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TWO LOWER CRETACEOUS DINOSAURS OF MONGOLIA<sup>1</sup>

BY HENRY FAIRFIELD OSBORN

The Third Asiatic Expedition of 1922 discovered four formations which, from preliminary definition and examination of the fossils they contain, were referred to the Cretaceous, namely:

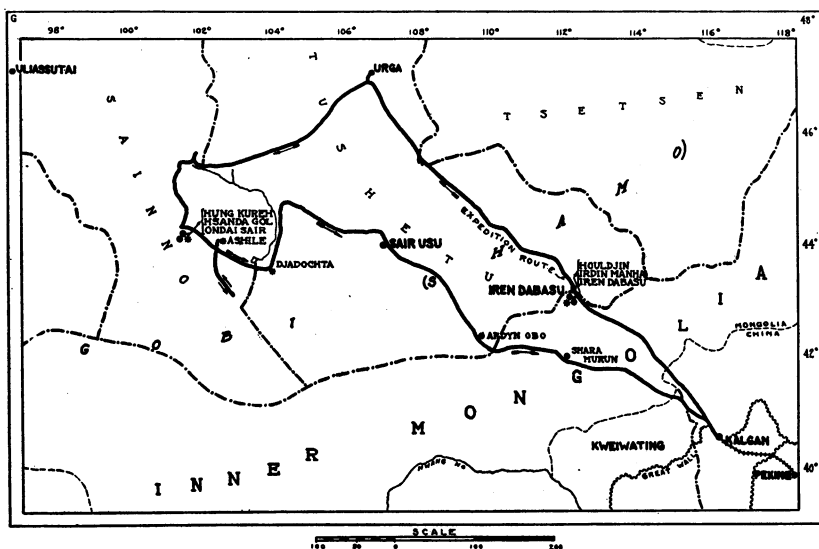


Fig. 1. Route of Third Asiatic Expedition in Mongolia, 1922, showing the localities of the Cretaceous and Tertiary formations discovered.

\*Cretaceous formations: °Tertiary formations.

**IREN DABASU FORMATION**, southeast Mongolia, containing (1) predentate dinosaurs, probably of the bipedal type; (2) carnivorous dinosaurs of at least two genera, the smaller one being of the *Ornithomimus* type; (3) crocodiles; (4) turtles of the *Trionyx* type; (5) a few pelecypod shells.

ONDAI SAIR FORMATION, Ussuk, Tsagan Nor basin, western Mongolia, containing skeleton (Amer. Mus. 6253) articulated and nearly complete, except skull which is mostly weathered out.

ASHILE FORMATION, Artsa Bogdo basin, western Mongolia, containing skeleton (Amer. Mus. 6254) in sandstone, tail and pelvis mostly weathered out, skull and jaws, backbone and large part of limbs in block.

DJA-DOCH-TA FORMATION, Kwei-wa-ting trail, east of Artsa Bogdo, Mongolia, containing type skull of *Protoceratops andrewsi*; nearly complete skull (Amer. Mus. 6251) and lower jaws, hornless and far smaller than that of any known ceratopsian or ankylosaur, being only about 160 mm. in length, as fully described by Granger and Gregory.

The geographic location of these four Cretaceous formations is shown in the accompanying sketch map (Fig. 1). The relative age of each can only be determined by careful comparison of the fauna found. The only specimens carefully examined up to the present time are the *Protoceratops andrewsi* type and the two new types from the Ondai Sair and Ashile formations to be described in the present bulletin.

#### ASHILE FORMATION

##### ***Psittacosaurus mongoliensis*, new genus and species**

The type of this new genus and species (Amer. Mus. 6254) is an almost perfect skull and jaws of an adult animal, with the skeleton, including the backbone, tail and pelvis and most of the limbs, in the block. This superb specimen, locally known as the Red Mesa (Ohshih) skeleton, was discovered by the Third Asiatic Expedition in the Artsa Bogdo basin through the bright observation of Wong, the Mongolian chauffeur engaged in Urga. At the time of the present description its characters are not fully known, because the partly exposed teeth (Fig. 2A) are not yet worked out and the skeleton still lies in the matrix. On the revelation of these still concealed characters the question of the affinity of *Psittacosaurus* to *Protiguanodon* will be decided.

The proportions of this skull are relatively short, deep, narrow in the facial region, broad in the cranial region. Teeth apparently confined to the maxillaries and dentary, crowns closely compacted; dentition not fully exposed. Functions of edentulous premaxillary and prementary element below suggested by powerful cutting and crushing rostrum or beak, for which the name *Psittacosaurus*, or parrot-beaked saurian, has been suggested by Dr. Gregory.

