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REMAINS OF ARMOURED DINOSAURS FROM THE UPPERMOST CRETACEOUS IN NEMEGT BASIN, GOBI DESERT

(Plates VI—IX)

Abstract. — This work contains a description of two fragmentary skeletons of armoured dinosaurs, found by the Polish-Mongolian Palaeontological Expeditions in Upper Cretaceous sandstone, locality of Altan Ula IV, Nemegt Basin, Gobi Desert. Both fragmentary skeletons consist of the distal parts of tail and fragments of the armature. The skeleton Z. Pal. No. MgD-I/43 is determined as *Dyoplosaurus* cf. *giganteus* MALEYEV, the skeleton Z. Pal. No. MgD-I/42 — as *Dyoplosaurus* sp.

INTRODUCTION

From the Upper Cretaceous beds of Mongolian People's Republic the following representatives of the armoured dinosaurs have been described: *Pinacosaurus grangeri* GILMORE (GILMORE, 1933), *Syrmosaurus viminicaudus* MALEYEV (not genus *Viminicaudus* MALEYEV, as cited erroneously by HUENE, 1958, 1959*a*, 1959*b*, and Romer, 1966), *Syrmosaurus disparoserratus* MALEYEV, *Syrmosaurus* sp.[1], *Talarurus plicatospineus* MALEYEV and *Dyoplosaurus giganteus* MALEYEV (MALEYEV, 1952, 1956).

Genus *Dyoplosaurus* PARKS, 1924 was known up to now from two species: *D. acutosquameus* PARKS, 1924 from the Belly River Formation, Red River, Alberta (PARKS, 1924) and the Two Medicine Formation, South Milk River, Montana (GILMORE, 1930), and *D. giganteus* MALEYEV, 1956 from Gobi Desert, Nemegt, Upper Cretaceous sandstone, designated by GRADZIŃSKI *et al.* (1968/69) as the Upper Nemegt Beds. *Dyoplosaurus acutosquameus* PARKS was described on the base of an incomplete skeleton, consisting mainly of the posterior part of axillary skeleton, only fragmentary parts of skull and a few teeth remains (PARKS, 1924). GILMORE (1930) described a fragmentary skull with 4 teeth of the same species. *Dyoplosaurus giganteus* MALEYEV (P.I.N. No. 551—29) consists of 12 free caudal vertebrae from anterior part of tail, metatarsus, phalanges of digits and dermal ossicles.

The collection of Upper Cretaceous dinosaurs, assembled by the Polish-Mongolian Palaeontological Expeditions in the Gobi Desert, Mongolian People's Republic (KIELAN-JAWOROWSKA & DOVCHIN, 1968/69) contains, among others, the remains of armoured dinosaurs. These were found in two regions: the Nemegt Basin and in the locality of Bayn Dzak. In the Nemegt Basin, armoured dinosaurs were found by the Polish-Mongolian Expeditions merely in Altan Ula IV. They were two fragmentary skeletons, assigned to the genus *Dyoplosaurus*

[1] According to ROZHDESTVENSKY (1955) the remains described by MALEYEV (1952) as *Syrmosaurus* sp. belong to *Psittacosaurus* OSBORN.

PARKS. The material from Bayn Dzak comprises an almost complete skeleton of *Pinacosaurus* sp. with a very well preserved skull, as well as several fragments of skeletons, including pelvic girdle, hind limbs and tail, probably belonging to the same genus. The material from Bayn Dzak will be described by the present author at a later date. This paper deals only with the remains from Altan Ula.

The fragmentary skeletons here described were found in the Upper Nemegt Beds of the Upper Cretaceous sandstone. One of them (Z. Pal. No. MgD-I/43) was found during the 1964 expedition by D. WALKNOWSKI (for localization see GRADZIŃSKI *et al.*, 1968/69, Text-fig. 4, No. 5) and is identified by the present author as *Dyoplosaurus* cf. *giganteus* MALEYEV. This skeleton consists of two free caudalia and 12 vertebrae forming the tail-club. The fragmentary skeleton designated by GRADZIŃSKI *et al.* (1968/69, Text-fig. 4) by numeral 7 (Z. Pal. No. MgD-I/42), found during the 1965 expedition by J. LEFELD, is described in the present paper as *Dyoplosaurus* sp. It consists of one free vertebra caudalis, 9 and half vertebrae of tail-club and 68 dermal scutes. As the skeletons described by the present author are not fully comparable with the specimen described by MALEYEV (1956), one cannot be entirely certain as to their correct assignment.

The specimens described in the present paper are part of the collection of the Palaeozoological Institute, Polish Academy of Sciences, Warsaw.

Abbreviations used:

Z. Pal. — Palaeozoological Institute of the Polish Academy of Sciences, Warsaw,
P.I.N. — Palaeontological Institute of the USSR Academy of Sciences, Moscow.

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DESCRIPTIONS

Family NODOSAURIDAE MARSH, 1890

Genus **DYOPLOSAURUS** PARKS, 1924

Dyoplosaurus cf. **giganteus** MALEYEV, 1956

(Pl. VI; Pl. VII, Figs. 1—3)

Material. — Distal part of tail (Z. Pal. No. MgD-I/43) from Upper Nemegt Beds, locality of Altan Ula IV, Nemegt Basin, Gobi Desert. This part consists of 2 free vertebrae, 12 vertebrae forming tail-club and 1 scutum. Neural arches are preserved on the whole section, hemal arches only in the distal part. The knob is almost complete, very slightly damaged on dorsal side.

