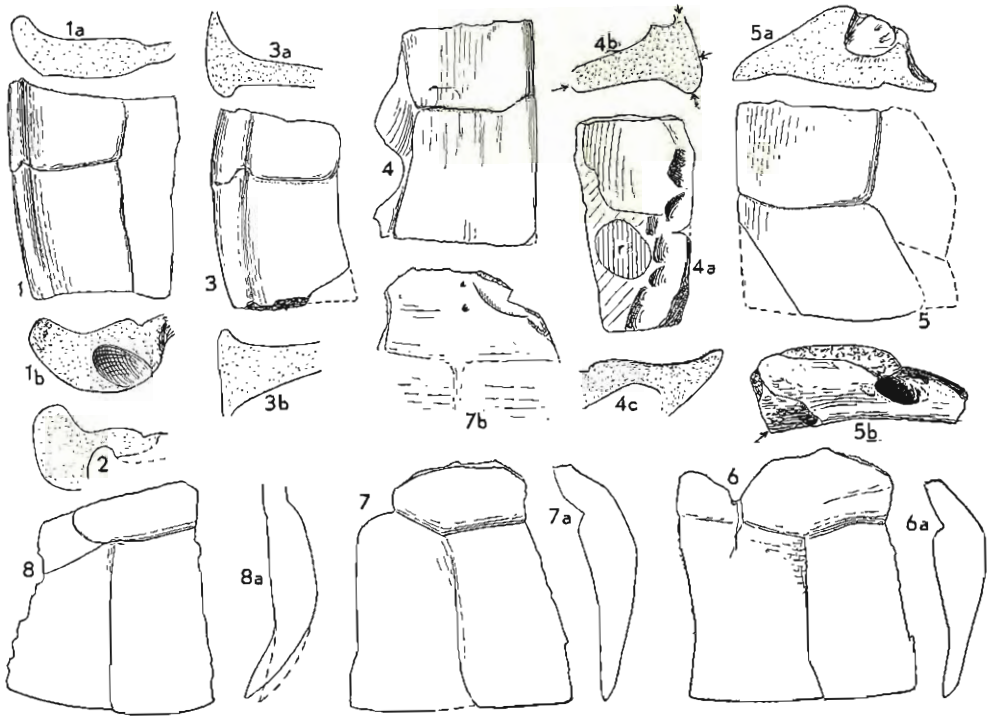


Fig. 43. *Osteopygis kansuensis*. Type. 1. Second peripheral. *a* Anterior, *b* posterior surface. — 2. Third. do. Anterior surface. — 3. Sixth do. *a* Anterior surface (upper side downwards), *b* posterior surface. — 4. Seventh do. *a* medial view (*r* rib pit with fragment of rib), *b* anterior surface (upper side downwards), *c* posterior surface. — 5. Elgth do. (left side). *a* Anterior surface (upper side downwards). *b* (right side): Medial view (direction of light shown by the arrow). — 6—8. Ninth—eleventh peripheral (8. reverted). 6*a*—8*a* Anterior surfaces. 7*b* part of lower surface. — All about natural size. — The arrows in fig. 4*b* show how the width of the upper and lower surfaces of the peripherals 3—7 was measured!

sis four more plates have sutural articulation, and it is in this respect intermediate between the subgenera *Osteopygis s.s.* and *Propleura*. The surface of the plates in the carapace is smooth.

The second peripheral (fig. 43: 1) has a deep pit for the foremost end of the axillary buttress. The third peripheral has a flattened rib pit, a large anterior pit for the articulation with the plastron continuous with that in the second (fig. 43: 2) and behind this three or four small pits sunk into a groove. The fourth (Pl. VI: 1) has a large rib pit occupying almost one third of the length of the plate and on the lower border four pits, a somewhat larger one at the anterior end continuous with the posterior pit on the third peripheral, and three smaller ones, the hindmost a few millimetres in front of the posterior end. The fifth

has only a rib pit. In the sixth small plastral pits begin opposite the rib pit or a little farther forwards—on the whole the sixth peripheral is built as the fourth but reverted. In the seventh the rib pit is large and conical (fig. 43: 4 *r*); it is situated in the posterior half and separated from the contiguous pits for the plastron by a wall of bone. The anterior part of the eighth (fig. 43: 5) is much like the posterior end of the second though the plastral pit is considerably larger and opens also on to the lower surface. The large compressed rib pit lies in the posterior half of the plate. The rib pit has the same position in the ninth (fig. 6) as in the eighth peripheral (fig. 5 *b*). In the tenth it is situated far back (fig. 43: 7), on the right side so far as to be open towards the posterior surface of the plate, touching the anterior surface of the eleventh. The costal scutes overlap on the anterior and posterior peripherals except on the pygal plate. Evidently they only reached the upper border of the peripherals 4—6.

Measurements for "46":

Peripheral	Length[2]	Width		Thickness
		Upper face	Lower face	
1	28	23	—	6
2	30	24	—	10
3	30	20+[1]	13+[1]	—
4	27	18[1]	12[1]	—
5	27	17[1]	13[1]	—
6	27	17[1]	12[1]	—
7	30	22[1]	18?[1]	—
8	32	30?	—	11
9	35	33	—	7
10	29	33	—	7
11	28	31	—	7

[1] Measurements taken as indicated by the arrows in fig. 43: 4 *b*.
[2] The length is measured on the free border.

Osteopygis latilimbata n. sp.

(Pl. VI, figs. 2—7; textfigs. 44 and 45)

Type: A specimen from Ta-ts'ao-t'an (Chia-yü-kuan) marked "94". Only the 8th left, and the 10th right and left peripherals, a few fragments of the costals and the plastron. Portions of the pelvis, a complete humerus, and a fragment of the tibia.

The species differs from *O. kansuensis* in having much thinner posterior peripherals (cf. figs. 43 and 44).

Further, the contact between the peripherals 8—10 and the corresponding costals lacks the deep notch in the border of the peripherals that seems to be present at least in most of the specimens of *O. kansuensis*. Another feature peculiar to this species, as compared with all other turtles from Chia-yü-kuan, is a fine and very dense striation, occupying

a zone a few millimetres in width along all the sutures (fig. 44: 2). Such striae are present also in *O. kansuensis* but there they are not so strictly parallell and not by far so crowded as in *O. latilimbata*.

Measurements:

	Length	Width	Thickness
8.	36	30	10
10.	36	41	5

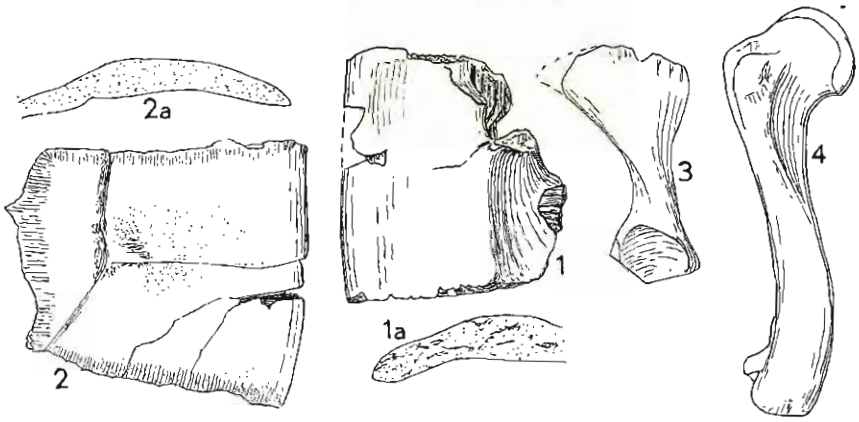


Fig. 44. *Osteopygis latilimbata*. Type. 1. Eighth peripheral. *a* Posterior surface (upper side downwards). — 2. Tenth do. *a* Anterior surface (upper side downwards). — 3. Right ilium. — 4. Right femur. — All natural size.

Some plates from the middle and anterior part of the margin (nr. 92) found near the type specimen of *O. latilimbata* may belong to this species. The most important ones are a partial nuchal plate and the left 5. and 6. peripherals (fig. 45). The sulci on the nuchal plate show that the nuchal scute was short and broad as in the American species of *Osteopygis*. The sixth peripheral is compressed dorso-ventrally (cf. figs. 45: 3 and 43: 3), the difference in the structure of this plate might well correspond to the difference in width and thickness in the posterior peripherals.

The rib pit in both peripherals is flattened. The swollen, free border of these plates is densely punctuated; in other parts of the surface where the external layer is not peeled off there is a fine pattern of scarce branching grooves (evidently impressions of fine blood vessels). In the 8. and 10. peripherals (type specimen) the punctuation is restricted to the very edge of the plates.

Measurements:

	Length	Width	
		Upper face	Lower face
5.	31	21.5	13
6.	31.5	22.5	11.5

Osteopygis acutus nov. sp.

(Pl. VI, figs. 8—14; textfigs. 46 and 53)

Type: A specimen from Ta-tsao-tan, Chia-yü-kuan, marked "74". Peripherals 1, 3, 6?, 9, 11 from the left side, 2, 3, 7, 9, 10 from the right side.

The name refers to the sharp edge on the free border of the peripherals (it is sharp even where this is strongly bent upwards as in the 1.—3.; fig. 46: 2). In *O. kansuensis* the

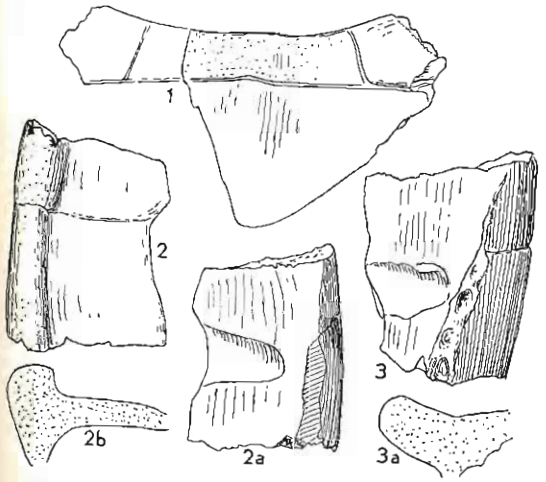


Fig. 45. *Osteopygis latilimbata.* 1. Partial nuchal plate. — 2. Fifth peripheral. *a* Inner side, *b* posterior surface. — 3. Sixth do. from below. *a* Posterior surface. — Nat. size.

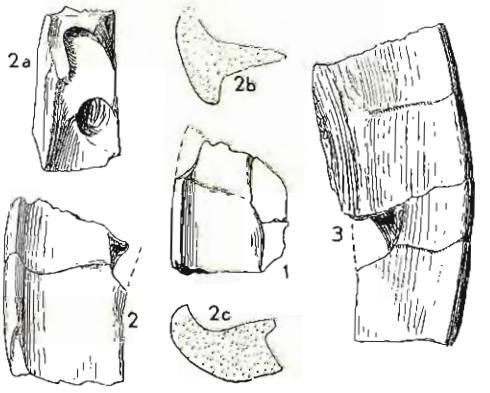


Fig. 46. *Osteopygis acutus.* Type. 1. First peripheral. — 2. Third do. *a* Medial view, *b* anterior surface (upper side downwards), *c* posterior surface. — 3. Second and third peripherals. — All natural size.

borders are thick and rounded from the 7th forward. The other characters of the species as compared with the species described above are best revealed at a comparison plate for plate with *O. kansuensis.*

1. The upper surface is so similar in the two species that no attention can be paid to minor differences on such a scanty material. In *O. acutus* the plate is thicker posteriorly than in *O. kansuensis.*

2. Is relatively shorter than in *O. kansuensis* (cf. figs. 46: 3 and 43: 1), the posterior surface is just touched by the axillary buttress, whereas in *O. kansuensis* a deep pit is excavated for its anterior end.

3. In *O. kansuensis* this plate has a broad expansion inside the costo-marginal sulcus, undoubtedly with a sutural connection with the costal along its whole length. There is a wide anterior groove for the axillary buttress connected with the pit on the second peripheral, and a narrow posterior groove with three or four small pits at its bottom. In *O. acutus* there might have been a sutural connection with the costal in the anterior $^1/_3$ which part is broken away on both sides, but posteriorly there is a sharp edge evidently following the costo-marginal sulcus. The attachment for the axillary buttress consists of two large, subequal pits, the anterior one touching the posterior side of the 2. peripheral, the posterior one resembling in its shape the rib pits on the peripherals farther back. Behind this pit there is quite a small one at the posterior end. The plate is much shorter and also

somewhat broader than that of *O. kansuensis* if only the part externally to the costo-marginal sulcus is measured.

6. Above, the position of this plate was marked with a "?" as there are no pits for the plastron on the lower border. But the large rib pit, more rounded than in *O. kansuensis*, is situated behind the middle as in the sixth peripheral of *O. kansuensis*. There must have been a notch for the rib in the upper border.

7. The seventh peripherals in the two species differ comparatively little. The rib pit in *O. acutus* is wider and more rounded and it interferes with the attachment for the plastron. In *O. kansuensis* the pit is oval and, as mentioned above, separated from the plastral pits.

9.—11. are almost identical in the two species though comparatively broader in *O. acutus*.

As a difference from *O. latilimbata* only the flattened rib ends in this species need be mentioned.

Measurements:

	Length	Width		Thickness
		Upper face	Lower face	
1.	?24+	21	—	5.5
2.	25	21	—	6.5
3.	23	15.5	16.5	—
6.	24.5	—	13	—
7.	23	15.5	15	—
9.	23	26	—	5.5

Other material of Osteopygis

The material comprises some specimens that at first sight look very like *O. kansuensis*. The connection between the costals and the peripherals, however, is different, usually so that the sutural connection is limited to the nuchal and the two anterior peripherals, thus even less than the minimum in *Osteopygis* according to HAY (1908 p. 127: Key to the Genera). As there is a certain amount of variation, for instance a sutural touch in specimens where the borders of the plates otherwise do not meet, I have not thought it feasible to found new species on this character only. There are other minor differences but the material is too incomplete to make sure to what extent they are constant, and if so, how they are combined in different forms.

No. 57 (Pl. VI, fig. 20; textfig. 47): The 11. peripheral of the left side, the pygal, and the 4. and 6.—11. peripherals of the right side.

In this specimen the sutural connection is approximately the same as in the type specimen of *O. kansuensis*. The posterior peripherals, however, are relatively broader, the areas separated by the sulci are not swollen as in *O. kansuensis* and therefore the sulci appear less deep, the plates thin out towards the free border but the edge is blunt, not sharp as in *O. kansuensis*. The seventh peripheral (fig. 47: 1) is more compressed dorsoventrally, the rib connected with it is flattened, and it seems to be separated from the

plastral buttress by a septum of bone. The sutural connection with the costals entered this peripheral and reached at least to a point opposite the middle of the rib (in *O. kansuensis* it evidently just reached the anterior end of the eighth peripheral). A character which this specimen probably has in common with *O. kansuensis*, though it cannot be observed on any specimen referable to that form, is that the sulcus marking the posterior border of the last vertebral scute ran in front of the pygal plate.

It is evident from the description above that these remains cannot be referred to *Osteopygis kansuensis*. They may on the other hand have belonged to a small individual of

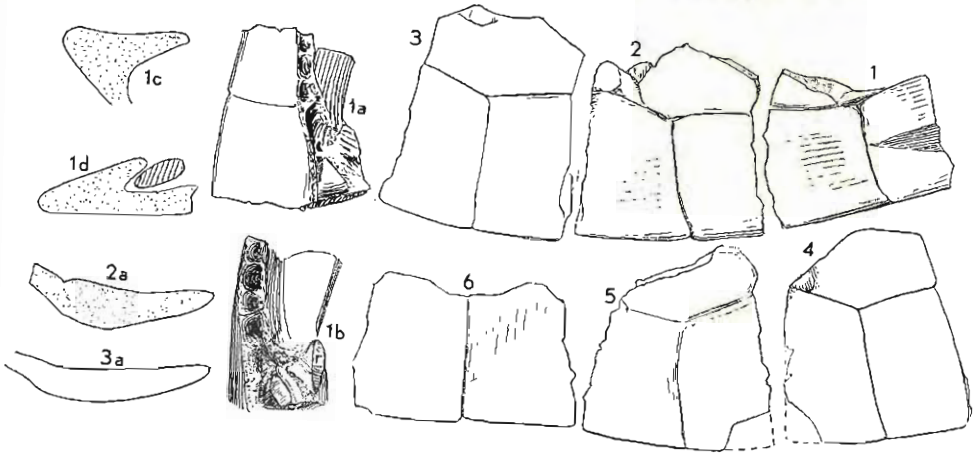


Fig. 47. *Osteopygis aff. latilimbata*. 1. Seventh peripheral. *a* From below, *b* medial view (r = rib), *c* anterior, *d* posterior surface (upper side downwards). — 2. Eighth do. *a* Posterior surface. — 3. Ninth do. *a* Posterior surface. — 4. and 5. Tenth and eleventh peripherals. — 6. Pygal plate. — All natural size.