LEFT LATERAL ASPECT (Fig. 2A).—Premaxillary distinct, uniting by suture with nasals. Edentulous borders of premaxillary and anterior portion of maxillary. Small narial opening, large orbital, large latero-temporal, small auditory fenestræ. Sutures of premaxillaries, prefrontals, supraorbitals, postorbitals, squamosal, partly separated. Quadrate

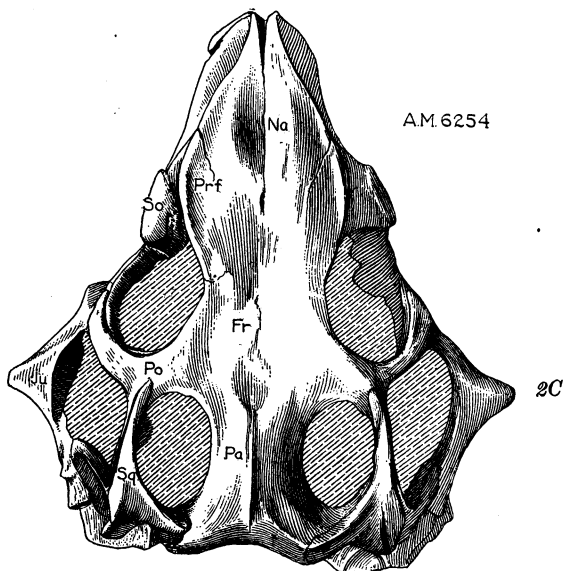
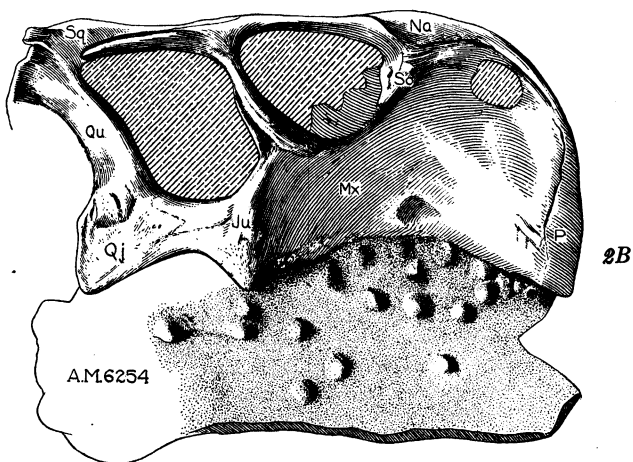
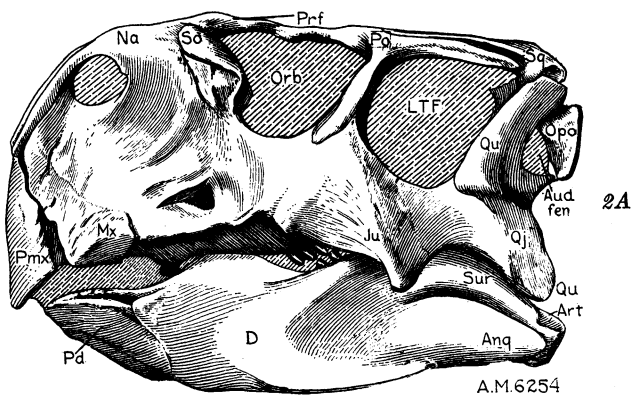
deep, forming anterior border of auditory fenestra, coössified with quadratojugal element below. Prominent osseous horns on sides of jugals. Broad and powerful jugal and infraorbital bar, indicating powerful muscles to control mastication, beak sheathed in horn. In the powerful jaw, surangular, angular, dentary and prementary regions fairly indicated; prementary coalesced with dentary in type.

RIGHT LATERAL ASPECT (Fig. 2B).—In this aspect the tubercular dermal armature of the side of the throat is revealed, consisting of numerous rounded dermal cones, which represent minute ostoses. Whether this armature belongs to the side of the jaw or is a throat armature slipped out of place is difficult to say; it corresponds in general appearance with some of the throat armature observed in the *Ankylosauria*. Similar rudimentary armature may have extended over the surface of the skull preliminary to the formation of dermal plates, as observed in the armored *Stegoceras* and *Ankylosaurus*. In other features the right lateral aspect agrees with the left, except that the supraorbital is less clearly exposed and the premaxillary is more firmly united with the maxillary.

