MAGDALENA BORSUK-BIAŁYNICKA

EOPELOBATES LEPTOCOLAPTUS SP. N. — THE FIRST UPPER CRETACEOUS PELOBATID FROG FROM ASIA

(plate 15)

Abstract. — The first known Upper Cretaceous frog from Central Asia (?middle Campanian red beds of Khermeen Tsav, Gobi Desert) is described and figured based on a specimen consisting of a skull and a pectoral girdle, both fragmentary. It represents the first Old World finding of a pelobatid frog older than the Middle Eocene. The following complex of character states: an arciferal pectoral girdle, short, uncleft scapula, *Megophrys*-like ethmoid together with a weak pitted sculpture of skull and lack of scapular anterior lamina, indicates the pertinence of the specimen to *Eopelobates leptocolaptus* sp. n. and thus makes a proof of the Holarctic distribution of *Eopelobates* in the Late Cretaceous. The derivation of the Old World primitive pelobatids from the North American stem is no longer justified.

INTRODUCTION

The Pelobatidae is one of the most frequently encountered families in the anuran fossil record. As noted by ESTES (1970), known pelobatid frogs represent three main phyletic groups. The first one is a primitive *Eopelobates* group flourishing mainly in the Eocene and Oligocene time and vanishing by the Miocene. Its first representative known hitherto is a quationably assigned ?*Eopelobates* sp. (ESTES 1964 fig. 31c and ESTES 1970 p. 315) from the Late Cretaceous Lance Formation of Wyoming (Lancian, approximately the equivalent of the Late Maastrichtian, see RUSSELL 1975). It was the only preeocene representative of the group known up to now. The remaining lines are the Eurasiatic *Pelobates* group and the North American *Scaphiopus* group, which appear and radiate in the Neogene and persist up to the present. Similarity of anatomical features between *Eopelobates* and the modern pelobatids indicates the probable derivation of the latter from the former, which is explicitly pointed out by ŠPINAR (1972) as well as by ESTES (1970). However, the lack of pelobatid fossils in the Lower Tertiary and the Cretaceous hinders the making of inferences concerning the time and place of this early diversification. Therefore the early course of evolution in pelobatids as shown by ESTES (1970 fig. 31) is only conjectural as mentioned by this author in many instances.

In this connection the finding of a rather well preserved specimen of *Eopelobates* in the Upper Cretaceous of Mongolia is of great interest both from a phyletic and paleogeographic point of view.

The abbreviation ZPAL used in this paper means Institute of Paleobiology of the Polish Academy of Sciences (Warsaw).

ACKNOWLEDGEMENTS

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DESCRIPTION

Family **Pelobatidae** STANIUS, 1856, nom. corr. ŠPINAR, 1971
Genus *Eopelobates* PARKER, 1929
Eopelobates leptocolaptus sp. n.
(pl. 15: 1-5)

Holotype: An incomplete skull with mandible and a part of the right pectoral girdle of the same specimen (ZPAL MgAb—III/1).

Type horizon: Red beds of Khermeen Tsav ?middle Campanian (see GRADZIŃSKI *et al.* 1977).

Type locality: Khermeen Tsav II, south/west of Nemegt Basin, Gobi Desert, Mongolian People's Republic.

Derivation of the name: *leptocolaptus* because Greek *leptos* = weak and *kolaptos* = engraved.

Diagnosis: — A middle-sized eopelobatid frog (skull length about 18 mm but the range of variability unknown), with a pit and ridge ornamentation on the squamosal crossbar and almost none on the remaining bones (except the frontoparietal which is unknown), only few pits occurring on the maxilla. The squamosal crossbar has above the form of a saddle, but its lower margin is straight. Its posterior part is shorter than the anterior one and rounded at the end. The nasals are transversely elongated and subquadrangular rather than triangular. The scapula lacks the anterior lamina.

Preservation: The skull with the mandible and the right girdle elements were associated, thus indicating their pertinence to the same individual. The pectoral girdle was forced under the posterior part of the skull but has been prepared free. The skull is well preserved on the right side but its left posterior part (squamosal, pterygoid, quadratojugal and a part of maxilla) is missing; the prootics and frontoparietals are missing as well. The occipital part, the posterior end of the ethmoid and the left nasal are damaged. The mandible closely adjoins the medial surface of the maxilla and the ventral and medial surface of the maxillary arcade, rendering separation impossible. The preserved fragment of the pectoral girdle comprises the clavicle, which is broken off at its distal end, the proximal part of the coracoid and the crushed scapula.

