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PRELIMINARY NOTE ON THE PALAEOGNATHOUS BIRD FROM THE UPPER CRETACEOUS OF MONGOLIA

(Plates XXXII-XXXIII)

Abstract. — The supposed palaeognathous bird, *Gobipteryx minuta* n.gen., n.sp., from the Upper Cretaceous of the Gobi Desert is described on the basis of the single skull. The new family, Gobipterygidae and order, Gobipterygiformes, are erected. The skull appears to have been rhynchokinetic. Although avian affinities are clearly indicated by the structure of the mandible, as well as the general pattern of the palate and edentulous beak, the quadrate is of an unusual shape, unknown among birds.

INTRODUCTION

During the Polish-Mongolian Palaeontological Expedition to the Gobi Desert in 1971 (KIELAN-JAWOROWSKA & BARSBOLD, 1972), a small, badly damaged birdlike skull was found by Dr. T. MARYAŃSKA in the Nemegt Basin, in the sandstones designated by GRADZIŃSKI *et al.* (1969) as the Lower Nemegt Beds, and by MARTINSON *et al.* (1969) as the Barun Goyot Formation. The age of the Barun Goyot Formation was established by KIELAN-JAWOROWSKA (1974) as ?Campanian, on the basis of the level of multituberculate evolution. This specimen was identified by the author as a palaeognathous bird and is described below as *Gobiteryx minutua* n. gen., n. sp.

The specimen described in the present paper is housed in the Palaeozoological Institute of the Polish Academy of Sciences in Warsaw, abbreviated as Z.Pal.

I should like to express my deepest gratitude to Prof. Z. KIELAN-JAWOROWSKA (Palaeozoological Institute, Polish Academy of Sciences) who kindly supervised by work and placed at my disposal the manuscript of the paper: "Multituberculate succession in the late Cretaceous of the Gobi Desert, Mongolia". I wish to acknowledge my debt to Dr. H. OSMÓLSKA and Dr. E. RONIEWICZ (both of the Palaeozoological Institute of the Polish Academy of Sciences) for their useful help during all my work on the specimen in question. I have great pleasure in expressing my sincere gratitude to Dr. K. DOBROWOLSKI (Institute of Zoology, Warsaw University) who gave me much valuable advice and placed at my disposal some comparative material. I am extremely grateful to Dr. PAT RICH (Department of Vertebrate Paleontology, American Museum of Natural History) whose detailed comments much influenced my interpretation of the specimen. My thanks are also due to Mr. M. KUCZYŃSKI and Mrs. J. SKARŻYŃSKA for their skillful preparation of the described specimen and also to Mr. W. SKARŻYŃSKI for taking the photographs. Particular thanks go to Mr. J. DZIK, student of palaeontology, who made the drawings.

Abbreviations for text-figures:

An — angular
Ar — articular
Bpt — basipterygoid process
D — dental
Ext — external process of the mandible
Int — internal process of the mandible
J — jugal
Mx — maxilla
Pal — palatine
Pmx — premaxilla
Ppq — pterygoid process of the quadrate
Pt — pterygoid
Pv — prevpmer
Q — quadrate
Qj — quadratojugal
Ret — retroarticular process of the mandible
Sa — surangular

Superorder PALAEOGNATHAE Pycraft, 1900
Order GOBIPTERYGIFORMES nov.

Diagnosis. — The elongate quadrate articulates with the pterygoid by means of pterygoid process. Pterygoids run subparallel and are continued by prevomers, which converge and fuse only far anteriorly.

Family GOBIPTERYGIDAE nov.
Genus **GOBIPTERYX** nov.

Remarks. — The new family and genus are monotypic, the diagnoses are the same as for the type species (see discussion on p. 108).

Gobipteryx minuta n. sp.

(Pls. XXXII, XXXIII; Text-figs. 1, 2*a*)

Type specimen: Z. Pal. No. MgR-I/12. Incomplete skull, so strongly compressed dorsoventrally that the basicranial and palatal fragments are superposed on the skull roof. The specimen is considerably cracked, missing temporal and occipital region. Quadrate and mandible are the best preserved parts.

Type horizon and locality: Barun Goyot Formation (Campanian), Khulsan, Nemegt Basin, Gobi Desert, Mongolian People's Republic.

Derivation of the name: Gobi — occurring in the Gobi Desert; Gr. *pteron* = wing; Lat. *minuta* = small.