O. latilimbata, though the posterior peripherals are not so thin and there is an external notch at the rib pit in the 8.—10. peripherals. This determination is supported by the presence of the same dense fine striation along the sutures.

The index: length/width × 100 for the tenth peripheral is 82.1; the same index for *O. kansuensis* is 87.8, for *O. latilimbata* 87.8. The specimen has been labelled *O.* aff. *latilimbata*.

Measurements:

Peripheral	Length	Width		Thickness
		Upper face	Lower face	
4.	22	17	9	—
6.	22	—	—	—
7.	25	20.5	16	—
8.	26	27	—	9
9.	24.5	29.5	—	5.3
10.	23	28	—	5.2
11.	25	27	—	4.9
pygal	29.3	19	—	4.0

No. 36 (Pl. VI, fig. 15—19; textfig. 48): Peripherals 2, 3 (fragment), 7—11 from the left side, 3, 6, 8, 10, and 11 from the right side. The specimen is comparatively small (comparison with other material from Chia-yü-kuan). It resembles *O. kansuensis* in most respects; compare for instance details like the posterior surface of the second peripheral and the shape of the 8.—11. peripherals. But the sutural connection with the costals is no doubt restricted to the nuchal (not represesented in the material) and the peripherals 1 and 2, evidently with a slight touch on the third (in another similar specimen the suture

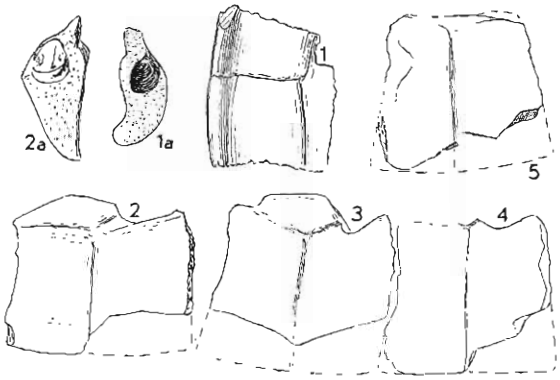


Fig. 48. *Osteopygis* sp. Second peripheral. *a* Posterior surface.—2. Eighth do. *a* Anterior surface.—3—5. Ninth — eleventh peripheral (fig. 5 reverted). — All nat. size.

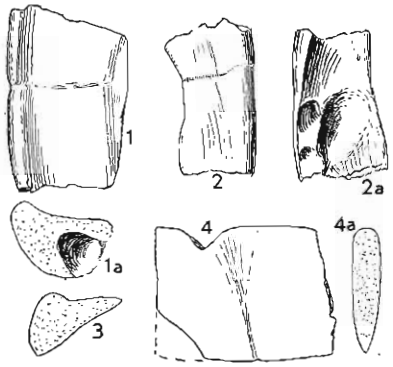


Fig. 49. *Osteopygis* aff. *kansuensis*. 1. Second peripheral. *a* Posterior surface.—2. Third do. *a* Medial view.—3. Fourth do. Posterior surface.—4. Ninth do. *a* Anterior surface.—All nat. size.

ceases a couple of millimetres from the posterior end of the second peripheral). Posteriorly there is no trace of a suture even on the 11. peripheral which hardly extends inside the costo-marginal sulcus. All specimens in which these characters are observed are much smaller than the type of *O. kansuensis* and it is possible that, when they grew larger, the ossification would have proceeded so that the costals and the peripherals obtained contact and a suture developed.

Nr 36 and three other specimens were labelled *Osteopygis* aff. *kansuensis*.

Measurements:

	Length	Width		Thickness
		Upper face	Lower face	
2.	22	17	—	6
3.	22	—	11	—
6.	22	12.5	9	—
7.	24	—	—	—
8.	24?	22	—	9
9.	—	—	—	5.2
10.	23?	21	—	4.5
11.	22?	21	—	4.5

Nr. 73 (fig. 49): Peripherals 2, 4, 7, 11 from the left side, 1—3, 7, 9, 10 from the right. A comparatively small specimen. There is a sutural connection with the central parts only in the nuchal (?), the anterior half of the first peripheral and in the eleventh (and pygal?). The upturned free border of peripherals 1—7 is thick and rounded but not very pronounced. In 2. there is a deep pit for the plastron, in 3. a large anterior and two small posterior pits. The rib pit on 3. is better delimited than in *O. acutus*. In the seventh it has almost edged out one of the plastral pits, otherwise 7 resembles closely the same plate in nr. 21 (fig. 50). In the 9. and 10. peripherals the free border is not upturned at all.

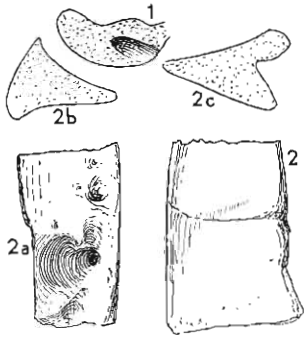


Fig. 50. *Osteopygis* sp. 1. Second peripheral. Posterior surface. — 2. Seventh do. *a* Medial view, *b* anterior surface, *c* posterior surface (in *b* and *c* upper side downwards).—All nat. size.

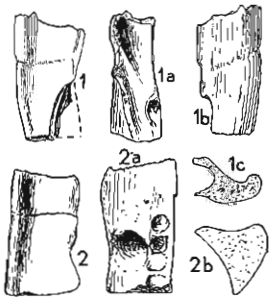


Fig. 51. *Osteopygis*. Small individuals. 1. Third peripheral. *a* Medial view, *b* lower surface, *c* anterior surface. — 2. Sixth do. *a* Medial view, *b* anterior surface. — All about nat. size.

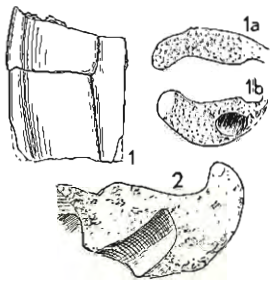


Fig. 52. *Osteopygis* sp. 1. Second peripheral. *a* Anterior surface (upper side downwards), *b* posterior surface. — 2. Second peripheral of a larger individual. Posterior surface.—All nat. size.

The specimen was labelled *O.* aff. *kansuensis*.

Measurements:

	Length	Width		Thickness
		Upper face	Lower face	
1.	—	15.5	—	6
2.	24.5	15	—	8
3.	23	13	11	—
4.	24	12	9	—
7.	25	14	14	—
9.	24	17.5	—	4.5
10.	24	18	—	4.5
11.	—	15	—	4

There are finally some small slender plates (Pl. VI, figs 21—24; textfig. 51) among which especially the 3. peripheral is worth noticing. It has a very small posterior plastral pit that is situated so that it is visible as a notch in the lower border (fig. 51: 1*b*). In a fourth and a sixth peripheral of the same size the rib pit is wide and conical. In the sixth it touches one of the plastral pits. These are unusally large, occupying almost $^1/_3$ of the

width of the internal surface of the plate. Average length of the plates 19 mm. These plates may derive from immature individuals.

Other parts of the carapace in Osteopygis

The costal plates are represented by fragments which could not be pieced together in any of the specimens collected. Most fragments are thin (cf. below); their surface is smooth with only some impressions of very fine blood vessels as in the peripherals and the plastron (see below). To judge from the fragments there is in one pair of costals (probably the 2. pair) a wrinkling of the surface behind the sulcus.

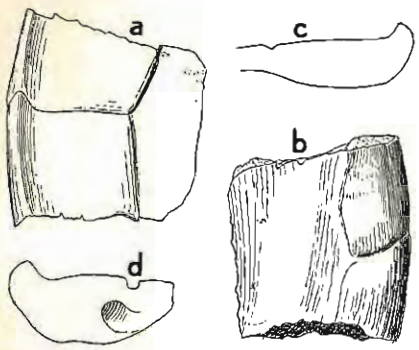


Fig. 53. *Osteopygis* cf. *acutus*. Second peripheral: *a* Upper, *b* lower, *c* anterior, and *d* posterior views.—Nat. size.

Neural plates are very scarce and those present are with two exceptions, two of the posterior ones, more or less damaged. They are mostly quite thin but one of them—? the first (fig. 55 *c*)—is much thicker than the rest; thus it is evident that the thickness of the carapax was not uniform, the anterior part being thicker than the middle and posterior parts.

Plastron

The plastron was fragile and loosely articulated and the preserved fragments do not by far allow a complete restoration. In fig. 56 the more important pieces were arranged as nearly as possible after their original position in the plastron following a drawing in Hay's

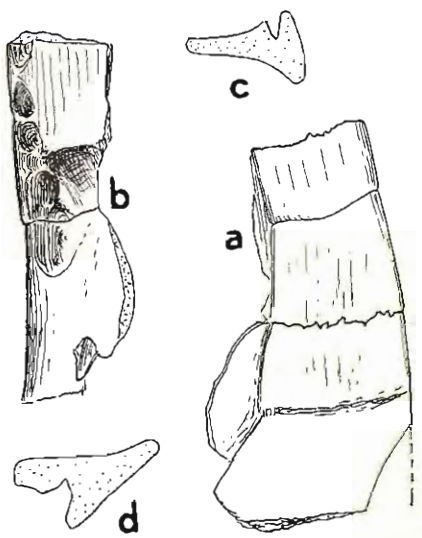


Fig. 54. *Osteopygis* sp. *a* and *b* Seventh and eighth peripherals: Upper and medial views. — *c* and *d* Seventh peripheral: Anterior surface (upper side downwards) and posterior surface.—Nat. size.

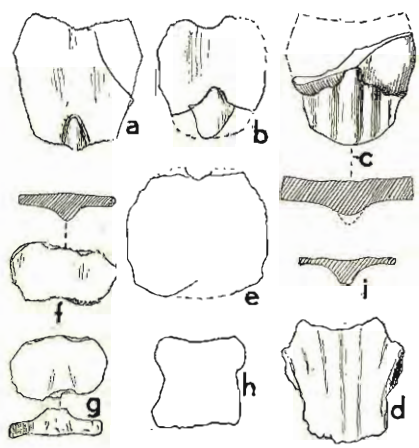


Fig. 55. *Osteopygis* sp. var. Neural plates. *a*, *b*, *c* Possibly first, third, and fifth neural in unknown order.—*d* Second or fourth?—*e*–*i* Posterior neurals? The cross-section in *g* with the upper side down.—*b* combined from two specimens. — All about natural size.

monograph of the plastron of *Osteopygis gibbi* (1908, fig. 144). The fragments derive from at least five individuals (*2* and *5* have the same field number). There may be a difference in size in individuals of the same species; and there are also undoubtedly remains of more than one species in the material and possibly also among the fragments in fig. 56.

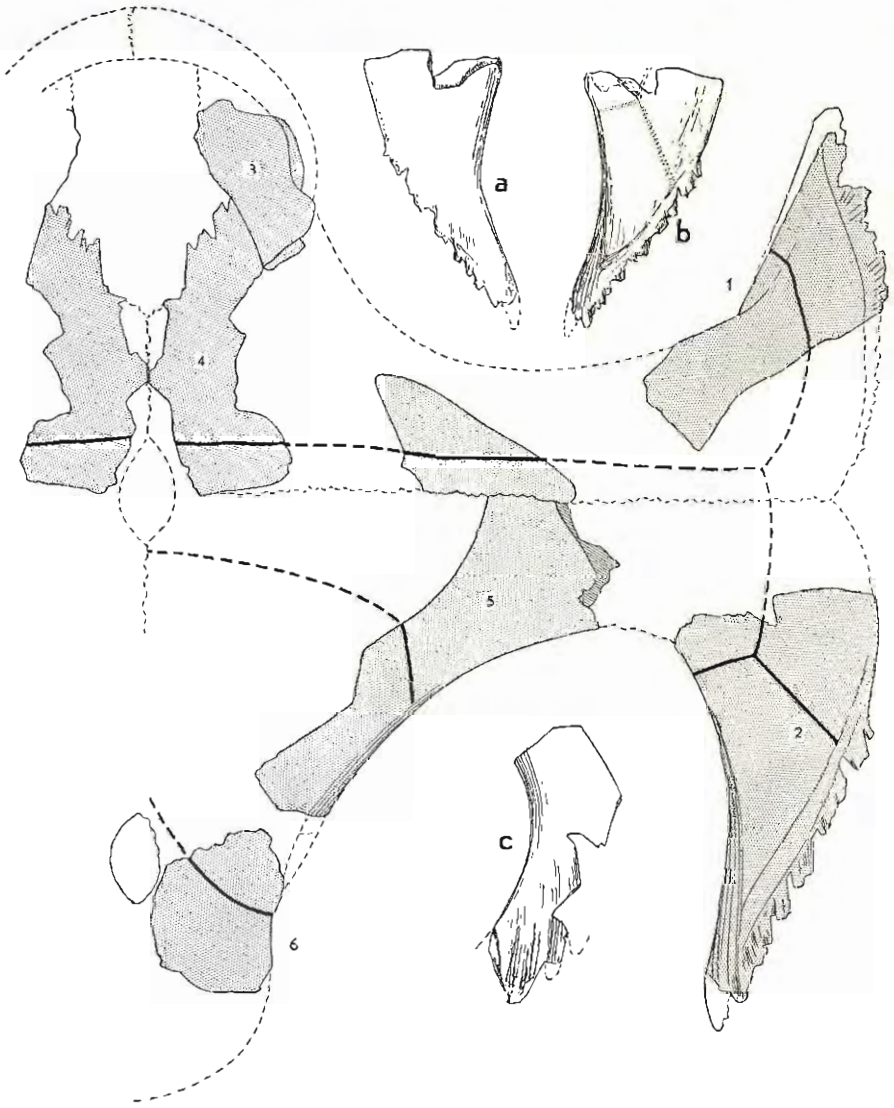


Fig. 56. *Osteopygis*. Left half of plastron from below. Diagram. Fragments from several individuals in their probable original position. Outline of plastron drawn after HAY. See the text. — *a–c* Inguinal buttresses. *a* and *b* Same as fragment 2 in the restoration of the plastron: Internal and external views. See p. 80.

The distance between the anterior and posterior ends of the buttresses holding the carapace was determined with the aid of the type of *O. kansuensis*. In this the pits for the axillary buttress occupy 64 mm of the lower border, those for the hypoplastron approximately the same, and the part where no connection is established (the fifth peripheral and contiguous parts of the fourth and sixth) 38 mm. In the hypoplastral fragment (*2*) used for

the diagram the attachment for the carapace is too short. It must have belonged to a small individual as it is very unlikely that the attachment should not have reached the sixth peripheral as in most specimens in which this plate is known (cf. p. 74). In the figure this fragment and fragment *5* are drawn on a much larger scale than the others.

Two types of buttresses are represented in the material. In one of them the border carrying the digitations is thick and it was evidently tightly appressed to the part of the lower border of the peripherals, lying medially to the row of pits receiving the digitations. The buttresses in the diagram are of this type (=fig. 56 *a* and *b*). In the other type (fig. 56 *c*) the surface of the buttress passes gradually into the sides of the digitations which are longer and more pointed than in the other type. The figure is an internal view—the outer side looks exactly the same, whereas in the first type the small denticles are less well set off on the internal than on the external side. As is evident from the description of the peripherals their connection with the costals is less extensive in some specimens than in others which is possibly parallelled by the difference in their connection with the plastron.