Description. — The skull, aside from the posterior occipital region is horseshoe-shaped. It would probably be more circular in outline, if this region were preserved.

The skull roof of the ethmoid is flat, perhaps indicating this condition for the frontoparietal as well. Owing to the lack of frontoparietal and its postorbital process, the condition of the posterior margin of the orbit must, be deduced from the position of the anterior and of the squamosum. The orbit seems to be subequal to the dorsal temporal excavation. There is no frontoparietal-squamosal contact. The crossbar of the T-shaped squamosal is broadly joined to the maxilla. Its posterior (tympanic) process is somewhat shorter than the anterior one and it is rounded at the end. The dorsal margin of the squamosal bar has a form of a saddle, thus being similar to that of *Pelobates fuscus*, but its ventral margin is straight. The descending process of the squamosum joins the crossbar at a point shifted a little backwards from the middle of

its length. It makes an angle slightly less than 90° with the anterior process of the crossbar. The maxillary arcade is complete, a thin bar of the quadratojugal extending from the maxilla to the quadrate and to the distal end of the squamosal. The angle between the squamosal and quadratojugal is about 62°.

The quadratum is transversely situated small bony bar. Its lateral end is fastened by the squamosal and quadratojugal, the former adjoining it from behind, the latter from below and in front (see fig. 1C).