Diagnosis. — Jaws moderately elongated. Quadrate long, with two mandibular condyles and large pterygoid process. Prevomers fuse at midline far anteriorly. Palatine with medial, tongue-shaped process covering pterygoid-prevomer articulation. Mandible with long symphysis, two large internal and retroarticular processes and one small external process. Articular region of the mandible ventrally smooth.

Measurements (in mm):

Length of the skull	ca 45
Quadrate:	
length from the top of the internal condyle to the damaged posterior end	11
width between the tops of the condyles	5
width at the narrowest place (behind the condyles)	2
Mandible:	
length from the anterior margin to the posterior end of the retroarticular process	38
length of the symphysis	9
length of the internal process	ca 8
length of the retroarticular process	ca 8

Description. — Anteriorly, the skull tapers gradually. Its bird appearance is due to the edentulous beak and the large braincase. The nasal openings are extended far anteriorly.

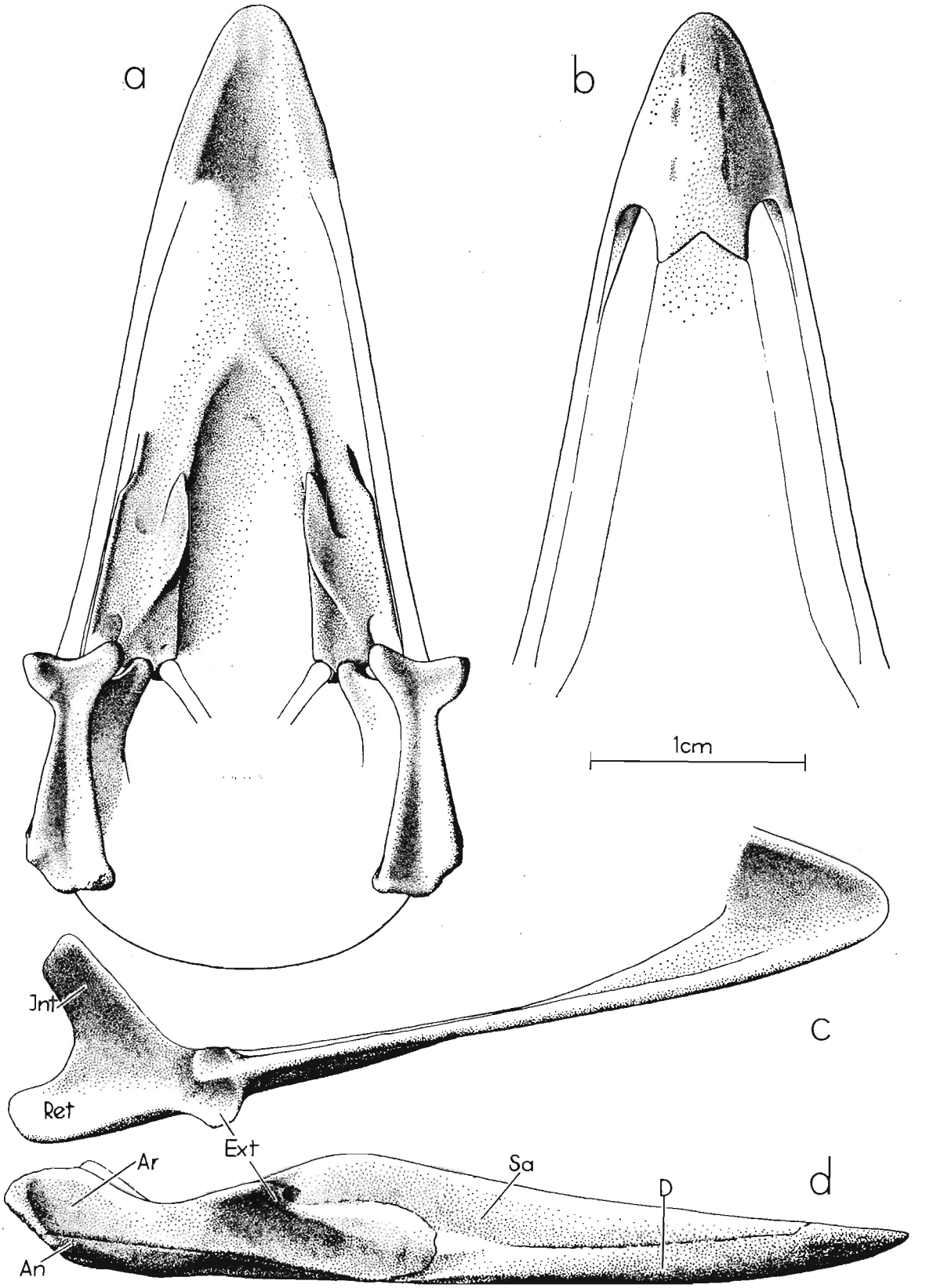

Fig. 1

Gobipteryx minuta n. sp.: *a* partial reconstruction of the skull in ventral view; *b* reconstruction of the anterior part of the skull in dorsal view; *c* reconstruction of the mandible in external view; *d* reconstruction of the mandible in dorsal view.

The suture between premaxillae is hardly visible. There are three nutrient foramina in each premaxilla. The edge of the upper part of the beak is flattened; 10 mm from the end of the beak there is a very distinct, symmetrical slit, forming an obtuse angle opening backwards (Text-fig. 1*b*). This slit separates the distal part of the beak from the rest of the skull roof. As seen from beneath, the slit is covered by continuous, osseous lamina. This slit may be indicative of some weak line crossing the upper jaw. Quite in contrast is the irregular shape of the corresponding breakage of the lower jaw, originated in connection with the upper one. Posteriorly, the skull roof continues as a rather uniform lamina; along its sides, the lamina must have been accompanied by the anteriorly far extended (originating 7 mm from the end of the beak) nasal openings. Laterally, these openings have been bordered mainly by the rod- or slatlike maxillae. As the author presumes, there must have been a common, continuous slat formed of the maxilla, jugal and quadratojugal, which, as it seems, has movably articulated with quadrate. The state of preservation of the specimen, however, does not allow these suppositions to be verified directly.