SUPERIOR ASPECT (Fig. 2C).—In this aspect the general triangular form of the skull, the broadened cranial, the narrow facial and rostral region are clearly shown, reminding us of the *Protoceratops andrewsi* skull. The orbital, laterotemporal and supratemporal fenestræ are clearly shown, placing this skull with the *Diapsida* group. The nasals, supraorbitals, postorbitals, squamosals and quadrates are shown. Beyond the auditory fenestra lies the paroccipital process of the opisthotic element. The sutures of the mid-cranial region are closed and the boundaries of the cranial bones not clearly defined.

POSTERIOR ASPECT (Fig. 2D).—In this aspect the skull is seen to be still partially enclosed in matrix. The borders of the occipital foramen, of the auditory and of the post-temporal fenestræ may be seen. The powerful quadrate exhibits its sutural line of union with the quadratojugal. The cranium itself is shallow but is given a depressed aspect by the downward extension of the quadrates and lateral osseous jugal horns.

ANTERIOR ASPECT (Fig. 2E).—In front aspect the parrot-beaked rostrum of *Psittacosaurus* is well shown, also the relation of the dermal armature of the right side of the skull (left in this figure) to the osseous jugal horns. It is the correlation of these horns with the dermal armature which first led the writer to the opinion that this animal may be ancestral to some member of the armored suborder *Ankylosauria*. In this front aspect the sutures of the maxillaries, nasals, prefrontals, supraorbitals,



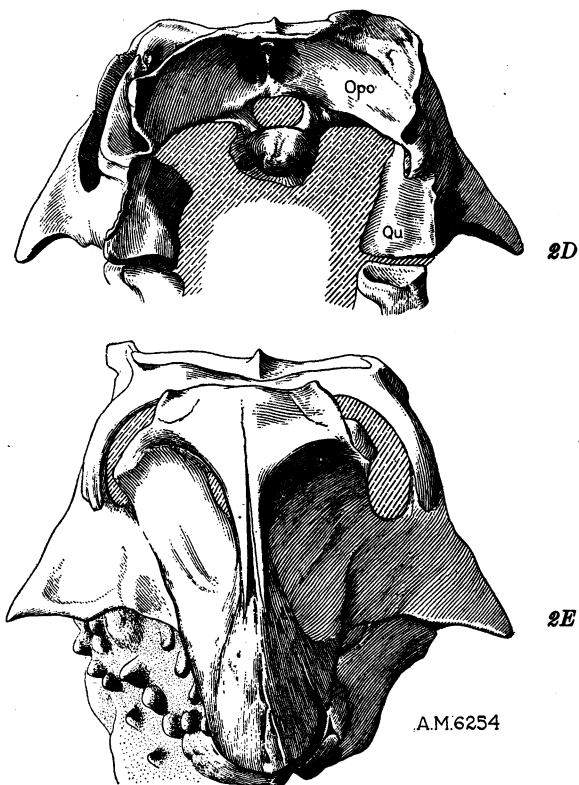


Fig. 2. *Psittacosaurus mongoliensis*, type skull (Amer. Mus. 6254).

- A. Left lateral aspect. One-half natural size.
- B. Right lateral aspect, showing impressions of dermal armature beneath the osseous jugal horns. One-half natural size.
- C. Superior aspect. One-half natural size.
- D. Posterior aspect. One-half natural size.
- E. Anterior aspect, showing dermal armature of the right side below quadratojugal horns. One-half natural size.

may be partly detected, as indicated in the drawing. It appears that the narial and orbital fenestræ face partly forward.

*Psittacosaurus mongoliensis*

Herbivorous diapsid reptile with pre-dentary bone and horny beak. Maxillary teeth compressed, not fully known. Skull short and deep, narrow anteriorly, broad posteriorly. Rostrum prominent, parrot-like, edentulous. Nostrils small, orbits large. Infraorbital region and jaw heavy, with attachment for powerful muscles. Primitive dermal armature in head region; lateral osseous horns on jugals.

Genotype of **Psittacosauridæ**, new family. Skeleton and teeth only partly known; supposed primitive armored dinosaurs, possibly related to the fully armored Upper Cretaceous types.

*Protiguanodon mongoliense*

Probably a diapsid reptile with pre-dentary bone and horny beak. Nine teeth on the dentary, of iguanodont pattern. Rostrum short, jaw very deep but relatively slender. Teeth less compacted than in *Psittacosaurus*. Skull probably deep and short, without rostral prolongation. No evidence of dermal armature. Skeleton of Pro-Iguanodontia type; limbs of prebipedal type. Manus functionally tridactyl with vestigial IV. Pes functionally tetradactyl with vestigial V. Prominent prepubic process. Ilium, scapulæ and limbs of Pro-Iguanodontia type. Osseous tendons and tail indicating bipedal locomotion.

