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TRILOPHODON COOPERI, SP. NOV., OF DERA BUGTI, BALUCHISTAN[1]

BY HENRY FAIRFIELD OSBORN

Forster Cooper described as '*Bunolophodon angustidens*' in his paper of 1922 on the "Miocene Proboscidia from Baluchistan" (pp. 610–620, figs. 1–7)[2] a younger palate (Brit. Mus. M12178), an older palate (Brit. Mus. M12179), and right and left fragments of a lower jaw (Brit. Mus. M12181).

The latter specimen (Fig. 1) is selected by the present writer as the *type* of a new primitive species, because of the possession of a perfectly preserved third right inferior molar (*op. cit.*, p. 614, "Lower jaw with third molar in the alveolus." As paratypes are selected: (1) The younger palate (Brit. Mus. M12178) "with second molars just erupting" (*op. cit.*, fig. 1, p. 611), and (2) the older palate (Brit. Mus. M12179) containing Dp^4-M^2, second molar with two anterior ridge-crests partly worn (Fig. 2).

The registered numbers of the jaw and palates, kindly furnished by Mr. Arthur T. Hopwood of the British Museum (June 22, 1932), are as follows:

Trilophodon cooperi

Osborn's type: Right ramus, Brit. Mus. M12181 (Cooper, 1922, fig. 2); cast Amer. Mus. 5205

Osborn's paratypes:

Older palate, Brit. Mus. M12179; cast Amer. Mus. 5211

Younger palate, Brit. Mus. M12178 (Cooper, 1922, fig. 1)

The type and paratype figures of Cooper and Osborn are as follows:

Type jaw: Figure 2 of Cooper (1922), figure 1 of Osborn

Paratype, older palate: Figure 2 of Osborn

Paratype, younger palate: Figure 1 of Cooper (1922), not figured in the present article

It gives the present writer great pleasure to dedicate this very important and geologically ancient new species to his friend C. Forster Cooper, in recognition of his valuable services to mammalian palæontology, especially his two expeditions to the Lower Miocene deposits of Dera Bugti, Baluchistan.

[1]This is the author's thirtieth communication on the evolution and classification of the Proboscidea since 1918, and the fortieth in his total list of papers on the Proboscidea since 1907. See the author's chronologic and classified Bibliography in his "Fifty-two Years of Research, Observation and Publication 1877–1929," published in 1930.

[2]Cooper, C. Forster, "Miocene Proboscidia from Baluchistan." Proc. Zool. Soc. London, Pt. III, September, 1922, pp. 609–626, Pls. I–IV, text figs. 1–12.

Cooper in his very detailed description and figures of these Dera Bugti mastodonts, and after comparison with Cuvier's '*Mastodon angustidens*' and Schlesinger's '*M. subtapiroidea,*' referred the specimens listed above to '*Bunolophodon angustidens.*' He concluded (*op. cit.*, p. 610): "This is consonant with the view, supported by other reasons, that the stage of *angustidens* represented by these Indian forms is earlier than that of the more typical French forms from Sansan, etc., and is possibly as early as any yet described."