Description. — *Free vertebrae.* The first preserved vertebra (Pl. VI, Fig. 2) corresponds probably to the 10th or 11th vertebra caudalis, assuming that the whole tail was composed of 23—25 vertebrae (PARKS, 1924; MALEYEV, 1956). Centrum of this vertebra is short (72 mm),

almost amphiplatyan anteriorly and platycelous posteriorly, with a well defined notochordal protuberance on both articulating surfaces. On ventral side of centrum there is a wide furrow. Neural arch about 70 mm high, neural canal — 40 mm. Sticklike prezygapophyses, 48 mm long, are disposed almost horizontally. Postzygapophysis also sticklike, 38 mm long, directed somewhat upwards. Neural spine broken off; judging from the preserved base, it ran parallel to the postzygapophysis and was of similar dimensions. Transverse processes reduced and preserved as well defined tubercules. Hemal arches missing. Visible in distal part of the centrum are facets for chevron bones, which in this part of tail are intervertebral.

The next and last free vertebra has a very well developed neural arch, completely fused with the neural arch of the succeeding one, which is the first vertebra of the tail-club (Pl. VI, Fig. 1). Centrum is amphiplatyan anteriorly. Prezygapophyses, 54 mm long, articulate freely with the postzygapophyses of preceding vertebra. Neural spine disposed horizontally, fused with the arch and prezygapophyses of the next vertebra. Postzygapophyses, beginning from this vertebra, are completely unidentifiable. It follows that the last mobile intervertebral joining was between the last but one and last free vertebrae. Transverse process of the last free vertebra preserved as a small, sharp tubercle. On ventral side there is a well marked furrow, on ventrodistal side — traces of chevron facets. Hemal arch is not preserved.

The site of coossification of neural arch with centrum differs in the last two free vertebrae. On the last but one, this arch fuses with the centrum about mid-length of the latter, while from the last free vertebra to the end of tail-club, the neural arches are fused to the anterior part of centrum, the width of the base of the arch being at least half the length of the centrum.

Tail-club. The next vertebra is the first of the tail-club. Its centrum, from proximal side, is not permanently joined to the centrum of the last free vertebra. On the other hand, from distal side one can observe the first ankylosis of the articulating surfaces of centra. This ossification is repeated all along the further section of tail. The first vertebra of tail-club is characterized by a much longer and lower centrum than in the free vertebra. Neural arch is well developed. The trace of transverse process has almost completely disappeared and is seen only as a flattened elevation. On ventral side, there is a ventral furrow, wider and shallower than in free vertebrae. There are no traces of coossification with hemal arch.

Second vertebra of tail-club is damaged. It seems that one and a half vertebrae are missing in this section. The rest of the tail-club is almost complete. The 4th, 5th and 6th vertebrae of tail-club have strongly flattened centra, neural arches massive and fused with centra at 2/3 length of latter. On ventral side of centra, a furrow is still visible. The coossification of hemal arches with centra, mentioned by PARKS (1924) in *D. acutosquameus*, and by GILMORE (1930) in *Palaeoscincus rugosidens*, is here absent. Distal part of centrum of 6th vertebra is damaged, neural arch of 7th vertebra — missing. Centra and neural arches of 7th, 8th and 9th vertebrae gradually become lower. Beginning from 7th vertebra, hemal arches are coossified with the centra. These arches appear as horizontally disposed beams, directed posteriorly. Hemal arches of successive vertebrae embrace each other from the outside, without being coossified.

Further vertebrae, 5 in all, are situated within the terminal knob (Pl. VII, Fig. 2). In this section, it is easiest to observe the structure of hemal arches, fused with centra. These arches are constructed as V-shaped beams, diverging anteriorly. Each chevron covers the centra of two vertebrae. The bifurcated ends of chevrons laterally embrace the pointed end of the arch of the preceding chevron to the point of divergence of this arch. The hemal arches of the last two vertebrae are formed by massive X-like disposed beams.

Neural arches of the last two vertebrae are exceptionally massive and wide. This, most probably, is connected with the presence of the knob and extension of attachment surfaces of

tendons, joining the knob with the axillary skeleton. Neural canal on the whole tail-club part — high.

The knob consists of two lateral, two terminal, a termino-ventral and dorsal plates. Lateral plates, 500 mm long, 200 mm high, maximum width 520 mm, laterally embracing about 5 distal vertebrae. Ventral side of lateral plates almost flat, slightly concave lengthwise; proximal part meets at an acute angle the strongly arched, convex, dorsal side, forming a latero-ventral keel. Terminal part of knob consists of two horizontally disposed, cone-shaped plates 150 mm long, total width of both parts 300 mm. Termino-ventral plate oval, 200 mm long, 175 mm wide, about 40 mm thick. This plate covers ventrally the last vertebra, partly overlapping the cone-shaped terminal plates. Most probably this is a secondary overlapping. Dorsal plate, about 25 mm thick, located between lateral plates, is only partly preserved. Along the whole length of the described part of tail, ossified tendons surround the vertebrae on lateral sides. They are damaged to such a degree that it is impossible to determine their course and length. Tendons on ventral side are so massive that it is difficult to distinguish them from fragments of hemal arches.

Armature. Only one incomplete, sharply pointed keel-like spine is preserved. It was recovered from rock at the level of 7th vertebra of tail-club; it is quite probable that the entire tail-club was provided with such spines.

Remarks. — A detailed comparison of the described specimen with *Dyoplosaurus giganteus* MALEYEV (MALEYEV, 1956) is impossible, as the distal part of the MALEYEV's specimen (P.I.N. No. 551—29) is missing. From MALEYEV's description (*l. c.*, p. 79), the hemal arches of the last free vertebrae in *D. giganteus* MALEYEV are not fused with the centra. According to MALEYEV, only the most proximal caudalia have chevrons coossified with centra. Measurements of the last vertebrae of the specimen here described and P.I.N. No. 551—29 are very similar (Table 1).

The here described specimen differs from that described by MALEYEV in the shape of postzygapophyses. In *D. giganteus* MALEYEV the postzygapophyses on last free vertebrae are completely reduced, while in Z. Pal. No. MgD-I/43 the postzygapophysis of last but one free vertebra is well developed. The here described specimen also differs from *D. giganteus* MALEYEV in the shape of the last free vertebrae and neural canals. It is quite probable that the coossification point of the vertebrae centra in various specimens was variable: in Z. Pal. No. MgD-I/43 it is shifted more to the front than in P.I.N. No. 551—29, and the tail-club section comprises vertebrae with still unreduced postzygapophyses and high centra.