The posterior part of the skull roof is well domed and indicative of the large braincase. On the braincase roof no suture is evident so it is difficult to say how much the parietals contribute to its structure.

The quadrate is elongate, slightly arcuate, concave posteroventrally and slants forward so that the jaw articulation was oriented anteroventrad (Text-fig. 1*a*). Two quadrate condyles form an obtusely angled furcula. The internal condyle is somewhat longer. Above the condyles, there is a flat, joint surface — undoubtedly for the quadratojugal articulation. A small, obscure fragment on the left side of the skull is tentatively interpreted as the quadratojugal (non figured in the reconstructions); on the one side is has a flat surface, possibly corresponding to that on the quadrate, from its other side projects a thin rod of bone. The quadrate articulates with the pterygoid through the large pterygoid process: anteriorly the capitulum of this process fits into the acetabulum of the pterygoid while posteriorly the process parallels the main body of the quadrate as a shelf of bone.

Medial and close to the acetabulum receiving the pterygoid process of the quadrate, the pterygoid is incised by yet another equally deep acetabulum for the basipterygoid process (Text-fig. 1*a*). Neither the basipterygoid processes nor the parasphenoid are preserved, but some rodlike, broken fragments, present in this region, can be assumed to be some remains of them.

The pterygoids run subparallel and articulate with the palatines along the oblique sutures. Under the palatines, it means in the anteroposterior midpoint of the skull, the pterygoids are thought to articulate with prevomers and some discontinuity can be seen in this region. The prevomers run as continuations of the pterygoids, converge gradually and fuse along the midline of the skull one third of the skull's total length posteriad of its anterior. end.

The palatine, preserved on the left side only, has two anterior processes. The lateral pojects presumably to the palatine process of the premaxilla — immediately anterior to the body of the palatine bone this process extends vertically, more anteriorly — horizontally. The medial, tongue-shaped, articulates suturally with pterygoid and overlappes its articulation with prevomer. Poorly distinct posterior process parallels the pterygoid.