Fragment *3* in fig. 56 is undoubtedly the anterior end of the hyoplastron. Its free border has a sharp edge, ending behind in a pocket: it is flanked externally by a deep groove of which it forms one side, and internally by a slight difference in level of the side of the edge and the internal surface of the plastron. This is the attachment for the epiplastron which was evidently (as in *O. gibbii* Hay, l. c. fig. 144) of a very moderate size.

Fragment *4* is too large for any other position in the plastron. The orientation of the bone structures radiate towards the median suture so that there is a difference of about 45° between the anterior and posterior ends of the fragment. In front the sutural digitations recede from the middle line to give place to the entoplastron (size and shape unknown). A sulcus is distinguishable in the posterior part, and on the posterior border there are traces of a suture. The sulcus is undoubtedly that between the areas of the pectoral and abdominal scutes, and the fragment belongs to the hyoplastron.

Fragment *5* comprises parts on both sides of the hyo-hypoplastral suture. This suture and the sulcus in front of it fixes the place of the fragment. On the external surface behind the suture the lateral end of the sulcus between the abdominal and femoral scutes is seen traversing the fragment from the posterior border forwards. It must have bent strongly inwards immediately in front of the fragment. At the extreme posterior end of the fragment the sharp edge of the free border still lies on the internal side. This causes some difficulty for its connection with fragment *6* in which the edge lies externally. Fragment *6* evidently reached the middle line though the serrations of the suture are broken away. Anteriorly it is bordered by a suture running forwards and outwards, and this suture is crossed by a sulcus running forwards and inwards. Thus there is no doubt that the fragment comprises the anterior part of the xiphiplastron.

? Osteopygis sp. from Ug-tokhoi

(Textfig. 56 *a*)

Some fragments from the badlands at Ug-tokhoi belong to the left hyoplastron of a form that shows great resemblance to *Osteopygis*. It differs from the specimens from Chia-yü-kuan in having a number of broad, well defined digitations separated by deep notches. The find was made in the sediments below the lava (p. 42).

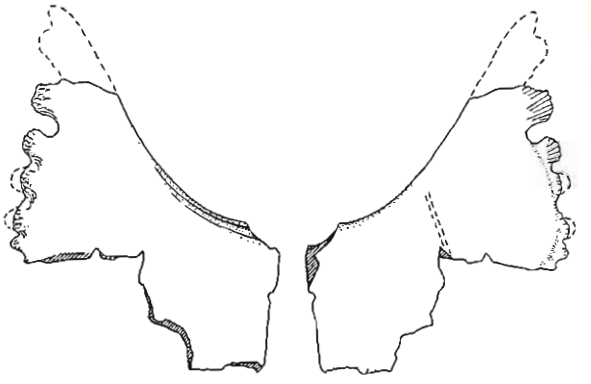


Fig. 56 *a*. ? *Osteopygis* sp. Fragmentary hyoplastron. Internal and external views. — Nat. size.

FAMILY DERMATEMYDIDAE

According to HAY's monograph this family is difficult to define, but from the general impression of his drawings two of the forms from Kansu must be referred to it, though in one of them the intergular scutes were not developed; they can, however, be missing in genera recognized as members of the family, for instance in *Xenochelys* (l.c. p. 282). The forms to be described are evidently new and they do evidently not belong to hitherto known genera. WIMAN has described a dermatemydid under the name of *Sinochelys applanata*. His material is not bad, but unclear in many respects where comparisons with one of the new forms would be of great value. There is some resemblance in the plastron, but important details at the anterior end are unknown in WIMAN's species; and *Alamosemys*, described by HAY (l. c. p. 260) agrees just as well.

GENUS PEISHANEMYS NOV. GEN.

Peishanemys latipons n. sp.

(Pl. VIII, fig. 1—2; Textfigs. 57 and 58)

Type: Partial carapax and plastron, and a number of skeletal bones of one individual.

Locality: Ehr-chia-wu-tung in the Peishan north of Yü-men-hsien, Kansu.

Horizon: Cretaceous (cf. p. 67).

The specimen is larger than the type specimen of *Osteopygis kansuensis* and probably any other of the forms from Chia-yü-kuan. The peripherals laid together give a broad oval with a length of 38 cm and a width of more than 30 cm; these measurements were taken with the plates laid "flat"; if the convexity of the shell were taken into consideration they might turn out somewhat shorter. The carapace must have been more elevated than in *Sinochelys* even if allowance is made for a dorsoventral compression after the embedding of the shell of the latter (WIMAN 1930, p. 12; compare the cross-section of *Sinochelys* in WIMAN's Pl. IV, evidently taken somewhere near the suture between the sixth and seventh peripheral, with the drawing of the anterior end of the 7. peripheral in *Peishanemys*.) The free border of the peripherals is everywhere acute, but not very protruding in

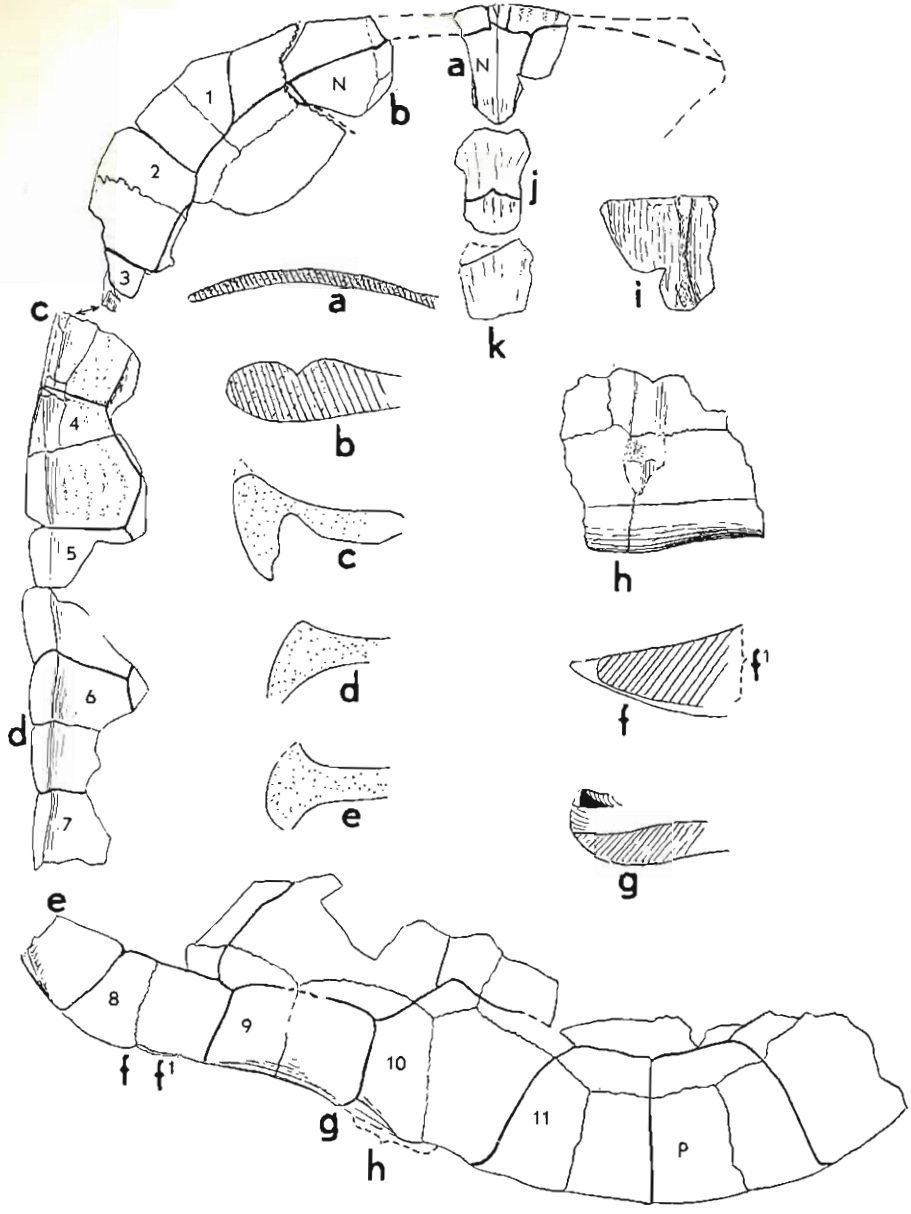


Fig. 57. *Peishanemys latipons*. Peripherals etc. In the external views the bones are laid flat which accounts for the discontinuities. — *a*—*g* Sections at points with the same letters. Shaded part in *f* = section at *f*1. — *h* Rib attachment between peripherals 10 and 11. — *i* Inferior view of nuchal plate. — *j*—*k* Neurals. — Upper views of peripheral plates, and figs. *h*—*k* × 1/2, other figs. natural size.

the peripherals opposite the bridge. The surface of both carapace and plastron is finely punctuated.

The thickness of the lateral parts of the nuchal to a point at least 20 mm from the suture with the first peripheral is 7 mm. In the middle, and at least 21 mm towards the sides, the plate is extraordinarily thin, its thickness being only 2 mm. The transition from the thicker to the thinner part may have been rapid but if it took place in less than 2 cm

the result must have appeared very strange. Thus the nuchal might have been very broad, measuring at least 12 cm along the free border—the length of the first peripheral is only $3^1/_2$ cm. This interpretation presupposes the presence of only 11 pairs of peripheral plates as in all others of the better known turtles in the material. There may, however, have been a separate pair in front of that which is here designated as the 1. peripherals (which are structurally like the 1. peripherals in *Osteopygis* and *Tsaotanemys*). If the plates of this extra pair were of the same size as those behind, the width of the nuchal would have been only about 5 cm. On its upper surface the nuchal carries a system of distinct sulci which show that the nuchal scute was very small, measuring only 8 by 8 mm (its posterior border was oblique), and that the first vertebral scute was narrow, measuring 20 mm at its anterior end and tapering backwards so that at the posterior end of the preserved part it measures only 13 mm—the preserved length is 29 mm, and the scute may not have been very much longer. On the sides of the nuchal scute several grooves extend from the free border to the sulcus between the narrow first marginal scute and the first costal scute. On the lower side a ridge extends to near the free border, undoubtedly an attachment for a vertebra (fig. 57 *i*). It seems as if this broad nuchal plate carried two scutes on each side of the nuchal scute which would make the total number of marginals 13.

The 1. peripheral is traversed by the sulcus marking the border between the 1. and 2. marginal scute; it begins near the posterior border of the plate and runs in a slight S-curve towards the anterior border, forming a very acute angle with the costo-marginal sulcus. The sulcus between the 1. and 2. costal scutes runs at the posterior end of the nuchal and does not touch the 1. peripheral. The posterior surface of the bone was undoubtedly reached by the foremost digitation of the axillary buttress.

The 2. peripheral receives the end of the axillary buttress in the same way as the 3. in *Osteopygis*. Beside the buttress there was no connection with the plastron, the lower margin, which is distinct along the whole length of the plate, forming a clear edge without the slightest trace of a sutural contact.

The same is true about the 3. peripheral. In this plate the inner surface is fairly uncomplicated. It seems to have connection with the plastron only at its very anterior end in a pit which it shares with the 2. peripheral. Between this pit and a slightly impressed attachment for the 1. rib the surface is smooth. The upper lamella is broken away, and only anteriorly a little of the costo-marginal sulcus is seen. The intermarginal sulcus lies a little behind the middle of the bone. Posteriorly the plate is very damaged and only above the lower margin part of the posterior surface is preserved. In fig. 57 the plates are placed so that the upper surface is horizontal; in this position the 3. peripheral cannot be connected with the 4.—the double arrow indicates the approximate location of the contact points.

At the posterior end of the 3. peripheral the upper and lower surfaces form an acute angle (fig. 57 *c*), at the posterior end of the 4. the sides are at right angles. Passing the 5., 6., and 7. peripherals the angle opens to more than a right (fig. 57 *d*). There are marked constrictions at the intermarginal sulci on these three scutes which make the sides, inclusive the free border, undulate slightly. The ribs were evidently very loosely attached to these

peripherals. There are no real rib pits but only broad shallow grooves ending in a shallow impression at the base ot the lower lamella. The attachments lie above the sutures between peripherals 3—4, 4—5, and 5—6, and a few millimetres behind the suture between 6—7. The upper lamella is best preserved in the 4. and 5. peripherals. The area occupied by the marginal scutes has a surface structure of ridges roughly parallel with the costo-marginal sulcus (indicated in the figure). The 7. peripheral has evidently no connection with the inguinal buttress.

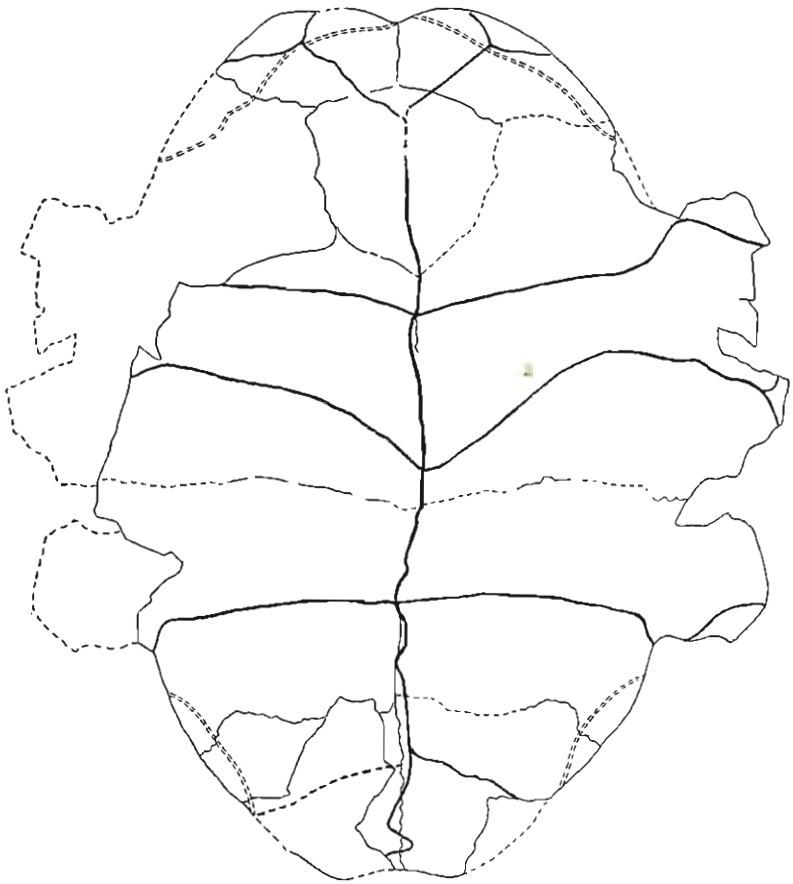


Fig. 58. *Peishanemys latipons*. Plastron: Inferior view. The broken, double lines show the approximate extension of the scutes on the upper surface. × 4/9

At the anterior end of the 8. peripheral (fig. 57 *e*) the upper and lower surfaces are still almost at right angles and the free border is upturned, but the transition to a very acute angle and a strictly lateral free border takes place within the anterior half of the plate. The strong posterior digitation on the inguinal buttress is received by a pit near the posterior end of the plate and it evidently reached also the anterior end of the 9. peripheral, which has a free lower border as far back as to the inter-marginal sulcus.

Within the area covered by the 10. marginal scute (or 11.; see above) the free border is strongly upturned, a feature that cannot be due to postmortal deformation as it occurs on both sides. The 11. peripheral plate is remarkable in so far as the costo-marginal sulcus runs several millimetres inwards from it as is the case also with the pygal.

In conclusion it may be said that the distance between the anterior end of the axillary and the posterior end of the inguinal buttresses is comparatively so much larger than in *Osteopygis* that the 1. and 9. peripherals have the same relation to the buttresses as the 2. or 8. respectively in that genus. Thus the bridges must have been very broad, hence the specific name *latipons*.