Genotype species of subfamily Protiguanodontinæ.

ONDAI SAIR FORMATION

**Protiguanodon mongoliense**, new genus and species

The type of this new genus and species is a nearly complete, articulated skeleton (Amer. Mus. 6253) lying on its ventral face, with the four limbs prone, the left jaw and portions of the skull weathered out, as represented in the diagram (Fig. 3). This figure, drawn by Mr. John Germann, exhibits only the parts from which the matrix had been removed at the time of writing and serves to supplement this preliminary description.

The animal is 53 inches (1350 mm.) in length; the outstretched fore limb measures about 12 inches (340 mm.); the outstretched hind limb measures about 480 mm., 140 mm. longer than the fore limb. These proportions are of a prebipedal type, in which the fore limb occasionally touches the ground. The balancing tail measures 710 mm. from the center of the ilium to the tip. The thoracic vertebræ measure 340 mm. from the center of the ilium to the base of the scapula. The neck has not yet been exposed and its length cannot now be established.

Peculiar iguanodont features are the ossified tendons lying above the transverse processes of the thoracic vertebræ; another iguanodont

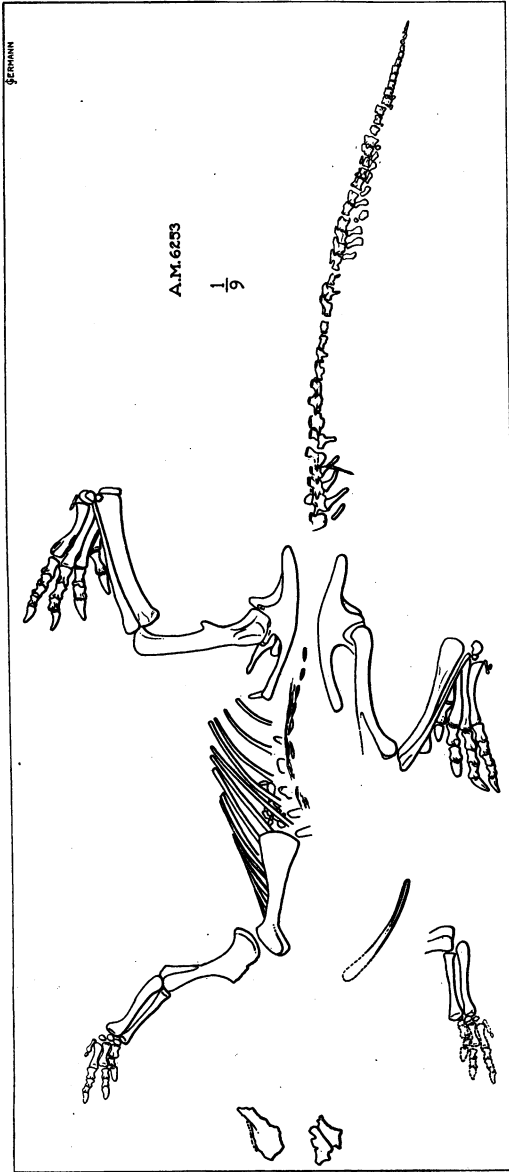


Fig. 3. Type skeleton of *Protiguanodon mongoliense* (Amer. Mus. 6253) from Ondai Sair Formation, as seen from above. In exposing this skeleton no trace of dermal armature was observed. The jaw and the summit of the skull are placed approximately as found. One-ninth natural size.

character is the presence of 11 stomach-stones opposite the superior border of the scapula.

The contour and proportions of the scapula and of the ilium are well shown in the diagram. Below the anterior border of the ilium is a prepubic extension of the pubis; the postpubis has not yet been exposed from the matrix. The manus is tetradactyl: I, Mtc, short, with two phalanges; II, intermediate, with three phalanges; III, elongate, with four phalanges; IV, vestigial, with single phalanx. Three equal-sized carpals. The pes is pentadactyl: I, Mts, short, with two phalanges; II, elongate, three phalanges; III, most elongate, four phalanges; IV, same length as Mts II, five phalanges; V, vestigial, one phalanx. Manus