The mandible of *Gobipteryx minuta* (Text-fig. 1 *c-d*) has a long, externally sculptured symphysis, with no trace of any suture. The sutures between the mandibular elements tentatively established for the external side, are no evident on the internal side. There is a distinct, medially inclined coronoid process that rises gradually from the upper mandibular edge po-

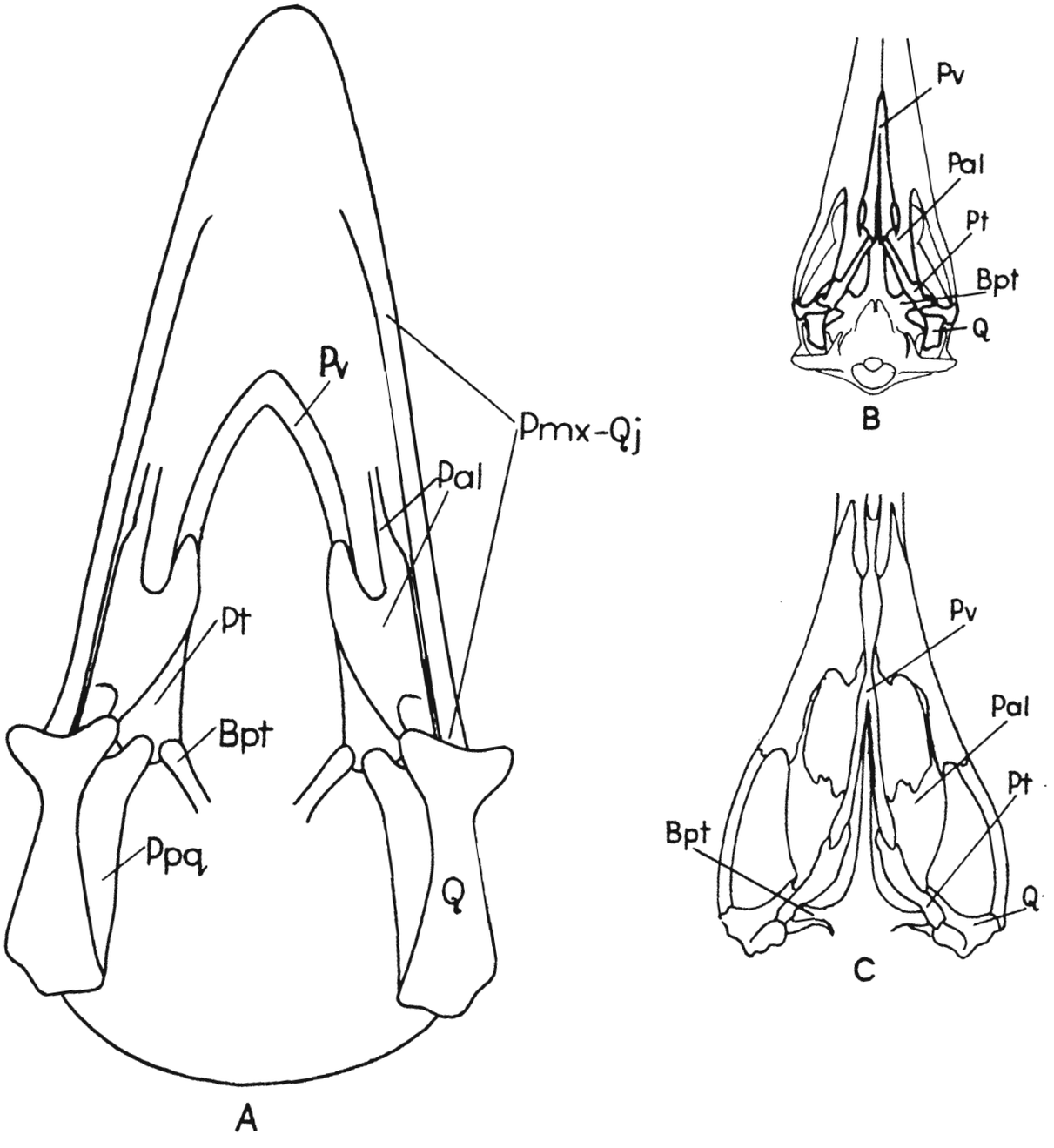

Fig. 2
Reconstructions of the ventral aspects of the skull: *A in Gobipteryx minuta* n. sp.; *B* in *Apteryx* (after BOCK, 1963); *C* in *Casuarius*after MAC DOWELL 1948). Not to scale.

steriad of the anteroposterior midpoint of the lower jaw. Below the coronoid process, on the internal side, there is a distinct, closed mandibular fossa, divided by a diagonal ridge into two areas of muscle insertion.

The articular surface of the mandible is divided in accordance with the two condyles of the quadrate. The external part of the surface is expanded laterally as the external process. The internal part slopes anteromedially downwards; behind, it is bounded by a small tuberosity. The big retroarticular process curves upward at its posterior end. From the lower edge of the retroarticular part projects a long internal process, directed upwards and somewhat posteriorly. The articular region is smooth ventrally, without any ridges on it.