A more detailed comparison is possible between the here described specimen and *D. acutosquameus* PARKS (PARKS, 1924), as the distal part of the tail is preserved in both specimens. The last free vertebrae are similarly shaped in both cases, however, here also, the shape of postzygapophyses differ. In *D. acutosquameus* the postzygapophyses of last vertebrae are reduced. PARKS (1924) does not mention coossification of the neural arch of last vertebra with arch of first vertebra of tail-club, which is the case in Z. Pal. No. MgD-I/43. It is possible that PARKS considered this vertebra as the first one of the tail-club, and not as the last free.

In the here described specimen it is certain that the centra of the last free and first tail-club vertebrae are not coossified with the hemal arches. Writing on the last free vertebrae, PARKS (1924) states: "The chevrons are not well exposed, but are undoubtedly fused to the vertebrae". Dimensions aside, there is a very marked difference between the compared specimens in that there is no coossification between the hemal arches of successive tail-club vertebrae in Z. Pal. No. MgD-I/43, which is the case in *D. acutosquameus*. There are also differences in the structure of the knob, as well as in number, shape and disposition of plates.

Table 1

Comparison of measurements of some vertebrae of the representatives of the genus *Dyoplosaurus* PARKS (in mm)

Species \ Measurements	Length of centrum	Width of centrum	Height of centrum	Height of centrum together with neural arch	Height of neural canal	Width of neural canal
Dyoplosaurus acutosquameus PARKS (PARKS, 1924):						
last free vertebra	60	70	75	—	25	10
first vertebra of tail-club	90	75	55	—	—	—
Dyoplosaurus giganteus MALEYEV (P. I. N. No. 551-29) (MALEYEV, 1956):						
last free vertebra 11	80	105	95	150	—	—
„ „ „ 13	129	100	60	—	—	—
Dyoplosaurus cf. *giganteus* MALEYEV (Z. Pal. No. MgD-I/43):						
free vertebrae:						
last but one	72	101	91	160	40	17
last	81	103	88	150	42	17
vertebrae of tail-club:						
1	95	92	67	115	—	—
2	—	80	52	107	30	17
3	—	—	—	—	—	—
4	—	76	52	102	—	13
5	139	73	50	—	—	15
6	—	75	45	94	—	17
7	145	69	45	89	—	13
8	140	62.	45	78	23	13
9	140	58	35	83	22	13
10	140	—	—	—	20	11
Dyoplosaurus sp. (Z. Pal. No. MgD-I/42):						
free vertebra	67	96	98	—	—	—
vertebrae of tail-club:						
1	—	44	23	61	15	9
2	—	45	22	55	11	8
3	—	45	21	47	10	7

Neither PARKS (1924) when describing *D. acutosquameus*, nor MALEYEV (1956) describing *D. giganteus*, mentioned the sudden change in the structure of vertebrae directly following one another, as occurs in Z. Pal. No. MgD-I/43. This refers to the changes in the structure of arches of the last but one and last free vertebrae, a change in the height of centra of the last free vertebra and first one of tail-club. These data, however, are not a sufficient base for establishing a new species.

The generic assignment could also be a matter for discussion. PARKS (1924) did not present a diagnosis of the genus *Dyoplosaurus*, considering the material at his disposal as insufficient. PARKS saw the structure of the tail as the characteristic feature of the genus. Only

after it has been firmly established that, in *D. acutosquameus*, the hemal arches were fused with vertebrae centra on the whole length of the tail, can *D. giganteus* and *D.* cf. *giganteus* be excluded from the genus *Dyoplosaurus*.

MALEYEV (1952, 1956) described a new genus and species of armoured dinosaur, *Talarurus plicatospineus*, from the Mongolian Upper Cretaceous sediments of Bayn Shireh. *D.* cf. *giganteus* differs from the latter in the presence of strong coossification between the distal caudalia, the presence of a knob and development of neural arches, which in *T. plicatospineus* are open on a section of tail. On the other hand, in both *D.* cf. *giganteus* and *T. plicatospineus* the hemal arches are fused with the centra only in the last section of the tail-club.

Dyoplosaurus sp.

(Pls. VIII, IX)

Material. — Distal part of tail (Z. Pal. No. MgD-I/42). One incomplete free tail vertebra, 9 and a half fused distal tail vertebrae, surrounded by tendons, forming a tail-club ended by a knob and 68 more complete or less scales and spines of the armature from the Upper Nemegt Beds, locality of Altan Ula IV, Nemegt Basin, Gobi Desert.

Description. — The free tail vertebra is preserved incomplete, with damaged neural and hemal arches and transverse processes. Judging from the preserved traces, the arches and processes were strongly developed, the hemal arches being permanently joined to the centra. Articular surfaces of the centrum almost amphiplatyan, with distinctly marked notochordal protuberances. Probable measurements of the vertebra are given in Table 1. Tail-club preserved in 4 parts (Pl. VIII, Fig. 1); joint length 765 mm, composed of about 9 and a half vertebrae. (It is not possible to give the exact number of vertebrae as they are not discernible in the distal part). Approximate measurements of the vertebrae are given in Table 1. The height of the vertebrae centra diminishes towards the end of the tail-club. Changes in width are less noticeable. The length of the centrum was not measured, as the boundaries of the vertebrae are covered by tendons. Neural arches are strongly developed and completely fused. Separated neural spines are missing. Neural arches of proximal vertebrae — high and strongly arched, those of the distal ones — lower and less arched. Prezygapophyses undiscernible. Chevrons are strongly developed, fused with the vertebrae centra and with each other. Anterior part of the arch is elongated, stretching into a V-shape, clasping the cuniform posterior part of the previous arch. Hemal processes very faintly marked as low spines fused with the arch. In distal part, the hemal canal changes from longitudinally oval to transversely oval.