Measurements:

Peripheral	Length	Width		Thickness
		Upper face	Lower face	
1.	36	30	—	9
2.	33	34	30	—
3.	38	—	28	—
4.	40	—	16 +	—
5.	39	—	—	—
6.	39	?34	20	—
7.	42	—	—	—
8.	42	—	—	—
9.	42	34	—	11
10.	43	36	—	8
11.	43	36	—	6
Pygal.	46	28	—	7

The fragments of the inner parts of the carapace do not suffice to give an idea of its structure. The position of the more or less fragmentary neural plates (Pl. VIII, fig. 1 *a*; Textfigs. 57 *j*, *k*) in the material cannot be determined.

Plastron

The central part of the plastron is so well preserved that the form of its lobes and the course of all the sutures and sulci can be determined (Pl. VIII, figs. 2 and 3; Textfig. 58). The bridges and the buttresses are less well preserved. Infra-marginal scutes were undoubtedly present, as indicated by the branching of the sulcus between the pectoral and abdominal scutes. On the internal surface of the posterior lobe, just behind the base of the buttresses, there are rugose areas for the attachment of the pelvis. For other details the reader is referred to the figures.

GENUS HEISHANEMYS NOV. GEN.

Heishanemys imperfectus nov. sp.

(Pl. VIII, figs. 13—15; Textfigs. 59)

Type: Posterior part of 5. and partial 6. and 7. peripherals from the right side, and the 9. peripheral from the left side (regarding the numbers of the peripherals, see below). A partial left epiplastron.

Locality: The Chia-yü-kuan badlands.

Though the fossil remains of this turtle are very scanty, they are so characteristic that the species is easily recognized as different from all other turtles from the Cretaceous of Western Kansu.

The determination of the numbers of the peripherals is somewhat uncertain. As we have seen above, the 8. in *Peishanemys* plays the part of the 7. in *Osteopygis*, and as the relationships of the present species are uncertain it may follow either type. In the description it has been assumed that the connection between carapace and plastron was as in *Osteopygis*. The plate designated as the 9. peripheral is uncertain also in its relation to the others.

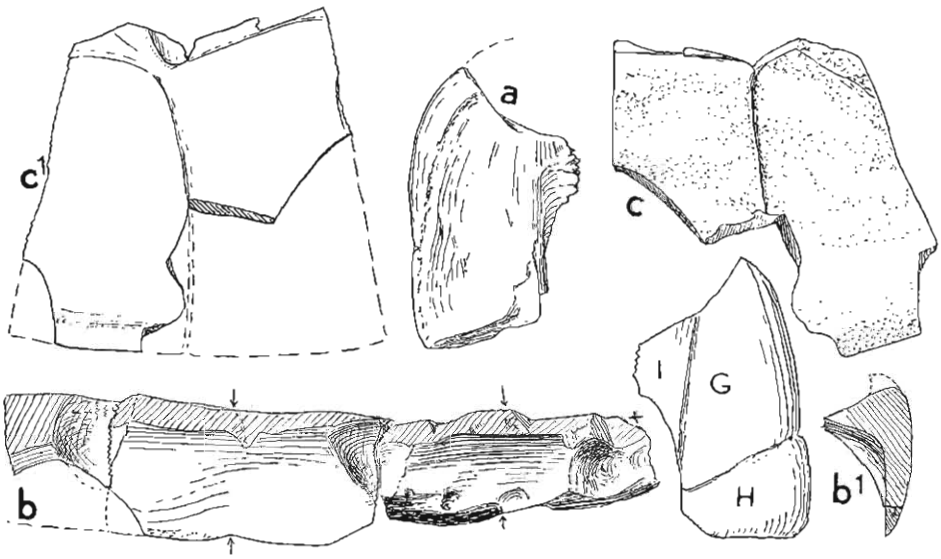


Fig. 59. *Heishanemys imperfectus*. *a* Epiplastron (I intergular, G gular, H humeral scutes). — *b* Peripherals (5), 6, and 7: Internal view. The arrows indicate the location of the intermarginal sulci, + ? part of a superficial rib attachment. *b*¹ Posterior surface of 6. peripheral. — *c* Peripheral 9: Superior view (*c*¹ inferior view). — All nat. size.

The plates have a marked, upturned free edge, that is rather low on the fragment of the 5. but increases in height backwards, being very pronounced and still distinctly upturned at the posterior end of the 7. The very edge is broken away from the middle of the 6. backwards. The ribs were attached at the sutures between the plates. At the sutures 5—6 and 6—7 there are distinct rib pits excavated in the inner side of the lower lamella; more than $^2/_3$ of these pits belong to the anterior bone. They open towards the upper surface 8 mm inside the free border (sharp upper edge of the pit); in front of the pit and behind it the upper surface must have been much broader as it is quite thick at the fracture (fig. 59 *b*); thus the upper surface must have been deeply notched at the ribs. Between the 7. and 8. plate the attachment for the rib seems to have been entirely superficial—the sloping outline at the + in fig. 59 *b* marks the inner end of the part belonging to the 7. peripheral. On the supposed 9. peripheral the attachment opens downwards (the distal end is seen in fig. 59 *c*¹). The 7. peripheral has a large posterior and two smaller anterior

pits for the inguinal buttress. A very small impression near the anterior border may be only the opening of a vascular canal. There are no pits for the plastron on the 6. peripheral and the question may arise if the numbering should not shift one step forwards to obtain fuller agreement with *Osteopygis*. The plate described here as the seventh lies, however, decidedly at the posterior end of the sternal chamber. The inguinal buttress probably touched the plate behind it but this plate must have been like the 8th in *Osteopygis*. The 9. peripheral is flat and of uniform thickness except near the free border where it becomes suddenly thinner and slightly turned downwards. The lower surface is smooth and even, except for the shallow intermarginal sulcus. The upper surface has an irregular relief and a deeper sulcus but it is not sculptured in any way. The plate evidently belongs to the left side (see p. 101).

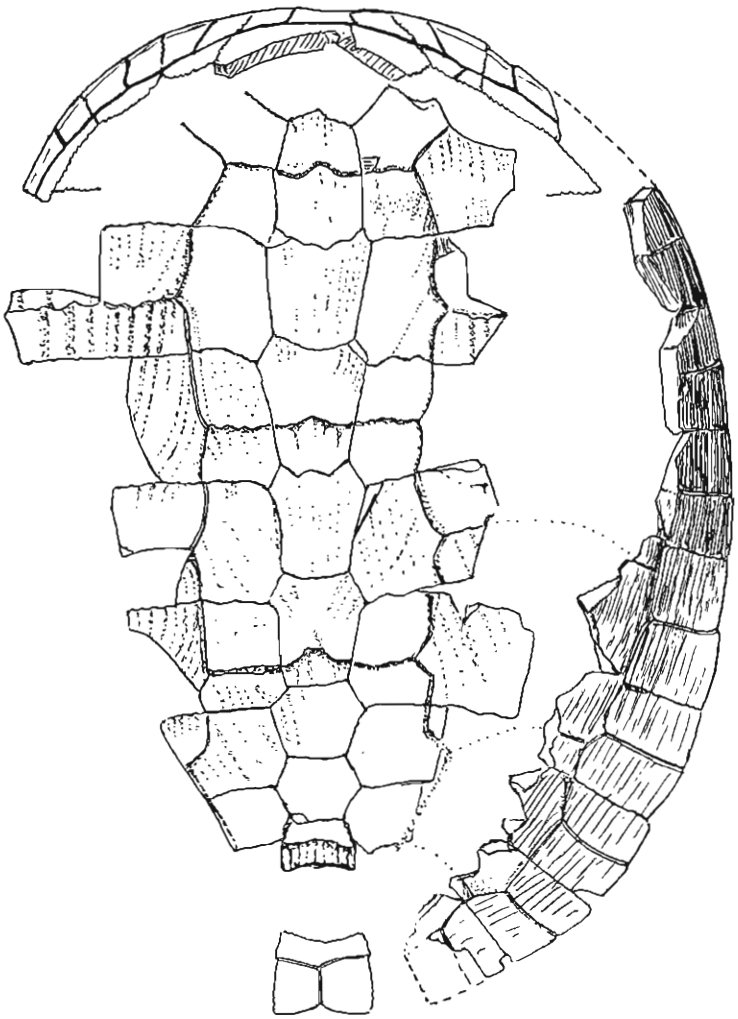


Fig. 60. *Tsaotanemys* sp. Parts of carapace (combined from four individuals). In the central part the plates are laid out flat.—Nat. size.

The length of the 6. peripheral is 39 mm, the width of its inner surface about 21 mm. The length of the 7. peripheral is also 39 mm. The length of the 9. was about 47 mm, its width 44 mm and its thickness 7 mm.

The epiplastron is 9 mm thick at the raised suture with the hyoplastron, otherwise its greatest thickness is 8 mm. It has a groove for the endoplastron on its median surface. The scutes marked by the sulci are probably the gular *(G)*, humeral *(H)*, and intergular *(I)*. An epiplastron of this type cannot have belonged to a Thalassemydid. Its massiveness indicates a solid plastron as for instance in the Baüridae as suggested by Hay's figure of *Taphrosphys* of his Bothremydidae (l. c. fig. 116), a genus which otherwise evidently shows very little resemblance to *Heishanemys*. The new genus has been provisionally referred to the Dermatemydidae, but in fact too little is known of it to assign it with certainty to any known family.

On the other hand the genus is very different from other genera represented in the material, one need only mention the peculiar rib pits and the arrangement of the scutes on

the epiplastron which among other characters distinguishes the genus from *Peishanemys*, which is the genus that seems to have at least something in common with it.

GENUS TSAOTANEMYS NOV. GEN.

Turtles referable to this genus are very common in the Chia-yü-kuan badlands, perhaps more common than any others. The material is rather heterogenous as will be evident from the description, but it is hard to tell what is individual variation and what can be considered as specific characters. It has, however, been found convenient to deal with the material in the same way as with that of *Osteopygis*: Some new species are described and other specimens are dealt with under the heading of their field numbers. Figs. 60—62

Fig. 61 *a. Tsaotanemys* sp. Portion of the anterior end of the carapace. Right half of first vertebral scute restored. × $^2/_3$.

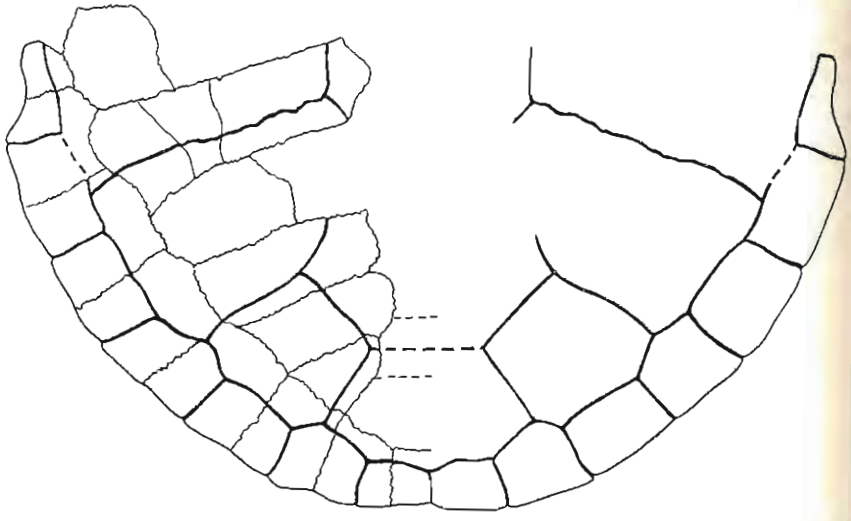


Fig. 61 *b. Tsaotanemys* sp. Posterior end of carapace. Combined from two individuals. Plates laid out flat. — Approximately × $^2/_3$.

are combined from several individuals. In fig. 60 the central parts with the exception of the 8. neural belong to one individual, the peripherals and the pygal belong to three other individuals. The parts might belong to more than one species but the combination must give a fairly correct idea of what these turtles were like: The outline of the shell was a regular ellips and the carapace was evidently rather elevated. Most of the plastron (fig. 62) belongs to the same individual as the neurals and costals in fig. 60 (see Pl. VII, fig. 11). Most parts are so well represented that the reconstruction is much more accurate than that of the plastron of *Osteopygis*.

On an average the species of *Tsaotanemys* are smaller than those of *Osteopygis*, the largest specimens attaining the size of the smallest ones of that genus, the shell is, however, thicker and of specimens of approximately the same size those of *Tsaotanemys* probably appeared heavier than the other ones.

In all specimens the posterior peripherals, from the pygal plate to the posterior end of the 8th, are thick at the costo-marginal suture, but they become rapidly thinner towards the periphery, and their free border forms a sharp edge; on the 8. the edge becomes blunt

and from there it becomes gradually thicker, reaching its maximum on the 5. and 4. plates. On the anterior half of the 3. peripheral the free border concentrates to a narrow upturned swelling which becomes thinner forwards and disappears on the lateral parts of the nuchal. The area covered by the nuchal scute is flat and its free border faces forwards. The axillary buttress of the plastron reached well beyond the middle of the 2. peripheral, the attachment for the inguinal buttress, on the other hand, did not occupy more of the eighth peripheral than in *Osteopygis*.

The epiplastra are narrow, transverse bones. There were evidently no intergulars. The median portions of the plastron are very thick.

The sculpture on the carapace consists of more or less distinct parallel ridges at right angles to the sulci, or small warts arranged into rows or fused to small irregularily branched ridges. All over its lower surface of the plastron shows a fine irregular structure of small elongate depressions between branching ridges which in places dissolve into warts, but on the whole this surface is very flat and even.

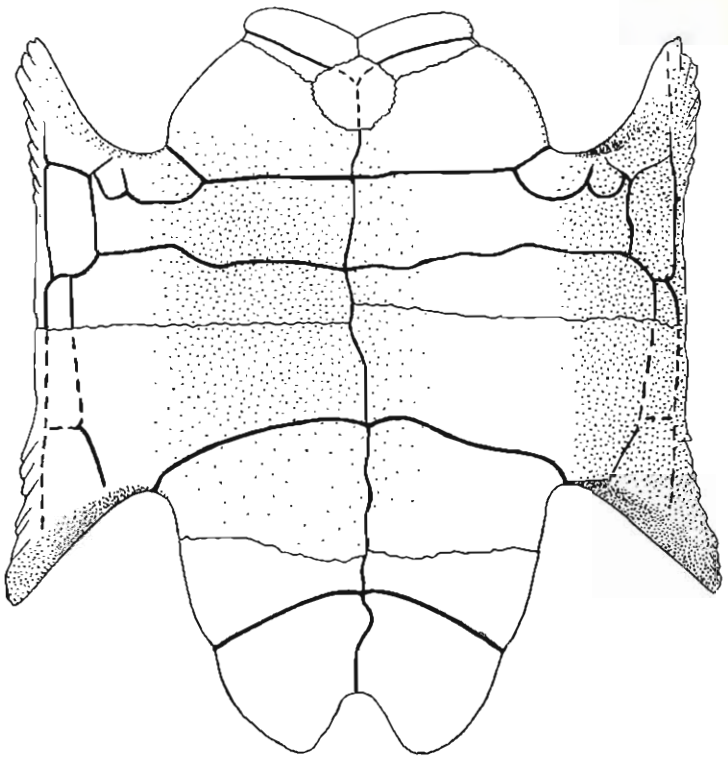


Fig. 62. *Tsaotanemys* sp. Restoration of plastron. Nat. size.

This general description has been given because there is no single specimen in which all parts are preserved. Many details in the description of the species below are, however, also characteristic of the whole genus.

Tsaotanemys rugosus nov. sp.

(Pl. VII, figs. 1—4; textfigs. 60—66)

Type: A specimen marked "10". 7. and 10. peripherals from the left side, 6.—11. from the right side. Fragments of costals and plastron.

Two other specimens were used for the description:

1. A specimen marked "19". 1.—11. peripherals from the right side. Parts of the plastron.
2. A specimen marked "52". Nuchal plate. 1.—7. peripherals from the left side; 1. and 2. from the right side; 1. neural; parts of costals and plastron.