COMPARISONS

As far as the author has been able to determine, *Gobipteryx* is not directly related to any living or fossil form.

The most important, generally avian characters of *Gobipteryx* are as follows: 1. uniform and sutureless braincase, 2. edentulous beak, 3. uniform sympysis of the lower jaw, 4. structure of the articular region of the mandible with conspicuous internal and retroarticular processes.

Among the preceding, general avian features, the presence of the large internal process of the mandible seems to be of special importance as indicative of the avian type of cranial kinesis. The internal process gives points of insertion for some portions of the pterygoid muscle (by some Neognathae at least — ventralis medialis and dorsalis caudalis). The development of the process reduces the transverse in favour of the longitudinal component of the forces involved in the activity of these portions of the pterygoid muscle (DZERZHYNSKY, 1972). The internal process would then seem to be a part of the general avian character complex related to the cranial kinesis.

The palatal configuration of *Gobipteryx*, as far as the author's reconstruction is correct, shows deep resemblances with that of palaeognathous birds, (Text-fig. 1) the term deprived of value by MACDOWELL (1948) and recently reintroduced by BOCK (1963). In the result of the thoroughgoing discussion, BOCK (1963) came to the conclusion of a considerable phylogenetic importance of the palaeognathous palate as a part of the "character complex associated with rhynchokinesis". Another important feature of this "functional unit of characters" consist in the extension of the nasal openings, clearly seen in the anterior part of the *Gobipteryx* skull.

Both the premises of the rhynchokinesis and the ratite affinities of *Gobipteryx* are substantiated by the direct evidence of the streptostylic and kinetic condition of the *Gobipteryx* skull. As the basipterygoid process is immovable, so, if both the pterygoid joints are to be functional (movable), both the quadrate and the pterygoid must move (Text-fig. 2A). An additional confirmation of the streptostyly is supplied by the surface if the evidently movable articulation with the quadratojugale.

As the palaeognathous affinities of *Gobipteryx* as well as rhynchokinesis of its skull appear to be justified to some extent, it is a tempting although not very serious possibility to relate the described earlier slit near the end of the beak (Text-fig. 2B) with to the rhynchokinesis. The slit would then indicate the line of flexion. A forward movement of the quadrate would raise the distal beak portion.

Irrespective of the considerations of the cranial kinesis, *Gobipteryx* shares with recent palaeognathous birds two general characteristics: 1. pattern of the palate, 2. extension of the nasal openings. As to the pattern of the palate, four of five positive criterions given by BOCK (1963), strictly apply to *Gobipteryx*: a) prevomers articulates posteriorly with pterygoid, b) the

pterygoid prevents the palatine from articulating with the basisphenoid rostrum,c) the palatine articulates with the pterygoid along a suture, d) the well developed basitemporal articulation is found in the posterior end of the pterygoid. There are, however, two differences in the palate of *Gobipteryx* as compared with the recent representatives of the palaeognathous birds. First, the relative large distance between the pterygoids (and also between posterior parts of the prevomers). Second, the peculiar quadrate-pterygoid articulation through the long pterygoid process.

The first, bearing in mind the age and the size of *Gobipteryx* as well as the diversity of particular arrangements of palatal bones among recent Palaeognathae, does not seem to constitute the real difficulty. All the known palaeognathous palates are structurally derivable from that of *Gobipteryx* or at least, this difference does not change the common pattern.

The second is more serious and causes the position of *Gobipteryx* to be somewhat ambiguous. No bird posses the well-developed pterygoid process of the quadrate. The latter is according to STRESEMANN (1927—1934) derivable from the first. Moreover, the quadrate-pterygoid articulation of recent Palaeognathae includes part of the orbital process. Hence, the fifth BOCK's criterion is partly satisfied, but the only reasonable hypothesis is the retention of some primitive condition in the quadrato-pterygoid articulation of *Gobipteryx*. On other side, *Archaeopteryx* has the well developed orbital and no pterygoid process. As the author hesitates to advance far-reaching hypotheses on the basis of such a poor material, the problem is left open. Unfortunately it has not been possible to examine the anterodorsal surface of the quadrate and the presence of the orbital process cannot be verified.