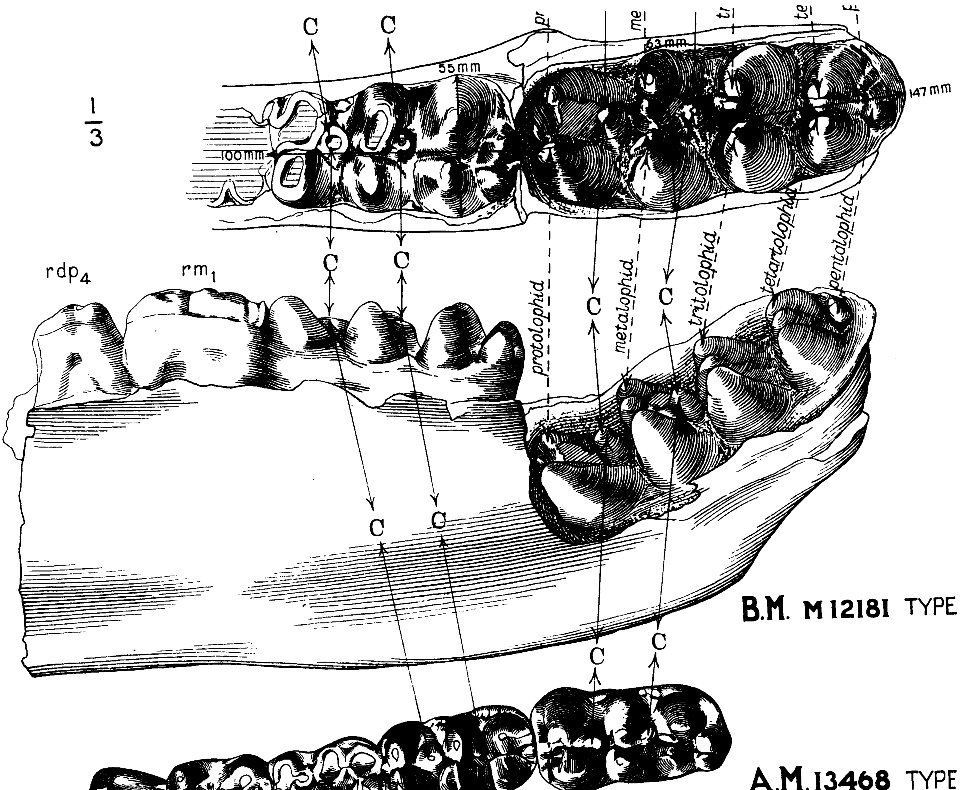

Fig. 1. Type mandible of *Trilophodon cooperi* Osborn (Brit. Mus. M12181; cast Amer. Mus. 5205) in comparison with the type of *Phiomia osborni* (Amer. Mus. 13468). One-third natural size. Conspicuous central conules (*C C*) present.

New and very close comparison with Cuvier's type of *Mastodon angustidens*, with Lydekker's type of *M. angustidens palæindicus*, with Osborn's holotype of *Trilophodon chinjiensis*, and with Pilgrim's type of *Trilophodon macrognathus*, confirms Forster Cooper's opinion and demonstrates beyond question that the type of *Trilophodon cooperi* represents an extremely primitive stage in the evolution of the highly characteristic inferior molars of *Trilophodon;* this stage is the next higher known above *Phiomia osborni* (see Osborn's forthcoming Memoir). The type and paratype grinding teeth may be characterized in the following specific definition.

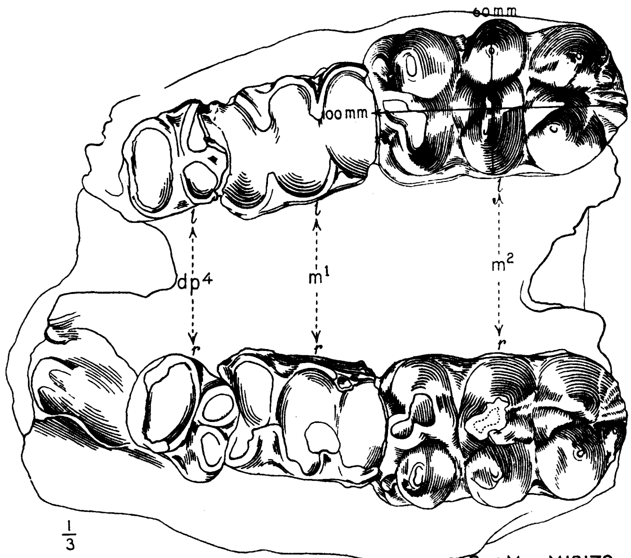

Fig. 2. *Trilophodon cooperi* paratype, 'older palate' (Brit. Mus. M12179, cast Amer. Mus. 5211) containing Dp^4-M^2; second molar with two anterior ridge-crests partly worn. One-third natural size. Central conules absent.

Trilophodon cooperi, sp. nov.

Inferior Molars.—Third inferior molars relatively long and narrow (ap. 147 mm., tr. 63 mm., index 43); with 4⅕ ridge-crests, relatively obtuse in lateral aspect; internal and external cones subdivided into two conelets; central conules (*C C*) in first and second valleys only. Second inferior molars relatively long and narrow (ap. 100 mm., tr. 55 mm., index 55), as in *Phiomia osborni;* with 3 obtuse ridge-crests.

Superior Molars.—Second superior molars relatively broad (ap. 100 mm., tr. 60 mm., index 60); with 3 ridge-crests; no central conules; internal cones subdivided into two conelets; external cones single not subdivided.

The significance of the above specific definition becomes more clear in the type figure (Fig. 1) and in a new synthetic diagram, for the

Memoir, which altogether has occupied several months in preparation and analysis of *Trilophodon* molar evolution, as follows:

THIRD INFERIOR MOLARS.—The 'ascending mutations' and species of the *Phiomia-Trilophodon* phylum invariably exhibit the following rectigradations or new characters arising orthogenetically:

(1) Central conules (*C C C*) which successively appear between the proto- and metalophid, then between the meta- and tritolophid (*Trilophodon cooperi*), then between the trito- and tetartolophid (*T. palæindicus*), and so on.

(2) The paired *cones* each divide into two *conelets*, the fissures becoming deeper progressively from the *Trilophodon cooperi* stage to the *T. chinjiensis* stage.

(3) Thus the summits of the internal cones wear into a dumb-bell pattern, then into the *trefoil* pattern, by the expansion of the median conelets into *trefoils*.

(4) Each new ridge-crest is heralded by two small *cones*, as seen also in M_2.

(5) The four *ridge-crests*, or proto-, meta-, trito-, and tetartolophids, are followed by the fifth ridge-crest, or pentalophid, which evolves from a rudimentary condition in *Trilophodon cooperi* into the well-developed *T. chinjiensis* stage. Finally the sixth ridge-crest, or hexalophid, is added in *T. chinjiensis* and *T. macrognathus*.

(6) The pentalophid progresses through *Trilophodon cooperi*, *T. palæindicus*, *T. chinjiensis* into the perfected *T. macrognathus* stage, in which finally the hexalophid is heralded as two rounded cones.