The nuchal plate (figs. 60 and 63) is broad and of almost uniform thickness (slightly thicker laterally). The distance between the sulci delimiting the nuchal scute is anteriorly

7 mm., posteriorly 9 mm. The length of the nuchal plate is unknown (cf. the reconstruction fig. 63 *e* of a nuchal of another specimen). The width is 29 mm.

On the 4. and 5. peripheral the free margin is very thick so that these plates almost form $^1/_4$ of a cylinder.

The peripherals are all firmly joined with the costals by sutures (of the 4. and 5. this is doubtful; see below), the 3.—10. also by the ends of the ribs. The end of the first rib is conical and the pit for it on the 3. peripheral is well separated from the attachment for the axillary buttress (fig. 66). On the 4.—6. peripherals the rib pits are strongly compressed, on the 7. the cross-section of the rib is circular, on the 8.—10. the ends of the ribs

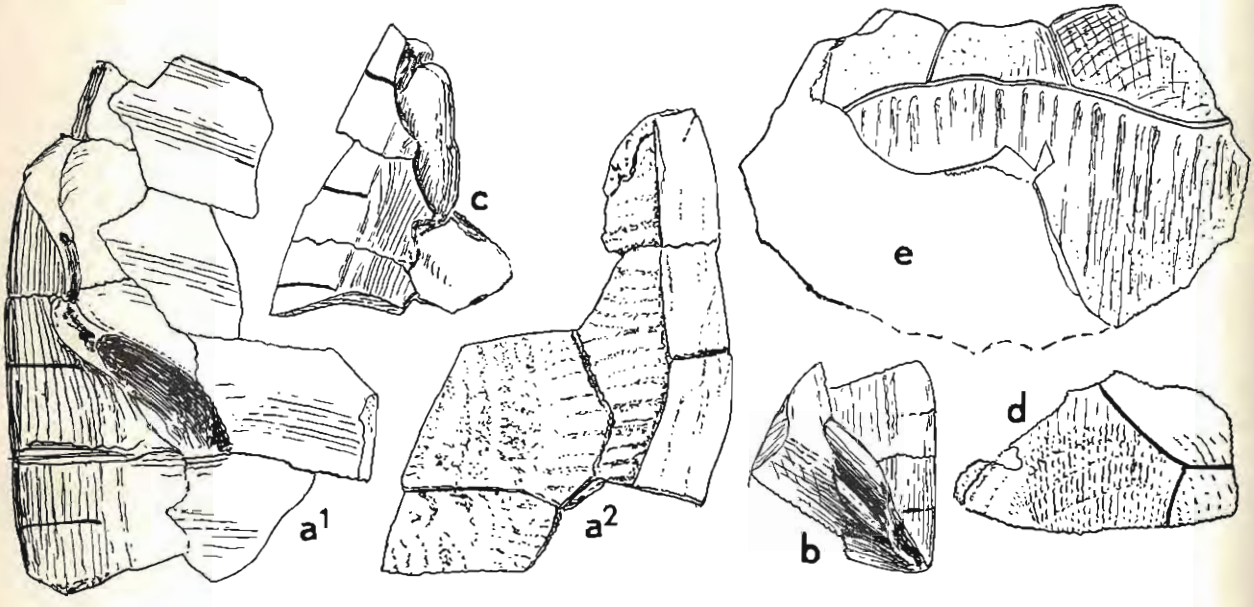


Fig. 63. *a Tsaotanemys rugosus*. Type. a^1 Peripherals 6—8 and parts of costals from below. a^2 Detail of sculpture (part of fig. 61 *b*). — *b Tsaotanemys* sp. Peripherals 2 and 3 with first rib and anterior digitation of axillary buttress from below. — *c Tsaotanemys* sp. Peripherals 7—9 with posterior end of inguinal buttress. — *d Tsaotanemys* sp. Left first costal. — *e Tsaotanemys* sp. Nuchal plate. — a^1, *b*—*d* Approximately nat. size; a^2, *e* × 2.

are again flat. There is sutural connection also with the plastron in the parts between the buttresses. The sulci are very well marked; on the costo-marginal sulcus the costal side is higher than the peripheral side. This sulcus passes also the pygal (fig. 60; the plate is not preserved in any of the specimens on which this description is chiefly based, but it is evident from the behaviour of the sulcus on the 11. peripheral that it must enter the pygal also in this species). There are sulci between costal scutes on the 1., 7. (anterior end), 8. (posterior end) and 10. (posterior end) peripherals; where the sulcus between the 2. and 3. costal scutes reaches the peripherals is uncertain, as there is no specimen that is well enough preserved to show it.

The sculpture on the plates is well developed, especially in the type (Pl. VII, fig. 4; textfig. 63 a^2), hence the specific name.

Peripheral [1]	10 L	10 W s	10 W i	10 T	19 L	19 W s	19 W i	19 T	66 L	66 W s	66 W i	66 T	5 L	5 W s	5 W i	5 T	52 L	52 W s	52 W i	52 T
1.	—	—	—	—					17	13.5	—	7	16.5	15	—	7	13.5	12.5	—	5
2.	—	—	—	—					17	14.5	14	9.5	17.5	17	—	10	14	13.5	—	7
3.	—	—	—	—					19	—	—	—	20	14+	14	—	16	13	10+	—
4.	—	—	—	—	17.5	—	8	—	—	—	—	—	19.5	—	13	—	16	12[2]	8	—
5.	—	—	—	—	17	11.5[2]	9	—	18	13[2]	—	—	—	—	—	—	17	11[2]	10	—
6.	—	—	12.5	—	18.5	11[2]	10.5	—					21	—	14	—	—	11[2]	—	—
7.	22	22	17+	—	18	20	15+	—	19.5	18	15	—	—	—	—	—	18.5	18	14+	—
8.	19	23	—	10	17	19+	—	8	—	—	—	—	—	—	—	—	—	—	—	—
9.	17	22	—	7	15	18	—	6	16	16	—	6.5	—	—	—	—	—	—	—	—
10.	17	19	—	6	15	17	—	5	14	15	—	6	—	—	—	—	—	—	—	—
11.	15	18	—	5	—	14	—	4.5	13	13.5	—	4.5	—	—	—	—	—	—	—	—
Pygal									13	10	—	3.5								

[1] L = Length. W s and W i = width of superior and inferior surfaces. T = Thickness.
[2] To the costo-marginal sulcus.

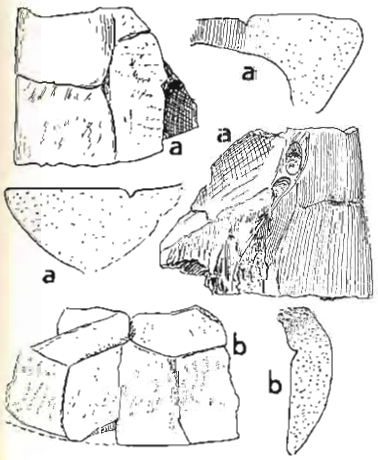


Fig. 64. *Tsaotanemys rugosus*. Type. *a* Peripheral 7 from above, from below, anterior, posterior surfaces. — *b* Do. 10 and 11 from above, and anterior surface of peripheral 10. — Approximately nat. size.

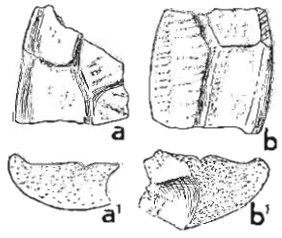


Fig. 65. *Tsaotanemys rugosus*. *a* First peripheral. *a*[1] Posterior surface. — *b* Second do. *b*[1] Posterior surface. — Nat. size.

Fig. 66. *Tsaotanemys rugosus*. Third peripheral: Upper, inner, anterior, and posterior views. Nat. size.

The seventh peripheral which is present in all these specimens differs somewhat in its proportions, that of specimen "19" being somewhat wider than the others. Specimens 10 and 52 agree in this respect, but in the latter the free border is thinner and slightly upturned. In specimen nr. 10 the upper surface is flat at the posterior end and even somewhat convex anteriorly.

Tsaotanemys compressus nov. sp.

(Fig. 69)

Type: A specimen marked "56". Peripherals 7 and 9. To the same species are referred specimens marked "66" and "70". In this species the 7. peripheral is more compressed dorso-ventrally than in *T. rugosus* (cf. figs. 64 and 69). There seem to be minor differences in the structure, but the material is partly so unclear that it cannot be decided to what extent these differences are constant.

To this species some 4.—6. peripherals probably belong in which the angle between the upper and lower surfaces is smaller than in *T. rugosus* and the free border thinner and more distinct (cf. fig. 71 *a*—*c*). In a 4. peripheral evidently belonging to *T. rugosus* the angle is so large at the posterior end (and thus at the anterior end of the 5.) that the surface facing towards the sternal chamber is almost perfectly flat. In a 5. and a 6. peripheral there is a distinct sutural connection with the costals interrupted by a deep notch at the rib.

There are two types of posterior peripherals found together with the type specimen. In one of them, probably the ninth, the surfaces on both sides of the intermarginal sulcus show no other relief than some ridges parallel with the free border (fig. 69 *b*), further, these surfaces lie almost in the same plane. In the other type, represented by two eighth and one ninth peripheral, the anterior surface is raised at the sulcus especially as its inner end and the posterior surface shows a slight swelling at the antero-internal corner. Both types may equally well belong together with the seventh peripheral. A comparison with other specimens having similar peripheral 7 makes the association with the last mentioned type probable, though some characters may decide in favour of the first type.

Measurements:

Peripheral[1]	56 L	56 W s	56 W i	56 T	63 L	63 W s	63 W i	63 T	70 L	70 W s	70 W i	70 T
2.	—	—	—	—	14	14	—	7.5	—	—	—	—
4.	—	—	—	—	—	—	—	—	15	—	8	—
5.	—	—	—	—	17	11[2]	10	—	17	10[2]	9.5[2]	—
6.	18	12	9.5[2]	—	17	—	—	—	18.5	12[2]	10	—
7.	18.5	18	18.5[3]	—	18	18	14 +	—	17.5	17	15.5 +	—
8.	(15.5	17	—	7)	17	15 +	—	6	17	15	—	7
9.	(13.5 +	? 15	—	5)	—	—	—	—	(16.5	18	—	5)
10.	—	—	—	—	(14 ?	14	—	4.5)	(14.5	17	—	4.5)
11.	—	—	—	—	(14	15.5	—	4)	—	—	—	—

[1] L, W etc. see table under *T. rugosus*.

[2] to the costo-marginal sulcus.

[3] the only specimen in which this surface is complete.

Tsaotanemys parvulus n. sp.

Type: A specimen marked "21" (fig. 70). Peripherals 2, 5, 7, and 9, from the right side. A similar form seems to occur among material marked "70".

The 7. peripheral is the most characteristic. It has no sutural connection neither with the costals nor with the plastron. The rib pit is rounded and separated from the attachment for the inguinal buttress by a thin lamella of bone as in the other species. But this attachment consists of three more or less distinct pits in a wide groove that is closed towards the eighth peripheral, though evidently continuing across the barrier into this plate.

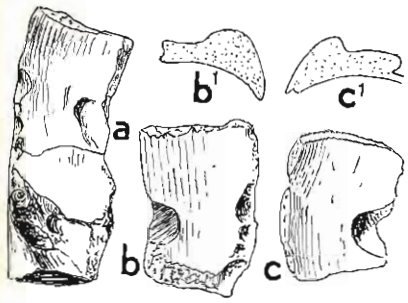


Fig. 67. *Tsaotanemys* aff. *rugosus*. *a* Peripherals 6 and 7. Inner side. — *b* and *c* Do. Peripherals 5 and 6 of another individual. b^1, c^1 Anterior surface of the respective bones. — Nat. size.

Fig. 68. *Tsaotanemys* aff. *rugosus*. Peripheral 10: Upper view and end surfaces. Approximately nat. size.

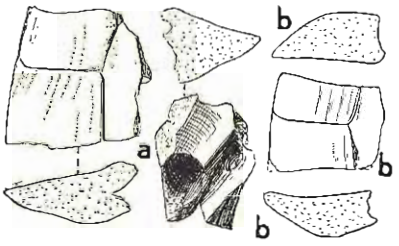


Fig. 69. *a Tsaotanemys compressus*. Type. Peripheral 7: Upper, inner, anterior, and posterior views. — *b Tsaotanemys* sp. Peripheral 9. Anterior surface (upper side downwards) and posterior surface. — Nat. size.

In the other species the pits are more irregular, sometimes smaller and more numerous, sometimes the bottom of the groove has pits only anteriorly (cf. figs. 67 *a*, 69 and 70).

There are two types of the 2. peripheral. That belonging to the type has a very broad sutural connection with the first costal as normally in the genus. The other type has such a connection only in the anterior half, and in the 3. peripheral belonging to the same individual there is no connection at all.

Peripheral	21 L	21 W s	21 W i	21 T	70 L	70 W s	70 W i	70 T
2.	13	13	—	6	13	13	—	6
3.	—	—	—	—	14	11	11	—
5.	14	11.5	8.5	—	—	—	—	—
7.	16	16	16	—	16	14.5	15.5	—
9.	16	—	—	4.5	—	—	—	—

Tsaotanemys undulatus nov. sp.

(Pl. VII, fig. 9)

Type: A specimen marked "92". Peripherals 8 and 9 from the left side with adjoining parts of costals. An isolated left 8. peripheral, two proximal ends of costals, parts of the plastron.

This specimen differs from the others in having a smooth, only slightly undulating outer surface on the preserved parts (Pl. VII, fig. 9; compare Pl. VII, fig. 4). The peripherals resemble the ninth peripheral mentioned above under *T. compressus*. The dimensions of

both 8. and 9. peripherals are approximately L 15, W 18, T 8 (eighth) and 6 (ninth). The same measurements for the 9. peripheral belonging to "56" ("type 1", see above) are 13, 16, and 6.5 (fig. 69 *b*).

An almost complete hypoplastron belonging to this find is transversely concave below, whereas in most other specimens it is flat.

Other material of Tsaotanemys

No. 14. A large specimen (one individual) comprising peripherals 7—9 and 11 on the left side, the pygal plate, and peripherals 9—11 on the right side, further fragments of costals and plastron. In this specimen the surface of the peripherals (at least the posterior ones) is almost entirely devoid of sculpture.

The hypoplastron is concave transversely.

Measurements:

Peripheral	L	W	T
7.	23	—	—
8.	21 ?	24	11 ?
9.	18.5	22.5	8
10.	15	20 ?	6
11.	15 ?	17	5
Pygal	14	12	3.5

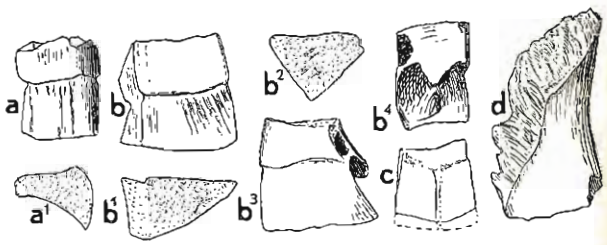


Fig. 70. *Tsaotanemys parvulus*. Type. *a* Peripheral 5. a^1 Posterior surface. — *b* do. 7. b^1—b^4 Upper, posterior, anterior lower, and inner views. — *c* Do. 10. — *d* Distal end of buttress of some other species. — Nat. size.

No. 50 is a very inhomogeneous lot (fig. 71). Of the figured plates those in *b* and *c* evidently belong to *T. compressus*. The 6. peripheral fits so well on the 7. of the type of this species that one would believe that they belong to the same individual though this can hardly be the case. The 8. peripheral in *e* may also belong to *T. compressus*; it is remarkable because the rib pit has failed to develop. Where the plates in figs. *a* and *d* belong is uncertain.

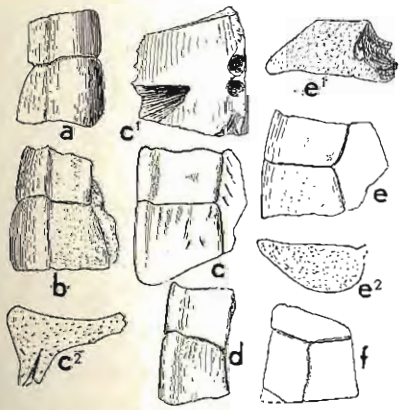


Fig. 71. *Tsaotanemys* sp. var. (see text) *a* Peripheral 4. — *b* Do. 5. — *c* Do. 6: Upper, lower, and posterior views.—*d* Do. 6. —*e* Do. 8. e^1 Anterior surface (upper side downwards). e^2 Posterior surface.—*f* Do. 10.—Nat. size.