Knob preserved incomplete (Pl. VIII, Fig. 2). It consists of two lateral, a terminal, and a thin dorsal plate. The right lateral plate is preserved complete, the terminal and dorsal ones — only partly. Length of knob about 297 mm, maximum width about 220 mm. The knob is built of spongy bone, probably of dermal origin.

Lateral plate (right) is 80 mm wide, 225 mm long, with maximum height 70 mm. From the vertebra side strongly depressed. Width, measured laterally — 32 mm, dorsally — 22 mm, ventrally — only 8 mm. Latero-dorsal part slightly longitudinally convex. Proximal end of the plate strongly narrowed and sharply ended. Distal end broadly arched. The plate does not cover the neural arches, tendons closest to the vertebrae or hemal arches. Ventral surface of the plate almost flat. Dorsal and ventral surfaces meet in an acute angle, forming a lateral keel. In lateral view the plate is almost symmetrical.

Only the dorsal part of the terminal plate is preserved. The fragment of dorsal plate,

situated between lateral plates, is about 5 mm thick. This plate is preserved in the distal part of the knob, more or less from mid-length of the lateral plates.

Tendons cover the vertebrae on the whole length of the tail-club. Because of the damaged state of part of the tendons, it is not possible to give their number or exact disposition. In dorsal view, the tendons overlap anteriorly and underlap posteriorly. Tendons branch off in a V, with pointed end directed forwards. From the ventral side, the tendons also diverge and are V-shaped, but the pointed ends are directed backwards. Within the knob the tendons distinctly separate the lateral plates from the vertebrae. Thus the lateral plates and vertebrae do not contact directly and are not coossified as those in *D. acutosquameus* PARKS (PARKS, 1924).

Armature. When found, the plates, scutes and spines of the armature were scattered. It seems that some of them belonged to the preserved part of tail. The fragments of armature were divided into VI types according to shape.

Type I (Pl. IX, Fig. 6), represented by two almost complete spines, some fragments of a third and core of a further. These are large spines (Table 2), hollow interiorly, strongly compressed laterally, in lateral view triangular. Their height measured vertically is about 300 mm, length of the base from 295 to 335 mm, width about 90 mm. Thickness of walls does not exceed 10 mm. Tip is strongly bent posteriorly, so that the length of the anterior, convex keel is almost twice the length of the posterior concave one. Keel and posterior edge sharp. Free lower edges convex and uneven. The spine is twisted into an S-shape. At base of the spine, which is preserved as a core, there is a fragment of an irregular, roll-like ossification which filled base of the spine. This element was probably embedded fairly deep in the skin, forming a support for the large, hollow spine.

Type II (Pl. IX, Fig. 2), represented by three spines similar in outline to those of Type I, but much smaller, bi-symmetrical, without the S-twist and with a filled interior. Their height does not exceed 49 mm, length 54 mm and width 30 mm. Tip of the spine rounded, the base slightly concave.

Type III (Pl. IX, Fig. 3), represented by 7 spines, somewhat laterally compressed, with a weakly marked anterior keel and tip strongly bent posteriorly. Height from 16 to 40 mm, length from 34 to 48 mm, width from 21 to 35 mm. Interior filled. Base slightly convex or flat, tips sharp.

Type IV (Pl. IX, Figs. 4, 5), represented by 32 spines in the shape of a less regular or more regular cone, with sharp top. Among them can be differentiated: thin-walled, larger spines and thick-walled or full smaller spines with a weaker or more strongly marked concavity of the base. Measurements of spines are given in Table 2.

Type V (Pl. IX, Fig. 1), represented by 2 trapezium-shaped, keel-like plates, almost completely preserved, and 2 fragments. The plates are long (up to 103 mm), with thick walls and sharp, elevated keel, asymmetrically disposed. Maximum width of plates 72 mm. Base strongly concave.

Type VI (Pl. IX, Fig. 7), represented by 17 irregular, nodular ossifications, up to 35 mm long, 26 mm wide and 19 mm high.

Remarks. — Only a partial comparison can be made between the here described species and *D. giganteus* MALEYEV. A detailed comparison of the structure of the distal part of the tails in both species is not possible, as the last (13th) preserved tail vertebra of *D. giganteus* MALEYEV is still a free vertebra. The only free vertebra of *Dyoplosaurus* sp., partly preserved, belongs probably to a section corresponding to 7th or 9th tail vertebra, judging from the traces of the strongly developed transverse processes. However, because of its bad state of preservation, this vertebra cannot serve as a base for comparison.

Table 2

Measurements of spines and scutes of *Dyoplosaurus* sp. (Z. Pal. No. MgD-I/42) (in mm)

Type	Height	Length	Width	Thickness of walls
I	310 295	295 335	89 —	8—10 8—10
II	49 37 43	54 51 42	30 29 27	full full full
III	16—39	34—48	21—35	full
IV	16—33 22—47	25—52 46—70	20—50 40—60	full thin walled
V	70 —	103 102	48 72	hollow hollow
VI	6—19	19—35	15—26	full

The number and state of preservation of the armature elements are sufficient for a comparison of these structures in Z. Pal. No. MgD-I/43 and *D. giganteus* MALEYEV (P.I.N. No. 551—29). Types I, II, IV and V, distinguished in *Dyoplosaurus* sp., have their counterparts in the spines and scutes described in *D. giganteus* MALEYEV (MALEYEV, 1956). This refers mainly to the shape of spines, as in *Dyoplosaurus* sp. their measurements are much greater. For instance, the spines of *D. giganteus*, which correspond in shape to Type I of *Dyoplosaurus* sp., are up to 190 mm long, 180 mm high and 50 mm wide. According to MALEYEV *(l. c.)*, spines of this type were disposed along the lower edge of the lateral surface of the tail. In the case of *Dyoplosaurus* sp. this seems improbable, as the animal's tail together with spines, would then have been over 1000 mm wide. PARKS' (1924) suggestion that this type of spine was situated in the upper row, is more probable.