These four ascending species compared with the primitive third inferior molar of *Phiomia osborni* enable us to synthesize the progressive evolution of the *Trilophodon* ridge-crests, cones, conelets, conules, and trefoils, as shown in the table on page 6.

The external elements or *ecto-cones*, conelets, conules, and trefoils evolve most rapidly in the *inferior* molars, while the *ento-cones*, conelets, and trefoils develop more slowly. In the *superior* molars just the opposite rate is observed, the most rapid evolution (Fig. 2) is upon the *internal* elements.

SUPERIOR MOLARS (FIG. 2).—The inferior molars are more rapidly progressive than the *superior* molars in which the cones, conelets, and trefoils are greatly retarded; for example, in *Trilophodon cooperi* M^2 exhibits six cones, rudimentary internal trefoils, no conules, whereas the third inferior molar, M_3, exhibits eight cones, two conules, and incipient subdivision of several of the cones and conelets.

SUMMARY.—Exclusive of trefoils, *Phiomia osborni* exhibits only ten conical coronal elements; *Trilophodon cooperi* nineteen conical coronal elements; *T. palæindicus* twenty conical coronal elements, plus rudiments of trefoils; *T. chinjiensis* twenty-seven conical coronal elements, with *prominent* ecto-trefoils; *T. macrognathus* twenty-six conical coronal elements, with eight trefoils (see Table, p. 6). A summary of Oligocene-Miocene evolution of M_3 is as follows:

OLIGOCENE: *Phiomia osborni,* length 75 mm., *ten* conical coronal elements
UPPER MIOCENE: *Trilophodon macrognathus,* length 225 mm., *twenty-six* conical coronal elements

It follows that this strictly orthogenetic, rectigradational, progressive evolution of the cones, conelets, conules, ridge-crests, and trefoils constitutes not only a sure means of defining generic, mutational, and specific stages, but it may precisely establish the *geologic horizon* in which these definitely ascending evolutionary stages occur. The specific gaps between these readily distinguishable stages in time will be filled in by intermediate ascending mutations.

GEOLOGIC FAUNAL HORIZONS.—These closely analyzed ascending mutations or stages in the evolution of the third inferior molars afford a new and very valuable time-scale in the ascending geologic horizons of the Upper Siwaliks, as indicated below.

Forster Cooper (1922, p. 609) describes these species as from "Lower Miocene deposits of Dera Bugti in Baluchistan." Recently (letter, Aug. 10, 1932) he states that all the mastodonts of his collection came from quarries near Gandoi or near Kumbhi. It now appears important to determine the exact localities of the type and paratype specimens of *Trilophodon cooperi.*

Forster Cooper also states that no mastodonts were found *in situ* at Chur-Lando, although mastodont specimens were found in various water courses near by. This quarry yielded *Paraceratherium* (Forster Cooper, 1911) *bugtiense* (Pilgrim 1910), a genus which it appears antedates *Baluchitherium osborni* Cooper (1913). The Chur-Lando horizon is further distinguished from the 'Bugti beds' by the presence of

		Ridge-crests	Cones	Conelets	Conules	Trefoils	Total conical elements	Total new elements
Upper Miocene	*Trilophodon macrognathus*	5½	12	19	4	8	26	34
Middle Miocene	*Trilophodon chinjiensis*	5½	12	21	4	14	27	35
Lower Miocene	*Trilophodon palæindicus*	4⅓	10	17	3	6–7	20	27
Basal Miocene	*Trilophodon cooperi*	4⅕	10	17	2	00	19	19
Lower Oligocene	*Phiomia osborni*	3⅓	8	10	2	00	10	10

numerous species of *Chilotherium*, including a stage close to *Chil. tagicus*, also a rhinoceroid stage close to *Brachypotherium depereti* Borissiak, similar to the Jilančik species of equal age. It also contains the genotype of *Gelasmodon gracilis* Cooper (1913) and of *Hemimeryx lydekkeri* Cooper (1913). *Aprotodon smith-woodwardi*, gen. nov., Cooper (1915) proves to be a rhinoceros allied to *Chilotherium* Cooper (1931–1932).

The Chur-Lando life zone, therefore, may be provisionally correlated with the *Indricotherium* Borissiak (1915) life zone, also with the *Baluchitherium grangeri* Osborn life zone of Loh, central Mongolia, which are now regarded as of Middle Oligocene age, thus antedating the Basal or Lower Miocene age of the 'Bugti beds.'

It would appear, therefore, that the 'Bugti beds' as exposed at Gandoi and Kumbhi are of Basal Miocene age and may be designated as the *Trilophodon cooperi* life zone, containing one of the most primitive known species of this Longirostrine Mastodont.

Trilophodon macrognathus of the Upper Chinji is the uppermost trilophodont stage thus far discovered. It is succeeded in the Jammu and Kangra, also in the Dhok Pathan levels, by progressive species of *Tetralophodon* and of *Synconolophus*, which doubtless will yield equally precise means of determining the higher geologic levels.