About the value of the species described above see p. 103.

Central part of carapace

All attempts at a complete reconstruction of the costals failed. The parts in fig. 60 are from the same individual (except the 8. neural), partly completed on either side to get the outline of the vertebral scutes. What is really present is seen in Pl. VII, fig. 2. The reconstruction of the posterior part in fig. 61 *b* is based on several fragments.

Measurements of neural p

Neural	Length	Width	Thickness
1.	18	12	5
2.	17	14	5
3.	18	15	5
4.	17	13	5
5.	15	13	5
6.	10	13	4.5
7.	9	11	4.5
(8).	8	10	3.8

The 8. neural belongs to the lot numbered "21", which is heterogeneous. It is so much thinner than the 7. that it may even belong to a species of *Osteopygis*.

Plastron

The plastron is so well represented by specimens which complete each other that the restoration in fig. 62 comes very near the real appearance. The best specimen belongs to the same individual as the neurals and costals in fig. 60 (Pl. VII, fig. 11). From this specimen the central parts could be drawn. There is some uncertainty as to the posterior end but on one side of the incision the natural border is preserved, on the other side the external border, and the tips are obtained by a fairly mild extrapolation. The entoplastron is missing but its size is evident from the gap between the surrounding bones. All sutures and sulci are plainly seen, the only uncertainty concerns the entoplastron, but it gives very little room for complications, and a simple course of the sulci as shown in the figure is the most probable one. The width of the bridges and details in their structure were obtained from isolated hyo- and hypoplastra with portions of the axillary or inguinal buttresses attached to them. Only the inframarginal scutes on the hypoplastral portion of the bridge are entirely unknown. The small rounded scutes behind the axillary notch are indicated by sulci in this place, but they might have been produced by wrinkles on the inner side of the pectoral scute. A specimen comprising the lateral portion of the hyoplastron shows that the contact with the peripherals was by a suture, thus there were no fontanelles, except perhaps in *T. parvulus* in which sutural connections of the peripherals had a very limited extension.

The ends of the buttresses are thick (fig. 70 *d*) and buried in wide pits on the lower surface of the carapace. There are rugosities for the ligamental attachment of the ischia on the inner side of the xiphoplastra.

GENUS INCERTAE SEDIS

GENUS YÜMENEMYS NOV. GEN.

Yümenemys inflatus nov. sp.

This is the only turtle found in the Hui-hui-p'u badlands and there is nothing like it among the numerous forms from Chia-yü-kuan. The type and only specimen marked

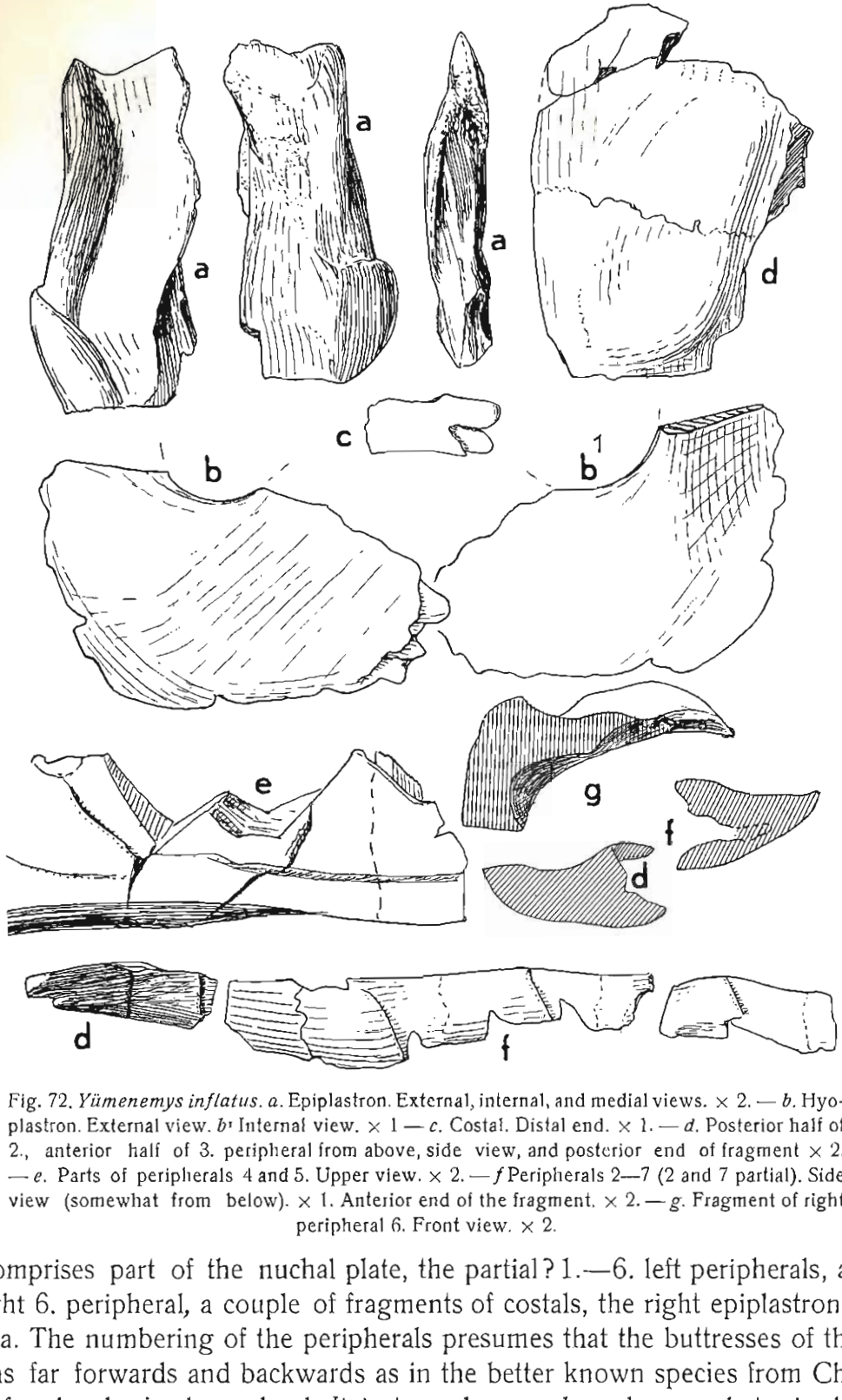


Fig. 72. *Yümenemys inflatus*. *a*. Epiplastron. External, internal, and medial views. × 2. — *b*. Hyoplastron. External view. *b*1 Internal view. × 1 — *c*. Costal. Distal end. × 1. — *d*. Posterior half of 2., anterior half of 3. peripheral from above, side view, and posterior end of fragment × 2. — *e*. Parts of peripherals 4 and 5. Upper view. × 2. — *f* Peripherals 2—7 (2 and 7 partial). Side view (somewhat from below). × 1. Anterior end of the fragment. × 2. — *g*. Fragment of right peripheral 6. Front view. × 2.

"136" comprises part of the nuchal plate, the partial? 1.—6. left peripherals, a fragment of the right 6. peripheral, a couple of fragments of costals, the right epiplastron, and both hyoplastra. The numbering of the peripherals presumes that the buttresses of the plastron reaches as far forwards and backwards as in the better known species from Chi-yü-kuan.

The free border is sharpedged. It is turned upwards and somewhat raised above the

upper surface on peripherals 6—4, on the third it begins to form the outer border and on two anterior peripherals it is developed as a thin very sharp edge facing straight outwards. A remarkable thing is, however, that at the posterior end of the 5. peripheral a terrasse line goes out from the free border diverging only slightly from this at first but then more rapidly; it ends in front of the rib pit on peripheral 4. Farther forwards three similar but weaker and less persistant lines are seen (Pl. VII, fig. 18). The sulci are oblique and directed inwards and backwards both on the upper and lower surface (fig. 72 *e* and *f*). The anterior side of the sulci is raised, the posterior one is flush with the surface behind so that the sulci look like terrasses facing backwards. The areas between the sulci are strongly inflated (hence the specific name). The rib pits lie at the sutures. There are wide notches in the upper surface at each rib attachment and there are notches in the costals too (Pl. VII, fig. 21, textfig. 72 *c*).

The length of the peripherals is about 25 mm (measured between the sulci on the fourth and fifth). The width of the upper surface of the fourth is 16 mm, and of the lower surface of the same bone 14 mm. The thickness at the suture between the 2. and the 3. peripheral is 8 mm; at that between the 1. and the 2. 6 mm. The thickness of the neural plate is 3.5 mm.

The epiplastron is an elongate bone with strong marginal swellings marking the position of the gular and intergular scutes (fig. 72 *a*). The median border has a complicated surface for the contact with the endoplastron (fig. 72 *a*). The hyoplastra are thin. They seem to have had sutural connection only between themselves. The lateral and posterior borders are developed as thin sharp edges and must have been surrounded by fontanelles. The distal end of the axillary buttress is not preserved but there are pits for its digitations on at least 2 cm of the lower border of the 3. and 4. peripherals.

The axillary notches were evidently narrower than in *Osteopygis* and the anterior lobe broader.

Limb bones of Mesozoic turtles

Together with the remains of *Peishanemys* great parts of the appendicular skeleton were found. Of other turtles such remains are scarce. Only the humerus and the femur are present in different genera in such a condition as to make a comparison between them worth while (figs. 44, 73, and 74).

Structurally the limb bones of *Peishanemys* differ considerably from those of *Osteopygis* and *Tsaotanemys*, which are rather similar. The tubercula in the humerus are connected at their base by a shelf whereas in the others they run down separately on the corpus. On the femur the connection between the trochanters is complete; in *Osteopygis* there is no connection; in *Tsaotanemys* the trochanters are joined by a shelf.

In *Osteopygis* and *Peishanemys* the size of the limb bones is proportionally the same. In *Tsaotanemys* the bones seem remarkably small. The figured specimens belong to the type specimen of *T. rugosus* which is one of the largest individuals in the material of *Tsaotanemys*.

TERTIARY TURTLES

The four areas in which Tertiary turtle were found have all yielded fossil mammals. These settle the age of the Tossun nor badlands to be Pontian (BOHLIN 1937 a) and that of the badlands in the Shargaltein Valley (Shih-chiang-tsu-ku) to be Late Oligocene (BOHLIN 1937 b). The Taben-buluk sediments were evidently deposited during a very long time

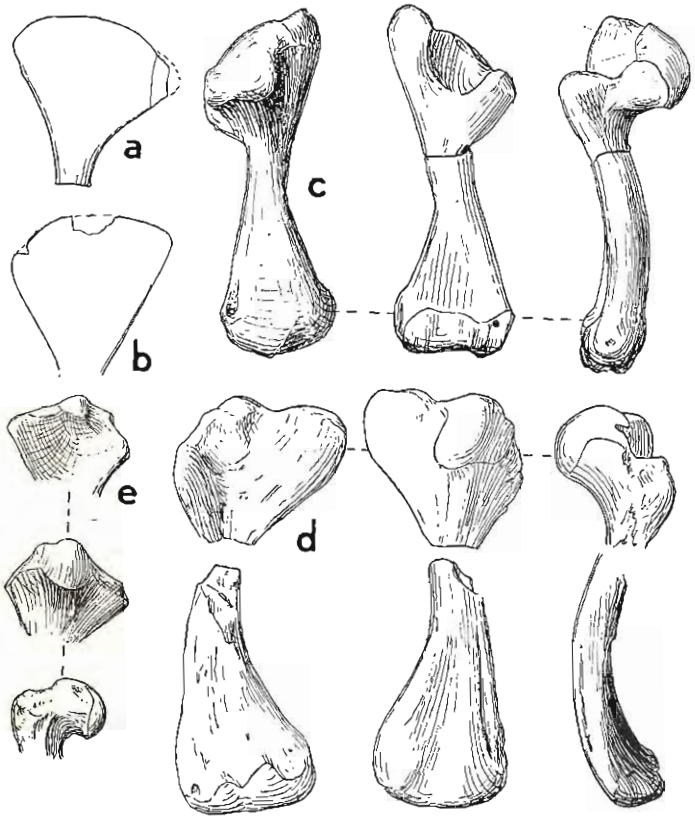


Fig. 73. *a. Peishanemys latipons.* Distal end of coracoid. × 2/3. — *b. Osteopygis* sp. Do. × 1. — *c. P. latipons.* Left humerus: Dorsal, ventral, and medial views. × 2/3. — *d. Osteopygis* sp. Right do. × 1. —*e. Tsaotanemys rugosus.* Left do. Proximal end. × 4/3.

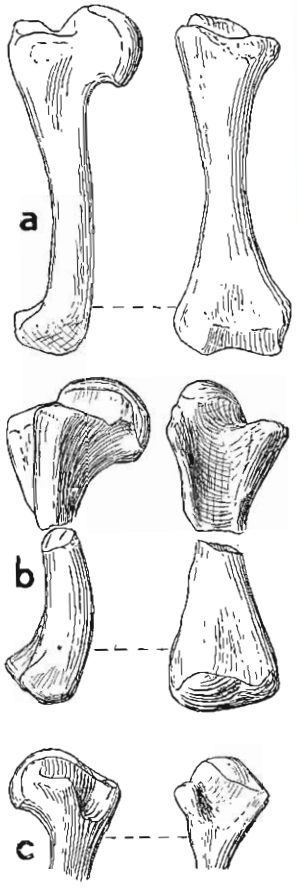


Fig. 74. *a. Peishanemys latipons.* Left femur. Ventral and medial views. × 2/3. — *b. Osteopygis* sp. Do. × 1. — *c. Tsaotanemys rugosus.* Right do. Proximal end. × 4/3.

and the Mammals from the lower part are undoubtedly Late Oligocene, whereas the finds from higher levels are probably Miocene (BOHLIN 1945 p. 248); the turtles, come from these younger beds. The age of the Shih-ehr-ma-ch'eng fauna is unknown (BOHLIN 1951). Of the species of turtles discussed below 5 are from Taben-buluk; the other badlands have yielded one species each. None of the species is common to two badlands.