Both in *Dyoplosaurus* sp. and in *D. giganteus* MALEYEV occur cone-shaped spines with an extended base (Type IV). According to MALEYEV (1956), they were disposed in the spaces between the big spines. Trapezium-like scutes (Type V), met with in both species, were — according to MALEYEV — disposed centrally along the dorsal line of the tail surface. Taking into account their shape, resembling very much the shape of the lateral plates of knob, it seems that they belonged to lower lateral line.

Small nodular ossification, differentiated in *Dyoplosaurus* sp. as Type VI, were described by PARKS (1924) in *D. acutosquameus*. Comparing, however, the spines and scutes of *Dyoplosaurus* sp. with elements of the same type in *D. acutosquameus*, one finds much less in common than in a comparison with *D. giganteus*. Spines and scutes of *D. acutosquameus* were much less differentiated. It is probable that Type I and II spines correspond to the scutes of the upper row in *D. acutosquameus*. Spines Type III and IV, most numerous in *Dyoplosaurus* sp., have no corresponding spines in *D. acutosquameus*. Perhaps they belong to that part of the tail, i.e. the tail-club, from which the spines are missing in *D. acutosquameus*. Only one plate

(PARKS, 1924, Pl. 4, Figs. 2, 3) was found near *D. acutosquameus*, which resembled in general outline the Type III spines. PARKS considered *(l. c.)* that this plate could have belong to the tail-club.

However, a basic difference between the elements of the armature in *Dyoplosaurus* sp. and *D. acutosquameus* is, that while PARKS (1924) considered typical scuta in *D. acutosquameus* to be thin-walled, keel-like, MALEYEV (1956) maintains that this feature is characteristic for the genus *Dyoplosaurus*. In *Dyoplosaurus* sp., besides thin-walled spines, there also occur thick-walled ones and even filled spines (Type II, III and partly IV). Spines, corresponding in shape to Type IV in *Dyoplosaurus* sp. were illustrated by GILMORE (1914, Pl. 31, Fig. 1*a-b*) as ossifications of an undefined armoured dinosaur, found in the Lance Formation.

Some types of *Dyoplosaurus* sp. spines have corresponding elements in armatures of other armoured dinosaurs, such as *Rhodanosaurus lugdunensis* NOP., *Struthiosaurus austriacus* BUNZEL (NOPCSA, 1929) or *Hierosaurus sternbergi* WIELAND (WIELAND, 1911).

Table 3

Comparison of tail-club measurements in representatives of the genus *Dyoplosaurus* PARKS (in mm)

Species / Measurements	*D. acuto-squameus* PARKS (PARKS, 1924)	*D.* cf. *giganteus* MALEYEV (Z. Pal. No. MgD-I/43)	*Dyoplosaurus* sp. (Z. Pal. No. MgD-I/42)
Length of tail-club.	1300	ca. 2000	ca. 1200
Knob: max. width.	170	620	ca. 220
length	260	640	ca. 297
length of lateral plates . . .	205	500	ca. 225
height of lateral plates . . .	78	200	70
max. width of lateral plates, upper.	70	520	80
max. distance of lateral plates from each other, anterior	120	160	ca. 135
min. distance of lateral plates from each other, upper	25	—	ca. 80
min. distance of lateral plates from each other, lower	75	130	ca. 52

The knob of *Dyoplosaurus* sp. differs from that of *D. acutosquameus* in the space between lateral plates (Table 3) and presence of dorsal plate. In the tail-club of *Dyoplosaurus* sp. one can observe a much stronger fusion of prezygapophyses with the spines processes and a smaller number of tendons than in *D. acutosquameus*.

A comparison of *Dyoplosaurus* sp. (Z. Pal. No. MgD-I/42) with *D.* cf. *giganteus* MALEYEV (Z. Pal. No. MgD-I/43) shows a different development of hemal arches, which in *Dyoplosaurus* sp. are completely fused, while in *D.* cf. *giganteus* they remain free. In addition, the knobs and last tail vertebrae in both specimens differ in shape and dimensions (Pl. VII; Pl. VIII, Fig. 2; Table 3). It would seem that these differences are outside the range of specific variability.

The notochordal protuberances on the articulating surfaces of the centra of free vertebrae in *Dyoplosaurus* sp. and *D.* cf. *giganteus* MALEYEV, probably played some role in facilitating the articulation of joints on the mobile section of the tail, which in these dinosaurs is comparatively short.