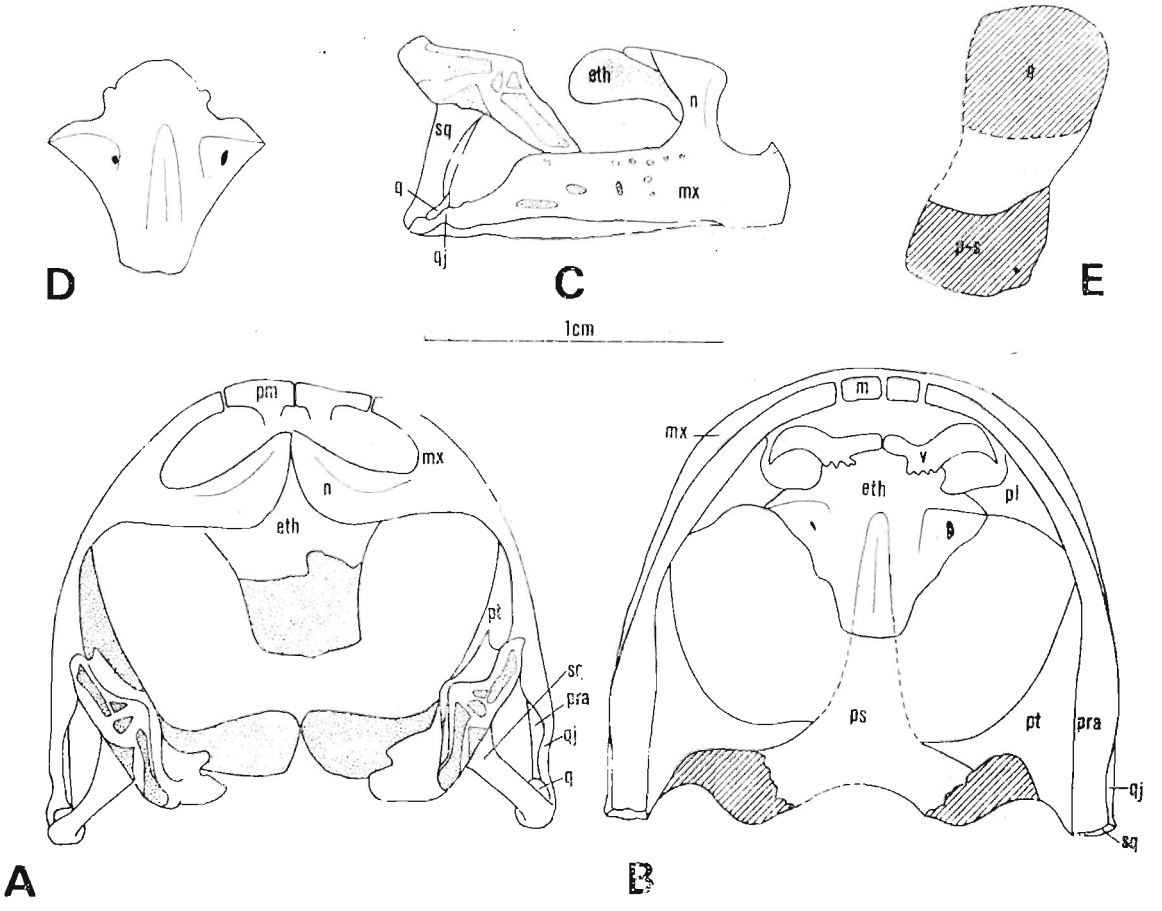

Fig. 1.

Eopelobates leptocolaptus sp. n. Skull. *A*, *B* dorsal and ventral view respectively with posterior left part reconstructed. *C* right side view, *D* ethmoid, dorsal view, *E* orbitotemporal relationship (right side). *eth* — ethmoid, *m* — mental, *mx* — maxilla, *n* — nasal, *o* — orbit, *pl* — palatine, *pm* — premaxilla, *pra* — prearticular, *pt* — pterygoid, *P-S* prootic and squamosal roof of ear region, *q* — quadrate, *qj* — quadratojugal, *sq* — squamosal, dashed line - - posterior border of orbit and restored border of frontoparietal

A pit and ridge sculpture is developed mainly on the crossbar of the squamosal (fig. 1C). The posterior part of the maxilla bears only few faint pits, the remaining bones being almost smooth.

The nasals are transversely elongated plates, quadrangular rather than triangular in outline. They are very narrow about the middle of their length, the fore-and-aft dimension making up about one fourth of the transverse one. At the suture with the maxilla as well as medially they become somewhat broader. Anteriorly they meet on the midline but diverge posteriorly thus making a dorsal exposure of the ethmoid.

The premaxillae are provided with strong nasal processes characteristic of frogs, and join with each other by a distinct medial suture.

The maxillae are very deep, especially so at the level of the joint with the nasals (about 3.5 mm), while getting lower posteriorly as well as towards the premaxillae.

Both the premaxillae and maxillae are dentigerous. The teeth are rather massive, closely spaced, attached to the inner surface of the jaws in a pleurodont fashion. Only the tooth bases, perforated at their tops, are preserved, the crowns having been obviously broken off at the abscission lines.

The general configuration of the ethmoid (fig. 1D) is very *Megophrys*-like in that the anterior process is very short and broad and poorly separated from the lateral processes. The lateral processes are short as well, and both processes pass gradually into the posterior part of the main body showing almost no emargination in this region. So far as this can be determined on the specimen in question, the ethmoid floor and roof are of about equal extent. The small capsular processes seem to be developed at both sides of the anterior process. This cannot, however, be stated with any certainty because this region of the ethmoid is partly covered by vomers. Posteriorly to the bases of each of the lateral processes there is a concavity perforated by foramina for the ramus profundus of the trigeminal nerve. Indicating the reach of the parasphenoid on the ethmoid surface, two longitudinal furrows extend along its bases (fig. 1D).

The vormers are transversely placed, S-shaped bone plates meeting on the midline. The major part of the vormer is situated anteriorly to the choanae, the postchoanal part being not developed. The medial parts of the vomers are provided with small tooth patches directed backwards. There are about four teeth on each patch.

The palatines are subtriangular plates concave in ventral aspect. Their medial parts underlie the lateral processes of the ethmoid and the nasals. The lateral parts become much broadened towards the sutures with the maxillae. The posterolateral part of the palatine almost touches the anterior angle of the pterygoid.

The pterygoid which is preserved only on the right side is a well developed subtriangular bone. Its medially directed angle produces a long process fusing intimately with the parasphenoid along an oblique suture (fig. 1B). The anterior part of the bone is fused with the maxilla, whereas its posterior angle adjoins to the squamosal and the quadratum. The middle and posterior part of the lateral border of the pterygoid is separated from the skull margin by a space, which is covered by the mandible in the described specimen.