TABEN BULUK

(Pl. VIII, figs. 4 and 5; Pl. IX, figs. 1—4; textfigs. 75 a—g)

Species A from Taben buluk (304) is represented by a small specimen. The width of the carapace anteriorly in the specimen in Pl. VIII, fig. 5, and textfig. 75 *a* and *b*, is 95 mm. The shell is strongly elevated, height in the middle at the third neural plate (not preserved) approximately 60 mm. The distance along the middle line from the anterior end

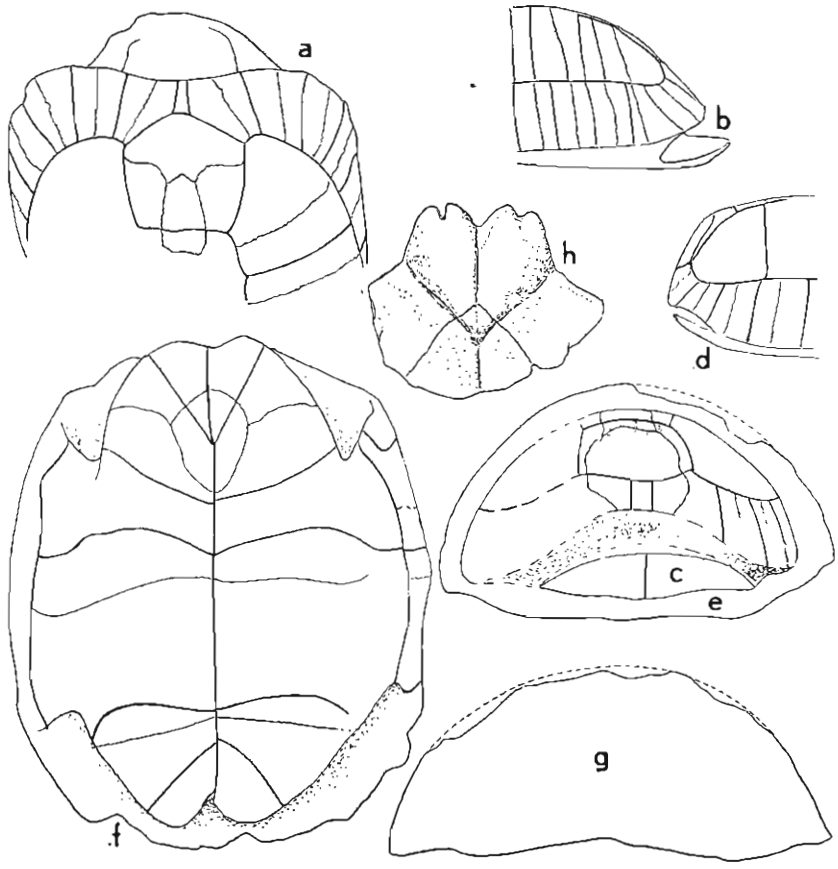


Fig. 75. Tertiary turtles. — *a* and *b* Species A, Taben-buluk (no. 304). *a* same as Pl. VIII, fig. 5; *b* side view. — *c*—*e* Species B. Taben buluk (no. 198). Anterior and lateral views, and section approximately at the middle of the shell. — *f* and *g* Species C, Taben buluk. Inferior view and section at the middle. — *h* Species F. Shih-ehr-ma-ch'eng. Anterior end of plastron. — All × 1/2.

of the plastron to the hypo-xiphiplastral suture is 76 mm, the total length probably about 110 mm. The anterior end of the carapace is broad and truncated with a broad shallow notch in the middle. The anterior end of the plastron is evenly rounded, the free edges of the hyoplastrals and the epiplastrals forming approximately a semicircle, without the sudden protrusion of the epiplastrals which is one of the characters of *Testudo* (Hay 1908, p. 373). The sulcus between the humeral and pectoral scutes passes the posterior end of the endoplastron. The pectorals are very narrow.

Species B. In a specimen (textfig. 75 *c—e*) of about the same size as A (comprising the anterior half of the shell) the plastron is of a similar structure, only the pectorals are broader. The anterior end of the carapace is, however, so different that it must belong to another species than A. In side view the nuchal plate stands almost vertically, at its posterior (upper end) a small surface is set off almost at right angles and the suture with the first neural is marked by three broad ridges, separated by elongate pits. In species A the nuchal slopes gently towards the free border.

Species C (179; textfig. 75 *f* and *g*) is small and rather strongly compressed dorso-ventrally, which must be the original condition as the specimen shows no signs of strong crushing. Compare the cross-sections figs. 75 *e* and *g*. The maximum width of the carapace is 115 mm, the height of the middle about 45 mm, the length of the plastron 126 mm. The anterior end of the plastron is somewhat damaged.

Two other species D and E are represented by larger individuals. One of these (D; Pl. IX, figs. 1 and 2) is almost circular (length and width equal). The other one (E; Pl. IX, figs. 3 and 4) is elongate. The carapace is damaged; the width at the middle is only about $^2/_3$ of the length of the plastron. The complications of the gular scutes in species E is probably an abnormality.

The turtles from Taben buluk have usually suffered badly from the tectonic movements which have raised the beds holding them to vertical position. The figured specimens are, however, remarkably little deformed, and the differences noted above are undoubtedly real. The sediments were evidently deposited in a delta in front of a mountain. The country was partly wooded (CHANEY 1935) and the climate moist. (In one place a thin coal seam was observed—a couple of centimetres thick only.) The great number of species in the comparatively small material collected, is therefore not surprising as there must have been ideal conditions for turtle life.

SHIH-EHR-MA-CH'ENG

(Pl. VIII, figs. 6 and 7; textfig. 75 *h*)

The very monotonous deposits at Shih-ehr-ma-ch'eng and at the northern side of the Hui-hui-p'u badlands have yielded several individuals all undoubtedly belonging to one species (F). The narrow protruding anterior and posterior ends of the plastron, the spacing of the plastral scutes, the shape of the whole shell etc. shows very little variation although there are very great differences in size (Cf. Pl. VIII: 6 and 7—the former is less than half as long as the latter; still bigger specimens were in such a condition that no details could be seen on them but there is no reason to believe that they belonged to other species (same outline and same elevation of the carapace).

SHIH-CHIANG-TZU-KU

(Pl. IX, figs. 5—7)

The small turtle from the Shargaltein Valley (species G) is not identical with that from Shih-ehr-ma-ch'eng—it lacks the long bifid protrusions on the epiplastra. Of the

Taben-buluk forms species C seems to show the greatest resemblance to sp. G, but the course of the sulci delimiting the pectoral scutes is entirely different.

TOSSUN NOR

(Pl. IX, figs. 8 and 9)

There is, finally, a large turtle from Tossun nor (species H) that must be distinct from those from Taben-buluk and the Shargaltein Valley as it is from a younger deposit—there are certainly also morphological differences but these are difficult to register on account of the poor preservation of the Tossun nor specimen. Two characters may be mentioned. The epiplastral lip is very thick (3.5 cm a couple of centimetres from the anterior end); the pygal plate is thick and rather strongly convex, a structure that is responsible for the peculiar outline at the posterior (lower) end in Pl. IX, fig. 8. None of these characters is present in any of the other species, and certainly not in species F, which is the only one that cannot be distinguished by stratigraphical arguments as its age is entirely unknown.

ADDENDUM

The interpretation on p. 86 of the rib attachment in the 7. peripheral of *Heishanemys* seems, on second thought, very improbable; at least there is another possibility. The large pit near the posterior end of peripheral 7 might be the rib attachment as it lies in the prolongation of a line through the two large pits in front. The surface at + must in that case be an artefact (the material was sent to China and is withdrawn from further examination). Then the attachment for the inguinal buttress was confined to the small pits in the anterior half of the bone. As the lower border of the supposed 6. peripheral forms a sharp edge, there was probably a fontanelle between the plastron and the peripherals in this place.

SUMMARY

The descriptions of two Crocodiles are based on a minimum of material, in each case only a fragment of a tooth. The two forms cannot be identical. One of them may belong to the genus *Shamosuchus* (p. 12), the other one must belong to a genus that is at least not formerly known from China. To this form the name *Chiayüsuchus cingulatus* was given (p. 44).

The Theropoda are represented by at least four species. The material consists mainly of isolated teeth and the determinations are partly based on stratigraphical considerations. There is a very small form from Ulan tsonch, thought to belong to the genus *Velociraptor* (p. 12), there is a very large one from Tebch that might be referable to *Prodeinodon* (p. 15). Both these forms come from localities situated not very far from those exploited by the American expeditions. Two forms are described from Kansu but not named, and they are undoubtedly distinct from each other (pp. 45 and 63). At least one of them seems to differ from all known Mongolian species. Some skeletal remains from Tsondolein-khuduk in Mongolia (p. 31) are doubtfully referred to a Theropod.

Only a single very fragmentary vertebra of a Sauropod was found in Mongolia (p. 43). The material from Kansu is somewhat better, and in it two types of teeth can be distinguished, one resembling *Mongolosaurus* (p. 65), the other one described under the new generic name *Chiayüsaurus* (p. 45). There may be also a third form related to *Chiayüsaurus* though specifically distinct from it (p. 64).

The Ornithischia dominate in the material. No less than 9 species were recognized and most of these were described as new. There is no doubt about the number of the species (it may possibly be put too low), but there may be some about the identifications with earlier described forms, and further about the systematical position of some of the new species which are based on a very small material.

1. ?Iguanodontidae. A small dinosaur from Tebch was provisionally referred to *Psittacosaurus mongoliensis* (p. 16).

2. Troödontidae. A new species of *Troödon* was named *T. bexelli*, after G. Bexell who discovered the remains. The find has its interest as it is the first one outside North America (p. 32).

3. ?Stegosaurids. The genus *Stegosaurides* was based on a couple of vertebral centra and a fragmentary dermal spine (p. 66). The heavy, almost cubical centra are unlike everything

else in the material; the spine is unique too, but if found alone, its reference to a new species may have seemed less justified, as a Nodosaurid with strongly varied dermal ossifications, including also spines, was found in the same region.

4. Nodosaurids. Two forms are represented by comparatively plentiful material, *Sauroplites scutiger* from Mongolia (pp. 19—31), and *Heishansaurus pachycephalus* from Kansu (pp. 47—59). Scarce remains of an armoured dinosaur possibly identical with *H. pachycephalus* was found at Tsondolein-khuduk in Mongolia. Of the first mentioned several large dermal plates are the most important parts. They suggest an animal resembling *Paleoscincus*. The remains of *Heishansaurus* were too scattered to give a clue to the appearance of the living animal. The dermal plates show a considerable variation in size and shape. The genus has in common with *Pinacosaurus ninghsiensis* Young and *Lametasaurus* Matley the presence of innumerable very small bony nodules.

Peishansaurus (p. 67) may be a Nodosaurid.

5. Ceratopsia. Three species were recognized in the material one of which is probably identical with *Protoceratops andrewsi* described by Granger and Gregory (p. 13). The other two are new, and undoubtedly belong to another genus that has been called *Microceratops*. The type species, *M. gobiensis*, comes from Tsondolein-khuduk in Mongolia (p. 34). The finds comprise several specimens of the axis, some of them with the attached atlas. It is evident that the latter was not reduced as in *Leptoceratops* and *Protoceratops* which originate a line of evolution leading to the total disappearance of the atlas. The atlas in *Microceratops* is instead enlarged and carries at least $^2/_3$ of the bowl-shaped articular surface for the occipital condyle. Of *Microceratops sulcidens* from Chia-yü-kuan a fairly complete hind foot is known. This, as well as some skeletal bones from Tsondolein-khuduk, agree with *Leptoceratops* though they are slenderer. As in *Leptoceratops* the terminal phalanges are rounded, almost claw-like, and quite different from the broad, flattened hoofs in *Protoceratops*. *Microceratops* and *Leptoceratops* are each the most primitive known member of its evolutionary line. Later members of the *Microceratops* line are not known.

Mesozoic turtles. The author has followed the same course as Wiman, and after him Young, and described under new names what could not be identified with genera described (mainly) in Hay's monography. Of the American genera only *Osteopygis* is present. Four new genera were created, two of them on scanty material, but undoubtedly distinct from the better known other three genera.

Of the genera *Osteopygis* and *Tsaotanemys* several species were described, but the fact that not two of the fairly numerous individuals of these genera are exactly alike makes one hesitate if there is not in reality only one very variable species of each genus. The characters used are on the whole the same as those used by Hay, but even those on which the subgenera *Osteopygis* and *Propleura* were founded appear doubtful. The types of the species are clearly different; the difficulties arise when other specimens have to be distributed on the species. Most of the material comprises only small parts of an individual and several of the finds are mixed. The validity of the new species and the doubts here expressed

about the usefulness of certain characters cannot be satisfactorily checked before at least the same number of complete individuals is available.

At Chia-yü-kuan turtles of the genera *Osteopygis* and *Tsaotanemys* are very common. The very few finds made at Hui-hui-p'u and Ehr-chia-wu-tung which lie not very far from Chia-yü-kuan belong to other genera. This may be pure chance, but as it is it adds to the faunal difference between these localities.

Eight species of Tertiary turtles were distinguished. It may only be stated here that the only species from Shih-ehr-ma-ch'eng is very different from all the others, and it gives no clue to the age of the peculiar mammals from that locality.

To get a fixed point for the correlation one may start with Ulan-tsonch. It is true that only one species, *Protoceratops andrewsi* is well represented, but this is one of the most important faunal elements of the Djadochta formation which is now considered to belong to the Upper Cretaceous. The determination of the other species was partly based on our knowledge of their age, but they agree well with figured specimens from the American expeditions.

As is evident from the table below two other localities have yielded a similar though not identical fauna.

DJADOCHTA	ULAN-TSONCH	TSONDOLEIN-KHUDUK	CHIA-YÜ-KAN
Shamosuchus	*? Shamosuchus*	— — —	Crocodile
Theropod (Deinodont)	— — —	? Large theropod	Medium-sized theropod
3 small theropods	Small theropod	— — —	— — —
— — —	— — —	*Troödon*	— — —
Pinacosaurus	— — —	Nodosaurid	*Heishansaurus*
Protoceratops	*Protoceratops*	*Microceratops*	*Microceratops*
Several mammals	— — —	Mammal	— — —

Both at Tsondolein khuduk and at Chia-yü-kuan a small Ceratopsian played an important part, though it was a more primitive form than *Protoceratops*. Thus there may be a slight difference in age. One may, however, see it from another point of view. The small Ceratopsians evidently lived in large herds and their abundant occurrence at three of the four localities in the table is due to a perishing of a whole herd at the time ("Massensterben"). If the herds were not mixed it is quite natural that the species which happened to make up the herd at the time of the catastrophe will dominate in the collection, and there is nothing remarkable in the entire absence of the other form. Among the forms from Tsondolein-khuduk *Troödon* is an Upper Cretaceous form. The presence of a mammal is a resemblance to Djadochta. There seems, finally, to be little doubt that the deposits at Chia-yü-kuan and Tsondolein-khuduk are contemporaneous—both contain *Microceratops*, and the Nodosaurid from the latter locality may be identical with *Heishansaurus*.

For the correlation of the localities in the part of Mongolia traversed by the Sino-Swedish expedition, the position of their sediments in relation to a great lava flow is of

importance. Both Ulan-tsonch and Tsondolein-khuduk are younger than the lava, and this is also the case with some red sediments at Ug-tokhoi.

Only one of the localities below the lava has yielded vertebrate fossils of importance, namely that at Tebch:

As is evident from the descriptions of the fossils the identification of the species with such from other parts of Mongolia is based on fairly meagre evidence. *? Prodeinodon* is represented only by a tooth, of *? Psittacosaurus* the material is more plentiful, but the type material is described in a way which makes a detailed comparison impossible. There is no doubt, however, that the deposit represents a lower level than Ulan-tsonch which is characterized by *Protoceratops*, a genus which is not represented at Tebch. *Sauroplites* furnishes no clue as to the age, but as it occurs together with other forms than *Pinacosaurus* it is probably generically distinct from this.

The provisional identification of two of the forms would indicate that the Tebch deposit is contemporaneous with the Lower Cretaceous Oshih formation.

The bulk of the sediments at Ug-tokhoi also lies below the lava. They are evidently Cretaceous, but there are no fossils that could link them up with Tebch.

The Hui-hui-p'u deposit, situated almost within sight of Chia-yü-kuan, is evidently not contemporaneous with the badlands at this place. One of the sauropod genera may be common to both areas but otherwise the vertebrate faunas show very little resemblance —that at Hui-hui-p'u is comparatively little known.

PLATE VI

Fig. 1. *Osteopygis kansuensis*. Type. Left peripherals 4–6 from below; right do. 1—3 and 5—11 from above.

Figs. 2—7. *Osteopygis latilimbata*. — 2. Partial nuchal plate. — 3. Peripheral 10 and part of 11, lower surface. — 4. Do. 5 and 6 from below. — 5—7. Type. Right peripherals 8 and 9 from below; left peripheral 9 from above.

Figs. 8—14. *Osteopygis acutus*. Type. — 8. Right peripherals 2 and 3 from above. — 9. Do. 7. — 10. Do. 9. and 10. — 11. Left peripheral 1 from above. — 12. Left peripheral 3, inner side. — 13. Do. 5. — 14. Do. 9 from below.

Figs. 15—19. *Osteopygis* sp. — 15. Left peripherals 8—10, lower surface. — 16. Do. 2. —17. Right peripheral 7, inner side. — 18. and 19. Right peripherals 8, 10 and 11 from below.

Same as textfig. 48.

Fig. 20. *Osteopygis* cf. *latilimbata*. Right peripherals 7—11 and pygal plate.