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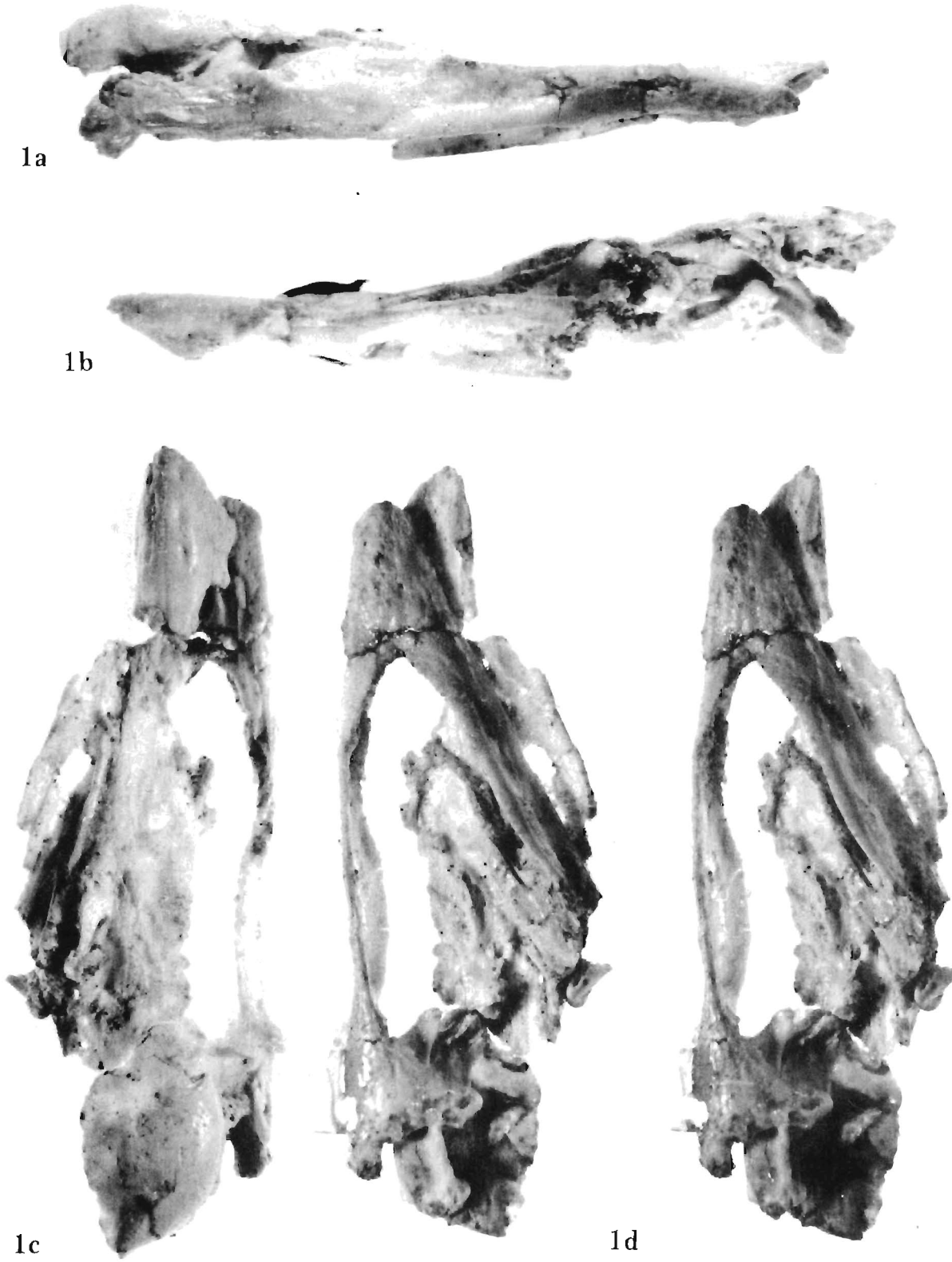
A. ELŻANOWSKI: PRELIMINARY NOTE ON PALAEOGNATHOUS BIRD

PLATE XXXII

Upper Cretaceous, Barun Goyot Formation, Khulsan, Gobi Desert, Mongolia

Fig. 1*a*. Photograph of the skull in right lateral view. Type specimen, Z. Pal. No. MgR-I/12; ×3.
Fig. 1*b*. Photograph of the same in left lateral view; ×3.
Fig. 1*c*. Photograph of the same in dorsal view; ×3.
Fig. 1*d*. Stereo-photograph of the same in ventral view; ×3.