The mandible, seen in ventral view, is a very narrow edentulous bone blade getting much broader in the posterior one third of the skull length. The posterior part is probably made of the prearticular, the anterior one of the prearticular and the dentary. The suture between the bones is not visible. Directly behind the premaxillae two small mental bones are situated. They are separated either from behind or from each other but were undoubtedly connected by cartilage in life.

Table 1

Eopelobates leptocolaptus sp. n. ZPAL MgAb III/I
Estimated dimensions of undeformed skull and measurements of pectoral girdle

Skull length	18 mm
Skull maximum width	21 mm
Skull width to length ratio	1.2
Length of preserved part of scapula	10 mm
Length of preserved part of clavicula over straight line	9 mm
The same over curve	12 mm
Clavicle to scapula length ratio	1.2

Pectoral girdle (fig. 2) — The scapula is proximally bicapitate. Its anterior border is not overlain by the clavicle, as it is the case in the Pipidae and in *Ascaphus*. However, the claviculoscapular joint is not situated at the top of the clavicular process but on its medial surface. The clavicle to scapula length ratio is difficult to calculate because of the poor preservation of

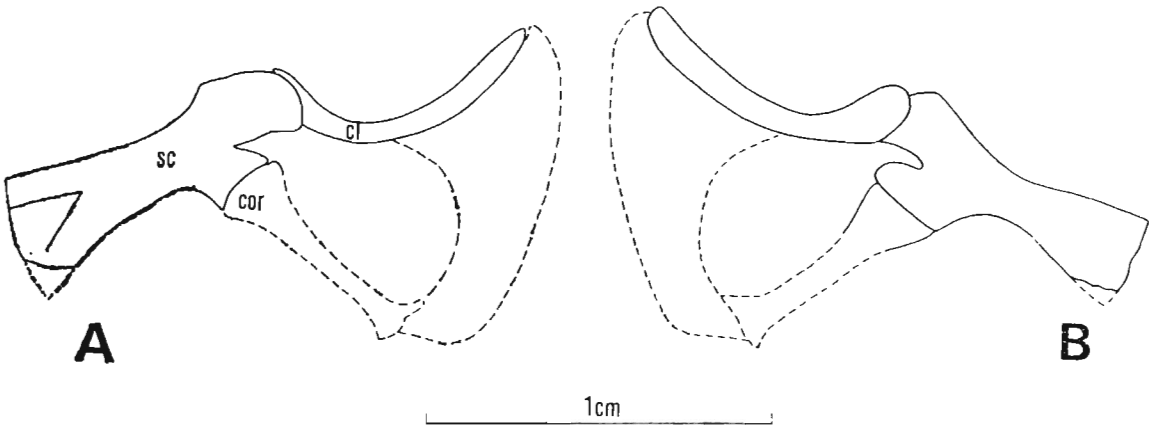

Fig. 2.
Eopelobates leptocolaptus sp. n. Pectoral girdle. *A* from without, *B* from within. Dashed line-reconstructed parts. *cl* — clavicle, *sc* — scapula, *cor* — coracoid.

the distal end of the bones but it is obviously not more than 2. No anterior lamina is preserved and it was probably not present at all.

The clavicle is arcuate and very thin. Its articular part extends along its shaft, which is not transversely expanded in this region. The proximal part of the coracoid, however, is much expanded. The coraco-scapular joint is nearly perpendicular to the bone surfaces.

DISCUSSION

When considering the systematic position of the Mongolian frog the main part to rely upon is its pectoral girdle. It is inferred to be arciferal on the evidence of the strongly diverging coracoids and clavicles, and thus cannot belong to any of the firmisternal families (Ranidae, Rhacophoridae and Microphylidae). As pointed out by PROCTER (1921) and GRIFFITHS (1963) the short and uncleft scapula is characteristic of the Pipidae and Palaeobatrachidae. This scapular character state allows the elimination of these families from the consideration, aside from the quite different structure of the skull of the Mongolian frog (squamosal and nasals reduced, palatines absent, quadratojugal absent or vestigial in Pipidae and Palaeobatrachidae, see NEVO 1968 and ŠPINAR 1972). A low clavicle to scapula ratio of the Mongolian frog precludes the Discoglossidae and Ascaphidae as well.