Figs. 21—24. *Osteopygis*. Plates from small specimens. — 21. ? Peripheral 9 (same as fig. 49: 4), inner side. — 22. Do. 2. (= fig. 49: 1). — 23. Do. 3. (= 49: 2). — 24. Do. 7.

Fig. 25. *Osteopygis* sp. ? Peripheral 9 from below.

All natural size.

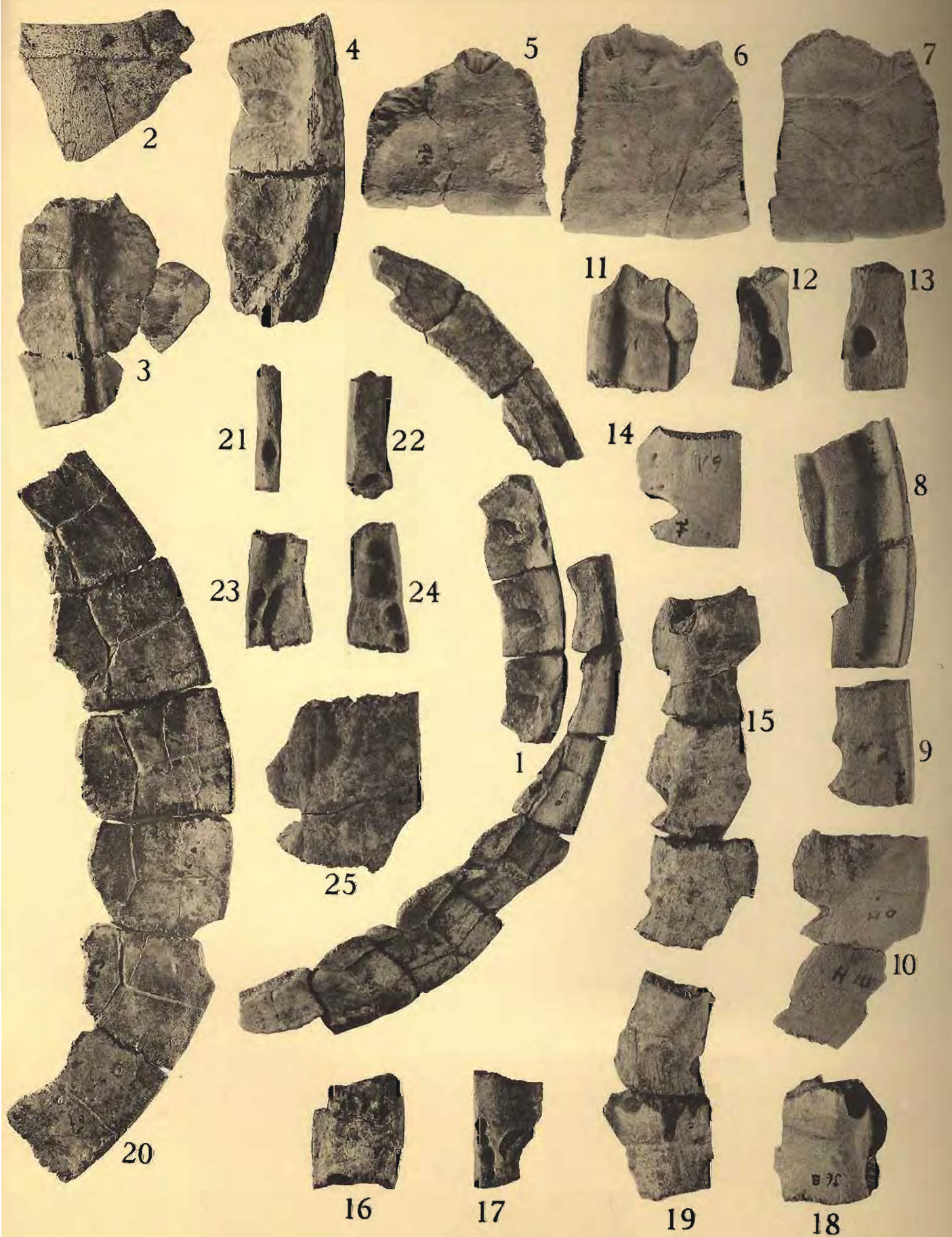

2
4
5
6
7
3
11
12
13
21
22
14
8
23
24
15
1
9
25
10
20
16
17
19
18

PLATE VII

Fig. 1. *Tsaotanemys rugosus*. Nuchal plate, left peripherals 1—3, right do. 1 and 2, parts of right and. left first costal (= textfig. 60).

Fig. 2. *Tsaotanemys rugosus*. Neurals and medial parts of costals (= textfig. 60; neural 8 from another ndividual).

Fig. 3. *Tsaotanemys rugosus*. Peripherals 4—11 (= textfig. 60).

Fig. 4. *Tsaotanemys rugosus*. Type. Peripherals 5—11, and parts of costals (partially same as textfig. 63 a^2).

Figs. 5—8. *Tsaotanemys*. Peripheral 7. Different types.

Fig. 9. *Tsaotanemys undulatus*. Left peripherals 8 and 9 and parts of costals. Light from the right lower corner!

Fig. 10. *Tsaotanemys*. Neural, and medial parts of costals from below.

Fig. 11. *Tsaotanemys*. sp. Plastron of same individual as the parts of the carapace in fig. 2.

Fig. 12. *Tsaotanemys*. sp. Hyoplastral portion of left bridge.

Figs. 13—15. *Heishanemys imperfectus*. — 13. Peripheral 5—7, inner side. — 14. Do. ? 9 from below. — 15. Epiplastron from below.

Figs. 16—23. *Yümenemys inflatus*. — 16. Parts of left peripherals 1 and 2. — 17. do. of 2 and 3. — 18 and 19. Left peripherals 3—6. — 20. Part of right peripheral 6. — 21. Part of ? costal 1. — 22. Part of ? nuchal plate. — 23. Hyoplastra, inner surface.

All natural size.

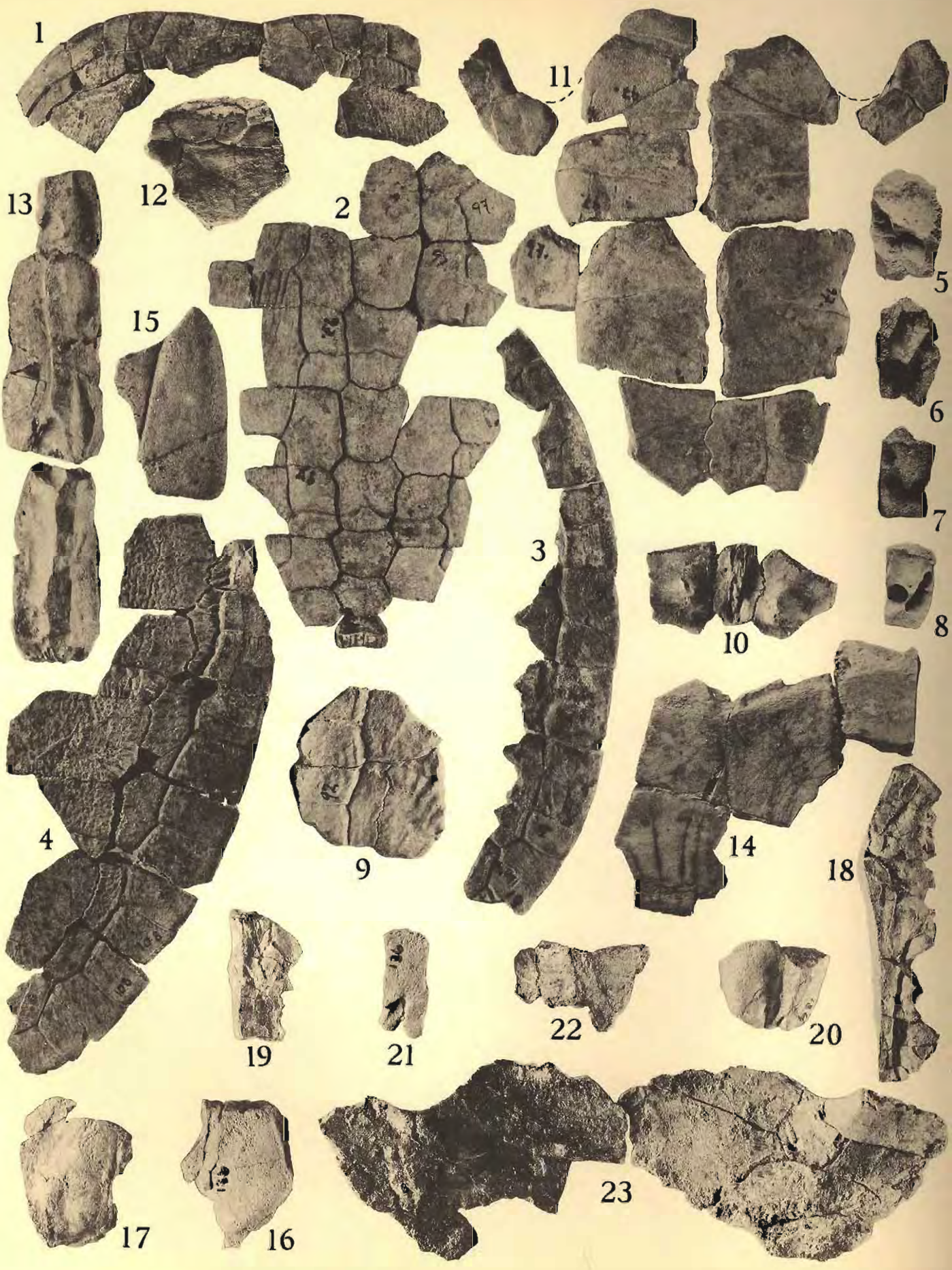

1
11
12
2
13
15
5
6
7
3
10
8
4
9
14
18
19
21
22
20
17
16
23

PLATE VIII

Fig. 1. *Peishansaurus latipons*. Fragments of nuchal plate, peripherals, and pygal plate. — 1 a. Fragmentary neural plates. × $^4/_9$.

Figs. 2 and 3. *Peishansaurus latipons*. Plastron, internal and external views. × $^4/_9$.

Figs. 4 and 5. *Testudinidae* sp. A. Taben-buluk. Inferior and antero-superior views. × $^4/_9$.

Figs. 6 and 7. *Testudinidae* sp. F. Shih-ehr-ma-cheng. -- 6. Plastron of small individual. × $^4/_9$. — 7. Carapace of large individual. × $^2/_9$.

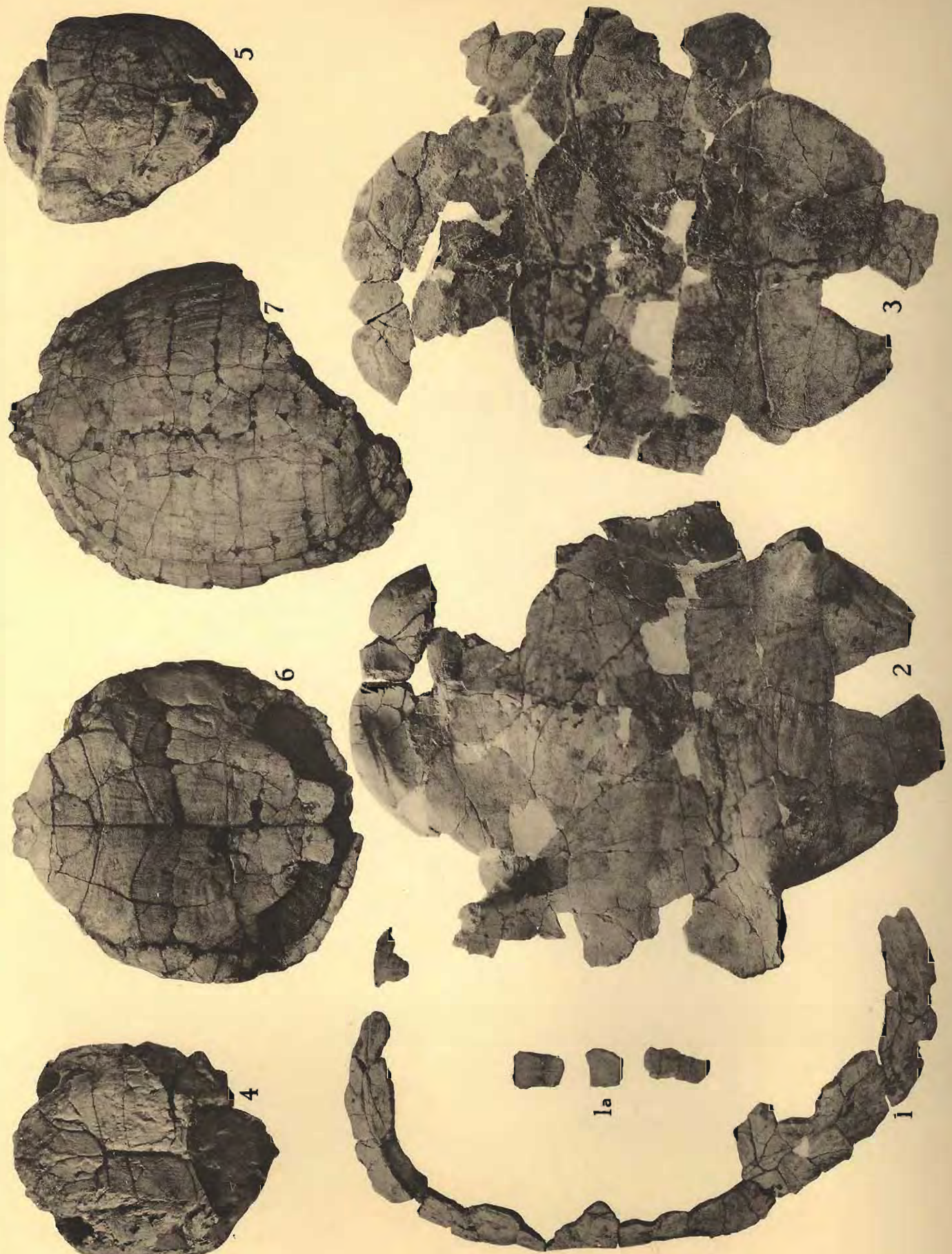

5
3
7
2
6
1a
1
4

PLATE IX

Figs. 1 and 2. *Testudinidae* sp. D. Taben-buluk. — 1. Anterior part of shell, upper view. — 2. Inferior view of complete specimen. — × 1/3.

Figs. 3 and 4. *Testudinidae* sp. E. Upper and lower views of the same individual. — × 1/3.

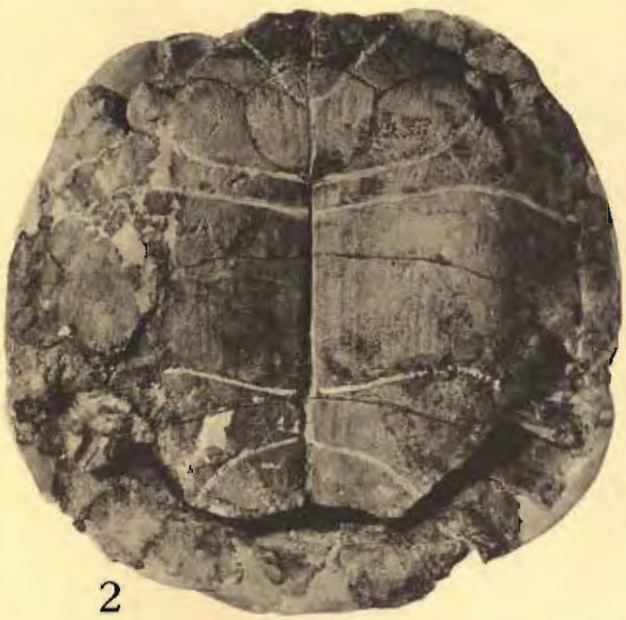
Figs. 5—7. *Testudinidae* sp. G. Shih-chiang-tzu-ku. — 5. Plastron. — 6. Nuchal plate — 7. First peripheral. — × 1.

Figs. 8 and 9. *Testudinidae* sp. H. Taben-buluk. — 8. Posterior part of carapace, postero-superior view. — 9. Left epi- and hyoplastra. — × 1/4.

1

7

5



2

3

6

8

9

4