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PLATES

PLATE VI

Page

Dyoplosaurus cf. *giganteus* MALEYEV 24

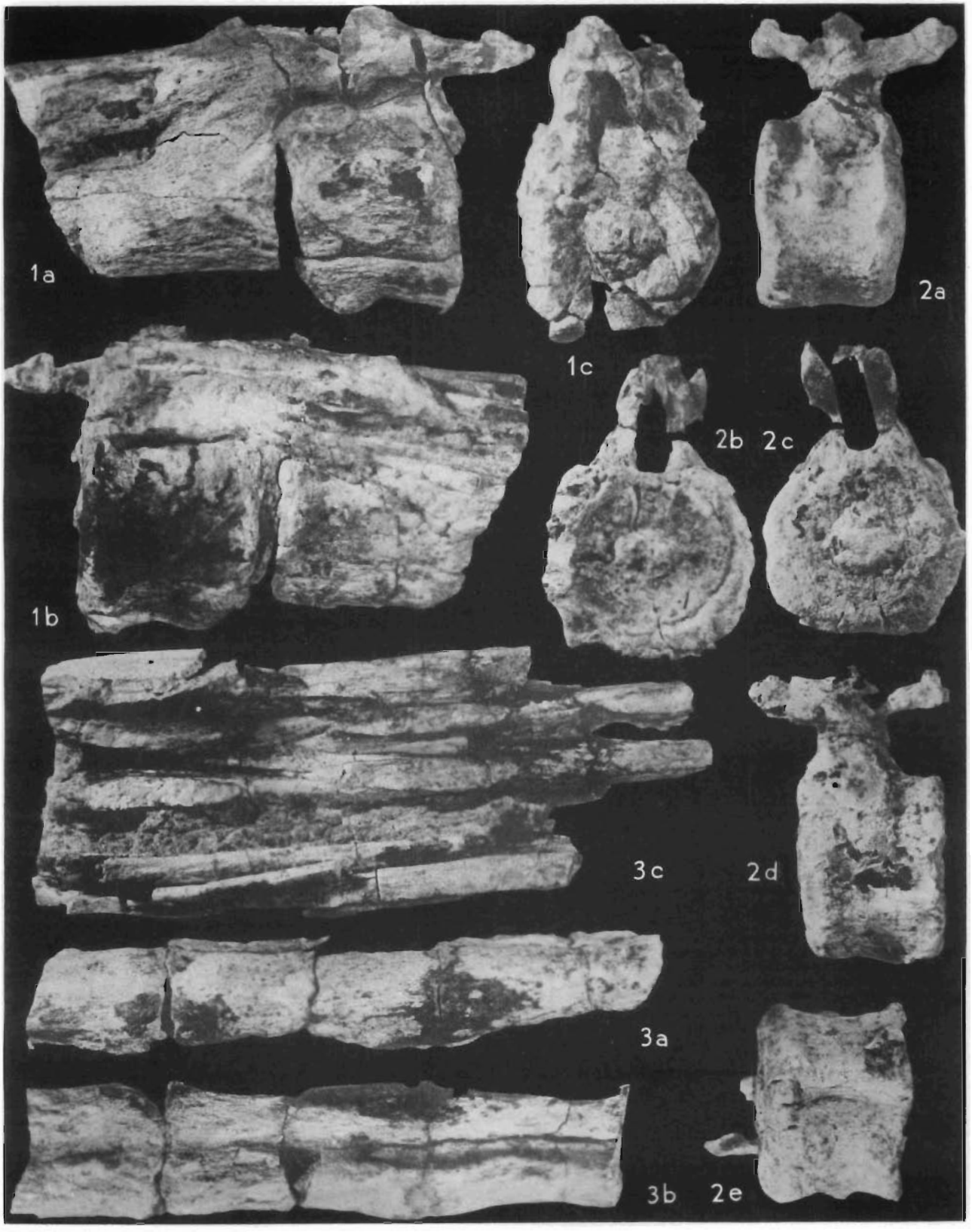
Upper Cretaceous, Upper Nemegt Beds, Altan Ula IV, Nemegt Basin, Gobi Desert

(see also Plate VII)

Fig. 1*a-b*. Last free vertebra and first vertebra of tail-club, lateral views; × 1/3.
Fig. 1*c*. Last free vertebra, proximal view; × 1/3.
Fig. 2*a-c*. Last but one free vertebra, lateral, distal, proximal and ventral views; × 1/3.
Fig. 3*a-c*. The 4th, 5th and 6th coossified vertebrae of tail-club, lateral and ventral views and inner view of damaged neural arches; × 1/3.

All fragments from the specimen Z. Pal. No. MgD-I/43

Photo: *W. Kleiber*



T. MARYAŃSKA: ARMOURED DINOSAURS FROM THE UPPERMOST CRETACEOUS

PLATE VII

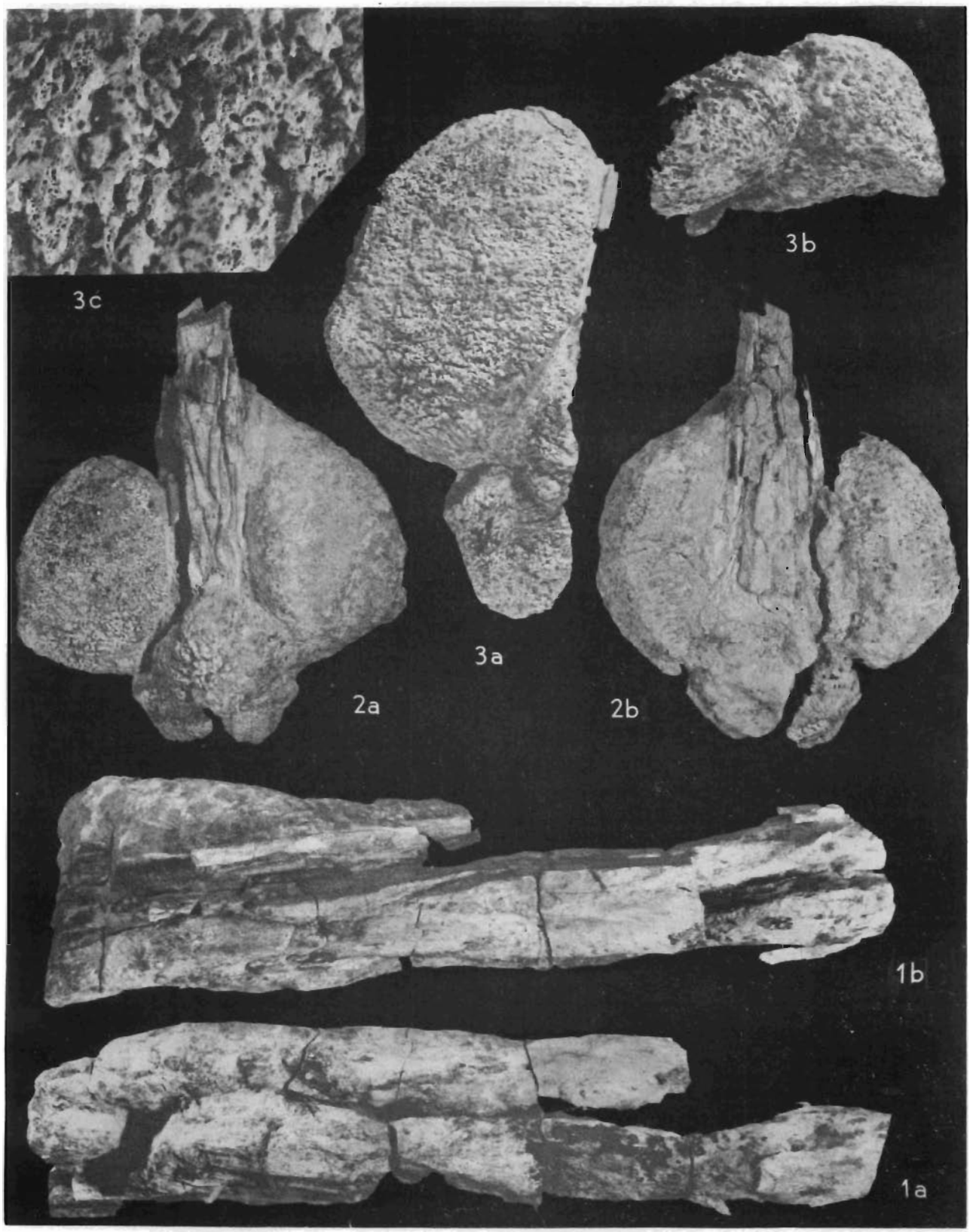
Upper Cretaceous, Upper Nemegt Beds, Altan Ula IV, Nemegt Basin, Gobi Desert