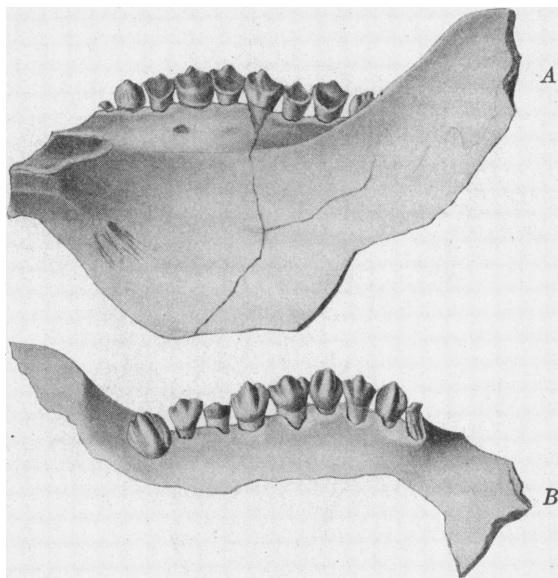


Fig. 4. Type jaw of *Protiguanodon mongoliense* (Amer. Mus. 6253).

- A. External view of dentary, showing in the outer aspect the nine dentary teeth. Natural size.  
B. Inner aspect of the upper portion of the dentary, showing same nine teeth from the sculptured internal surface.

and pes, although differing in size, are homodynamous. Four tarsals are observed, including an astragalus closely united with the tibia. Both manus and pes are in the same stage of evolution as those of *Hypsilophodon*, except that the Wealden genus has four digits in the manus.

Affinity to the suborder Iguanodontia is revealed in these skeletal characters, which indicate a prebipedal stage. The affinity shows still more clearly in the jaw (Fig. 4) and teeth, as worked out of the matrix by



Mr. Falkenbach and carefully drawn by Mr. R. Weber. Of the nine teeth in the dentary, the unworn ninth tooth of the left side of the mandible shows a most clearly typical structure, consisting of a prominent median ridge, with lesser anterior and posterior ridges serrated along the superior border. Less worn teeth are No. 4 and No. 6; in more advanced wear are the apparently trilobed Nos. 3 and 8; completely worn are Nos. 1 and 7. In external aspect the triserrate interior view of No. 9 appears in front of the anterior border of the coronoid. The jaw itself is short and deep, apparently edentulous anteriorly, a thin border rounding inwards, as shown in Fig. 4. Thus the animal is short-jawed.

Comparing this animal with *Hypsilophodon* of the Wealden, with *Thescelosaurus* of the Lance, with the three genera composing the family Laosauridae of Marsh (*Nanosaurus*, *Laosaurus*, *Dryosaurus*), and with the families Iguanodontidae and Trachodontidae, we may define it as belonging to a new genus, *Protiguanodon*, typified by the genotypic

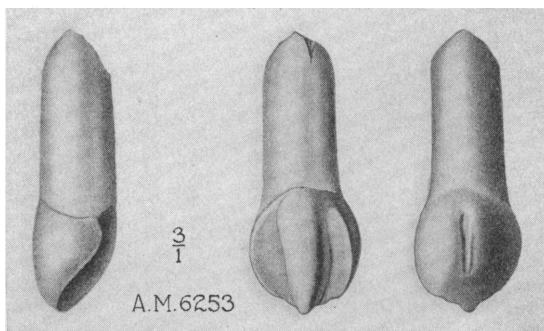


Fig. 5. Greatly enlarged ( $\times 3$ ) anterior, exterior and interior aspects of a single tooth, which may belong in the maxillary series.

species *Protiguanodon mongoliense*. When more fully known it may prove to belong to a distinct subfamily of the Iguanodontidae, for which the subfamily name Protiguanodontinae would be appropriate.

The writer is of the opinion that this animal is distinct from the reptile above described, but Dr. W. K. Gregory, to whom the writer is deeply indebted for valuable notes and comparative observations, considers that it represents a juvenile stage of an animal similar to the very adult stage which constitutes the type of the genus *Psittacosaurus*. In favor of the view that the animals are the same are (1) close similarity in

size; (2) close resemblances in the parietals of the skull, as far as observed in this type, with that of the skull described above; (3) general similarity in the quadrate. Against the idea that these animals belong together are the following: (1) absence of dermal armature; (2) comparative unlikeness of the skeleton and skull, as far as observed; (3) wide geologic separation of the two types. The question will be positively settled by the following means: (1) by the complete exposure of the dental series in *Psittacosaurus*; (2) by the exposure of the skeleton in the same; (3) by minute comparison of the tooth structure of the two types. In case the animals prove to be the same, *Psittacosaurus* will have precedence.