The present specimen differs strongly from the Bufonidae and the Hylidae by the structure of its ethmoid. In the Mongolian frog it is characterized by a strong development of its lateral wings which are directed transversely and shifted slightly backwards from its anterior end, whereas they are directed forwards and fused with the ethmoid main body, producing just a slight anterior broadening of the bone, in the Bufonidae and Hylidae. The ethmoid has a shape of a block rather than of a cross in the last named families, as is the case also in the Discoglossidae and the Ranidae.

It is difficult to comment upon such exotic groups as the Leptodactylidae, Rhinophyrynidae, Dendrobatidae and Pseudidae which are limitted to South America nowadays and are absent from the Polish collections. Based on the character state sets displayed by some representatives of the family Leptodactylidae, as figured by Lynch (1971), the Mongolian specimen could be readily assigned to this family. However, according to Lynch (*l. c.*) the Leptodactylidae are a group of a basicly Gondvanian origin, only their basal stock the Megophryinae having originated on northern landmasses.

All character states of the Mongolian frog discussed above, the connection between the squamosal crossbar and maxilla included, are in common with the pelobatids, thus making its assignment to the Pelobatidae the most probable.

Assignment of the specimen to genus based only on the incomplete skull, has proved to be difficult. Allowing for differences in specifically changable features, the skull agrees very well with those in the genera *Pelobates* and *Eopelobates* while differing from *Scaphiophus* by a complete maxillary arcade. Whether it belongs to *Eopelobates* or to *Pelobates* is somewhat of a problem because of the bad preservation of the diagnostic parts of the skull. Basing on the dorsal flatness of the ethmoid part of the skull and its horizontal position, the posterior part of the cranial roof, i. e. the frontoparietal, is presumed to be flat as well. The orbit, reconstructed as indicated above, is subequal to the temporal opening (fig. 1E). However, both these *Eopelobates* characters — the flattened skull table and the orbit subequal to the temporal opening, are merely conjectural on the described specimen. They are supported by the structure of the ethmoid, which is very much *Megophrys*-like and *Eopelobates*-like in its robust body, poor ossification of the anterior process and its dorsal roof reaching far forwards.

All these characters seem to be consistent with the assignment of the fossil to *Eopelobates*, the more so that *Eopelobates* is very likely to be encountered in the Cretaceous of Asia.

When comparing the Mongolian *Eopelobates* to the other representatives of this genus, it is obvious that it represents a different species which is called here *Eopelobates leptocolaptus*.

It differs from the remaining species of this genus by the following characters:

1. The absence of the anterior lamina of the scapula (the same seems to be true for *E. guthriei*, as described by ESTES 1970, but this character is not sufficiently known).

2. A somewhat different shape of the nasal than in the majority of species of *Eopelobates*, its maximum anteroposterior dimension being much lesser in relation to the transverse one than it is in most of them. *E. anthracinus* is the only *Eopelobates* representative similar to *E. leptocolaptus* in this respect.

3. A very scant sculpture developed in lesser degree than in any other *Eopelobates* species, as can be judged from the skull roof lacking a frontoparietal. *E. anthracinus* is again the most similar to *E. leptocolaptus* in this respect. However, the maxillae of *E. anthracinus* are more sculptured than those of *E. leptocolaptus* (see ESTES 1970, fig. 8 left).

4. Although characteristic of pelobatids, the specific outline of the squamosal crossbar, with its straight lower margin and the angular upper one.

The characters numbered 2-4 seem to be of a specific rank, whereas the first one (1) is probably a primitive pelobatid character retained in some modern Megophryinae (see e. g. *Megophrys monticola* in ESTES 1970 fig. 9c) as well as in *Scaphiopus*. Perhaps it should be regarded as a character of more than specific rank because of a comparative stability of a scapular shape within the genus (PROCTER 1921). Since I consider the Mongolian form to be closely related to *Eopelobates* I do not erect a new genus before new evidence comes.

It seems worth while to notice that the pit and ridge sculpture of *Eopelobates leptocolaptus* is very much like that of all the known Old World *Eopelobates* representatives, although less developed than this. At the same time it differs quite decisively from the granular sculpture of the New World forms.