(see also Plate VI)

Fig. 1*a-b*. The 7th, 8th and 9th coossified vertebrae of tail-club, lateral and dorsal views, × 1/3.
Fig. 2*a-b*. Posterior part of tail-club, ventral and dorsal views; × 1/10.
Fig. 3*a-c*. Lateral plate of knob, ventral and distal views; × 1/6, 3*c* fragment × 1.

All fragments from the specimen Z. Pal. No. MgD-I/43

Photo: W. Kleiber



T. MARYAŃSKA: ARMOURED DINOSAURS FROM THE UPPERMOST CRETACEOUS

PLATE VIII

Page

Dyoplosaurus sp. 28

Upper Cretaceous, Upper Nemegt Beds, Altan Ula IV, Nemegt Basin, Gobi Desert

(see also Plate IX)

Fig. 1*a-b*. Whole preserved part of tail-club, dorsal and ventral views; ×1/8.
Fig. 2*a-c*. Posterior part of tail-club, dorsal and ventral views and cross-section of the same fragment; ×1/3.
Fig. 3*a-b*. Fragment of tail-club, ventral view and cross-section of the same; ×1/3.
Fig. 4. Cross-section of the fragment of tail-club; ×1/3.
Fig. 5*a-b*. Proximal fragment of preserved part of tail-club, lateral view and cross-section of the same; ×1/3.