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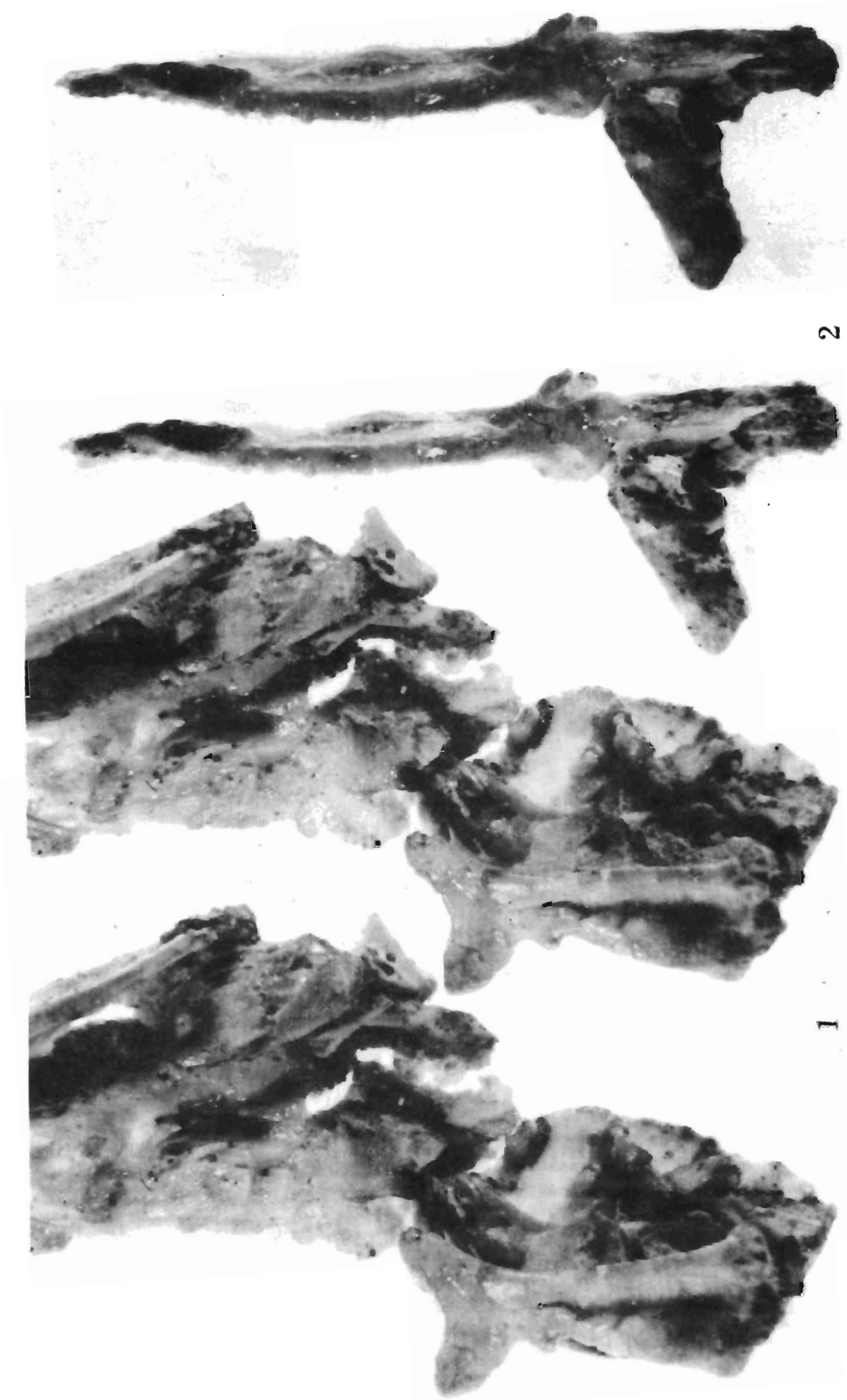
A. ELŻANOWSKI: PRELIMINARY NOTE ON THE PALAEOGNATHOUS BIRD

PLATE XXXIII

Upper Cretaceous, Barun Goyot Formation, Khulsan, Gobi Desert, Mongolia

Fig. 1. Stereo-photograph of the posteriorpart of the skull in ventral view. Type specimen, Z. Pal. No. MgR-I/12; ×5.

Fig. 2. Stereo-photograph of the posterior part of the mandible of the same specimen in dorsal view; ×5.



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