It follows that *Eopelobates leptocolaptus* is a typical representative of the Old World primitive Pelobatidae, which is characterized by such primitive features of *Eopelobates* as a lack of a scapular anterior lamina and a weak sculpture. It could be assumed that it represents and ancestral form for the Old World eopelobatids and probably for the Megophryinae.

However, the extreme scarcity of the fossil evidence on the preeocene pelobatid history and the incompleteness of the present specimen makes the above suppositions merely hypothetical. None the less, the paleogeographic phylogeny of the primitive pelobatids may be represented in a slightly different way than it is in ESTES's (1970, fig. 31) diagram which was plotted before the discovery of the Upper Cretaceous Asiatic pelobatid. It seems no longer justified to affiliate the Old World eopelobatids upon the North American stem.

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EXPLANATION OF THE PLATE

PLATE 15

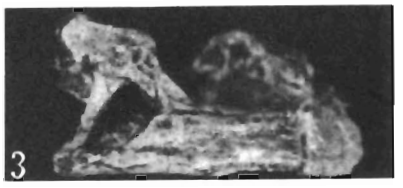
Eopelobates leptocolaptus sp.n. ZPAL MgAb III/I

Upper Cretaceous, red beds of Khermen Tsav, Khermen Tsav II, Gobi Desert, Mongolia

1a. Stereo-photograph of the skull with pectoral girdle before preparation. Dorsal view.
1b. Skull. After preparation. Dorsal view.
2a. Stereophotograph of the skull after preparation. Ventral view.
2b. Skull with pectoral girdle before preparation. Ventral view.
3. Skull. Right side view.
4. Skull. Anterior view.
5. Right pectoral girdle with supposed cleithrum lying aside *a* from inside, *b* from outside.

All×3


5a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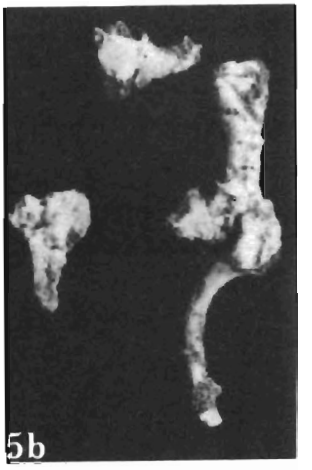
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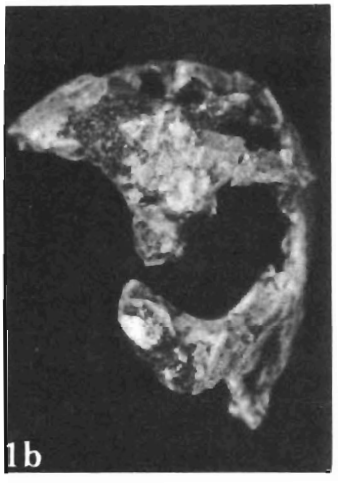
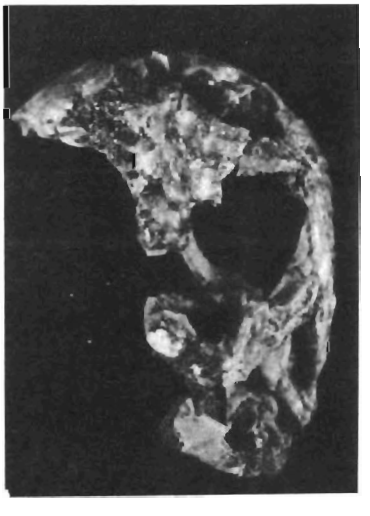
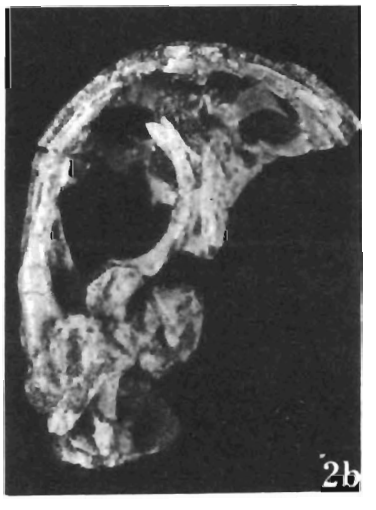
2a


1b


1a




2b