All fragments from the specimen Z. Pal. No. MgD-I/42

Photo: M. Kleiber

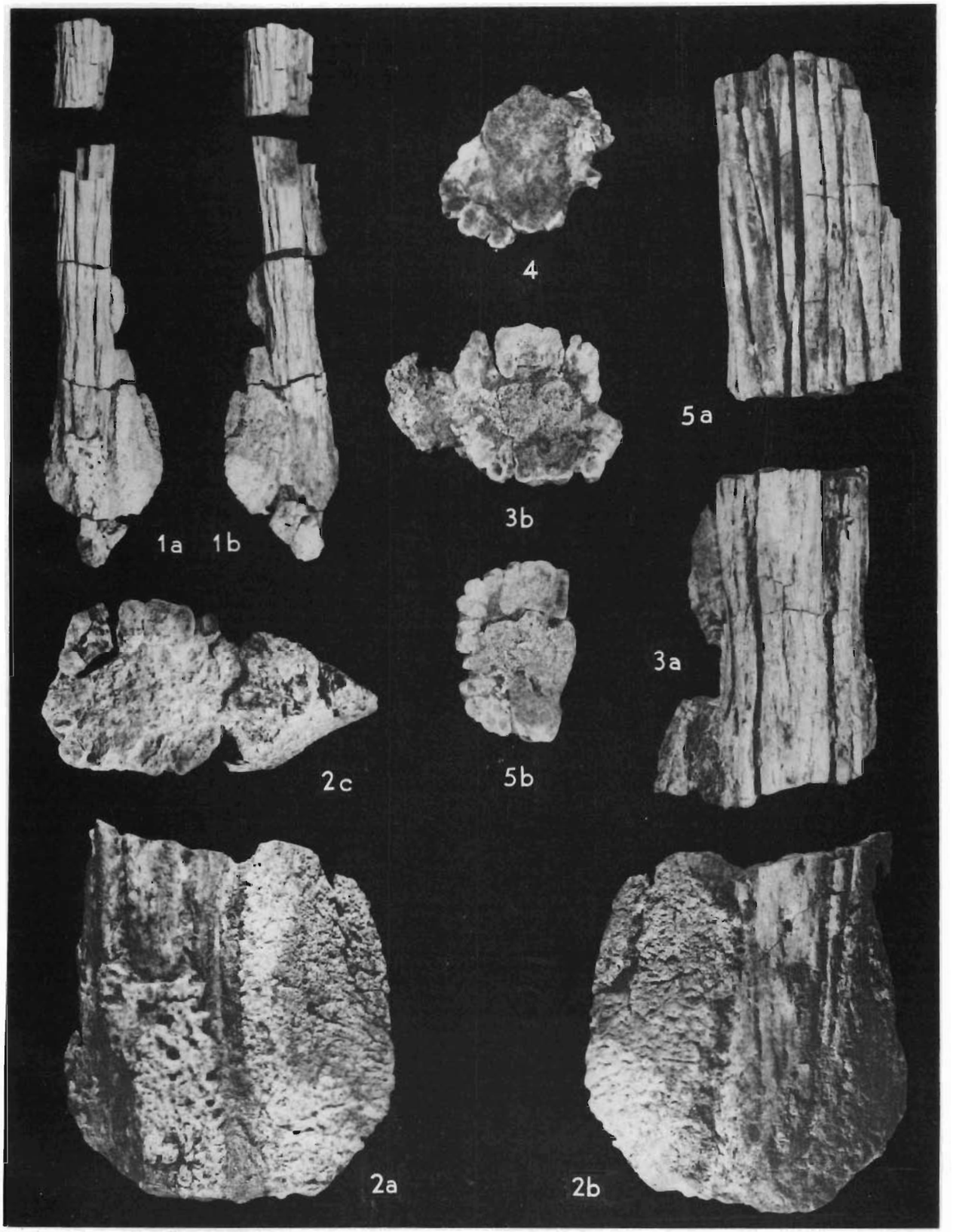

1a
1b
4
5a
3b
3a
5b
2c
2a
2b

PLATE IX

Page

Dyoplosaurus sp. 28

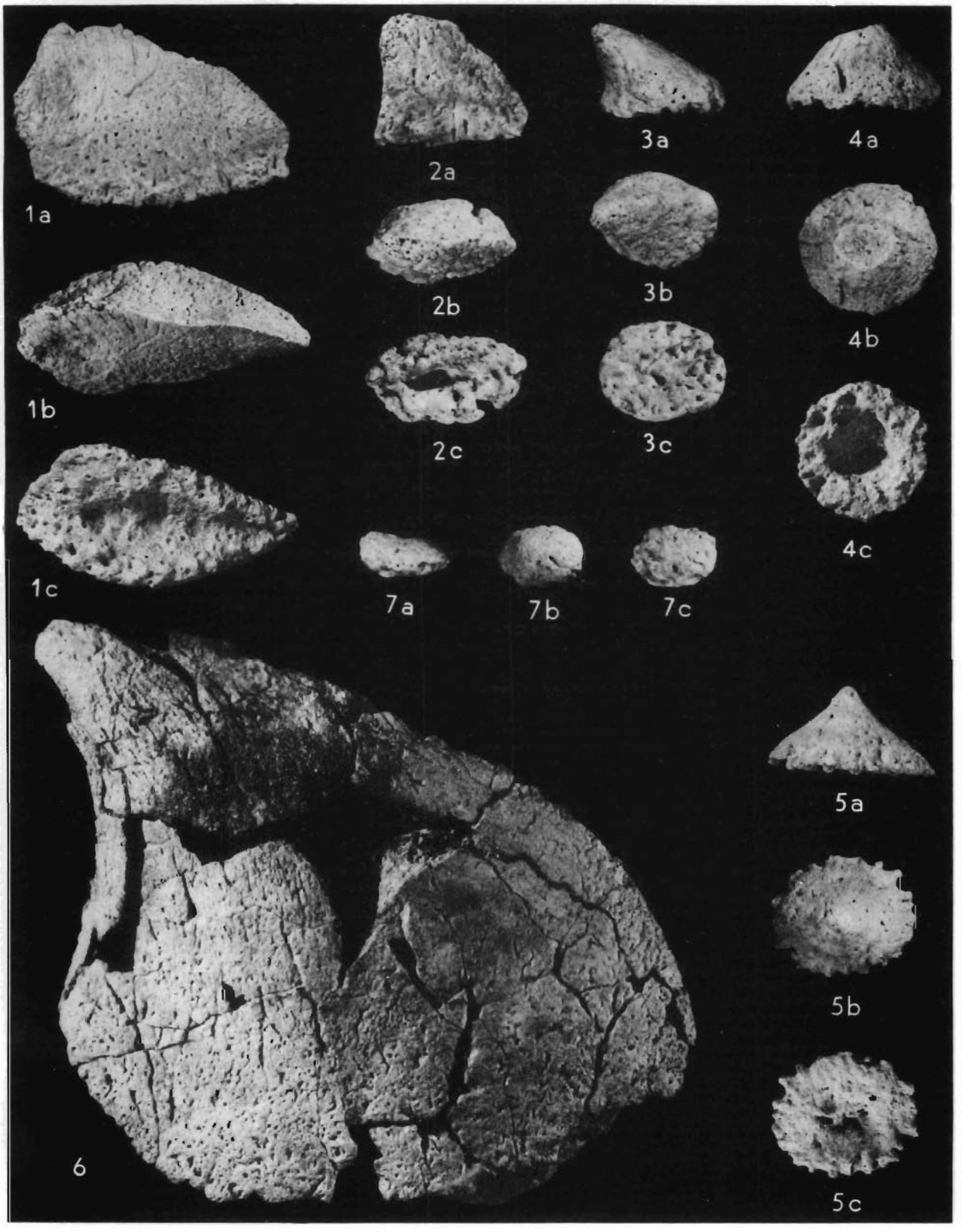
Upper Cretaceous, Upper Nemegt Beds, Altan Ula IV, Nemegt Basin, Gobi Desert

(see also Plate VIII)

Fig. 1*a-c*. Scute, type V, lateral, dorsal and ventral views, ×1/2.
Fig. 2*a-c*. Spine, type II, lateral, dorsal and ventral views; ×1/2.
Fig. 3*a-c*. Spine, type III, lateral, dorsal and ventral views; ×1/2.
Fig. 4*a-c*. Spine, type IV, lateral, dorsal and ventral views; ×1/2.
Fig. 5*a-e*. Spine, type IV, thin walled, lateral, dorsal and ventral views; ×1/2.
Fig. 6. Spine, type I, lateral view; ×1/3.
Fig. 7*a-c*. Scute, type VI, lateral, dorsal and ventral views; ×1/2.

All spines and scutes from the specimen Z. Pal. No. MgD-I/42

Photo: M. Kleiber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3c
4c
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7a
7b
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5a
5b
5c
6