simpler than the molars. Narial opening deeply excavated; nasal bones and premaxillaries long. Manus with complete, but much reduced fourth digit. Oligocene; Lower White River beds. *T. osborni* Lucas.

(*c*) *Leptaceratherium* Osborn. Dental formula: $\frac{2.1.4.3.}{2.0.3.3.}$. Premolars somewhat complex. Oligocene; Lower White River beds. *L. trigonodum* Osborn.

(*d*) *Ronzotherium* Aymard. Skeleton not known. Premolars much simpler than molars; those in the lower jaw with incomplete ridges. Superior molars without crista, crochet and antecrochet. Oligocene; Europe. *R. velaunum* Aymard, Ronzon; *R. gaudryi* Rames. In the Phosphorites of Quercy and in the Brown Coal of Bohemia and Piedmont, as well as in the Bohnerz of Swabia, *Rhinocerinae* also occur which probably belong to this genus.

(*e*) *Aceratherium* Kaup (*Caenopus* Cope) (Figs. 177-181). Dolichocephalous. Nasal bones small, projecting freely above the narial openings, hornless;

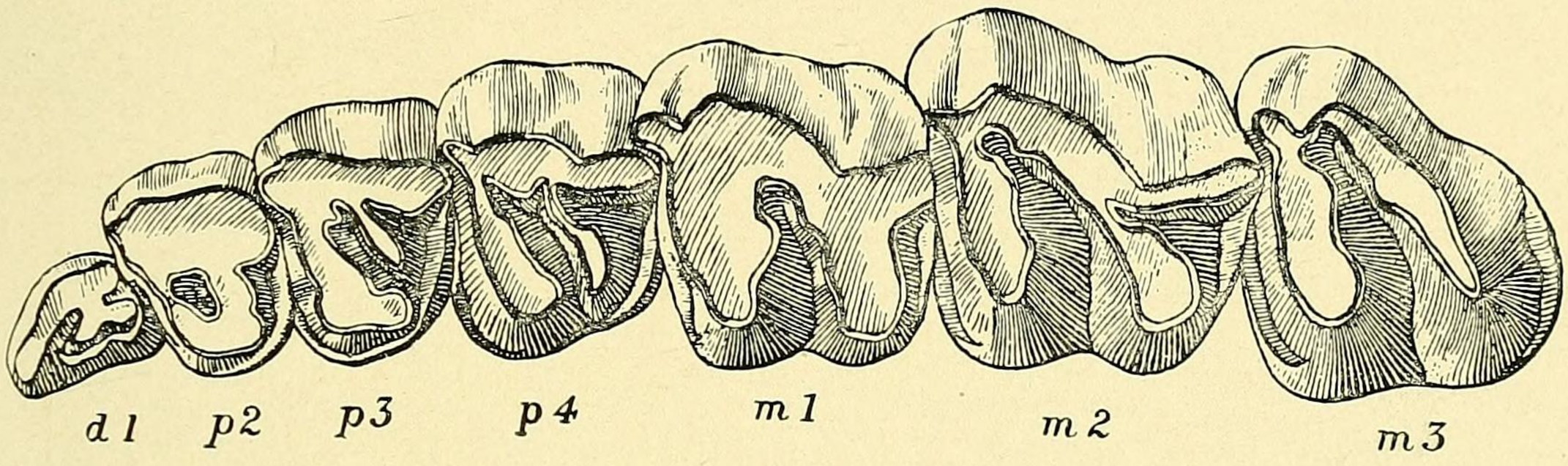

FIG. 181.

Aceratherium platycephalum Osborn. Oligocene (White River beds), Dakota. Left upper cheek teeth. 1/2. (After Osborn.)

frontal bones smooth above; mastoid process (post-tympanic) independently developed and separated from the postglenoid process by a furrow. Dental formula: $\frac{2\text{-}1.0.\ 4.\ 3.}{2\text{-}1.0.4\text{-}3.3.}$. Upper incisors with low laterally compressed crowns elongated antero-posteriorly and with the wear oblique. Lower inner incisors diminutive, deciduous, chisel-shaped; outer very large, procumbent, triangular, with wear posterior. Premolars less complex than the molars. Manus often still tetradactyl, pes tridactyl. To *Aceratherium* belong the earliest representatives of *Rhinoceros*, from the Oligocene Phosphorites of Quercy—*Aceratherium filholi* Osborn. In the Lower Miocene are found *A. lemanense* Pomel (= *R. gannatense* Duvernoy); in the Middle Miocene, *A. platyodon* Mermier; in the Upper Miocene, *A. tetradactylum* Lartet, and *A. zernowi* Borissiak from Sebastopol; and in the Lower Pliocene, *A. incisivum* Cuvier. From the Lower Pliocene of Samos are known *A. samium* and *schlosseri* Weber, the latter nearly allied to *A. blanfordi* Lydekker, occurring in the Siwalik and in China. *A. persiae* Pohlig has been described from Maragha. In the Oligocene of North America (White River beds) are found several species, *A. occidentale* Leidy; *A. tridactylum* Osborn; *A. platycephalum* Osborn and Wortman; *A. mite* Cope.

(*f*) *Diceratherium* Marsh. Dental formula: $\frac{1.0.\ 4.\ 3.}{2.0.4\text{-}3.3.}$. Dolichocephalous.

Each nasal bone usually furnished with a protuberance for the small horns, which are placed side by side. Nearly all premolars molariform. Oligocene; Bohnerz, Europe; *D. zitteli* Schlosser. Lower Miocene; *D. croizeti* Pomel. Middle Miocene; *D. douvillei* Osborn. Upper Miocene; *D. steinheimense* Jäger. One species, also, in the Lower Pliocene. North American Oligocene; *D.*

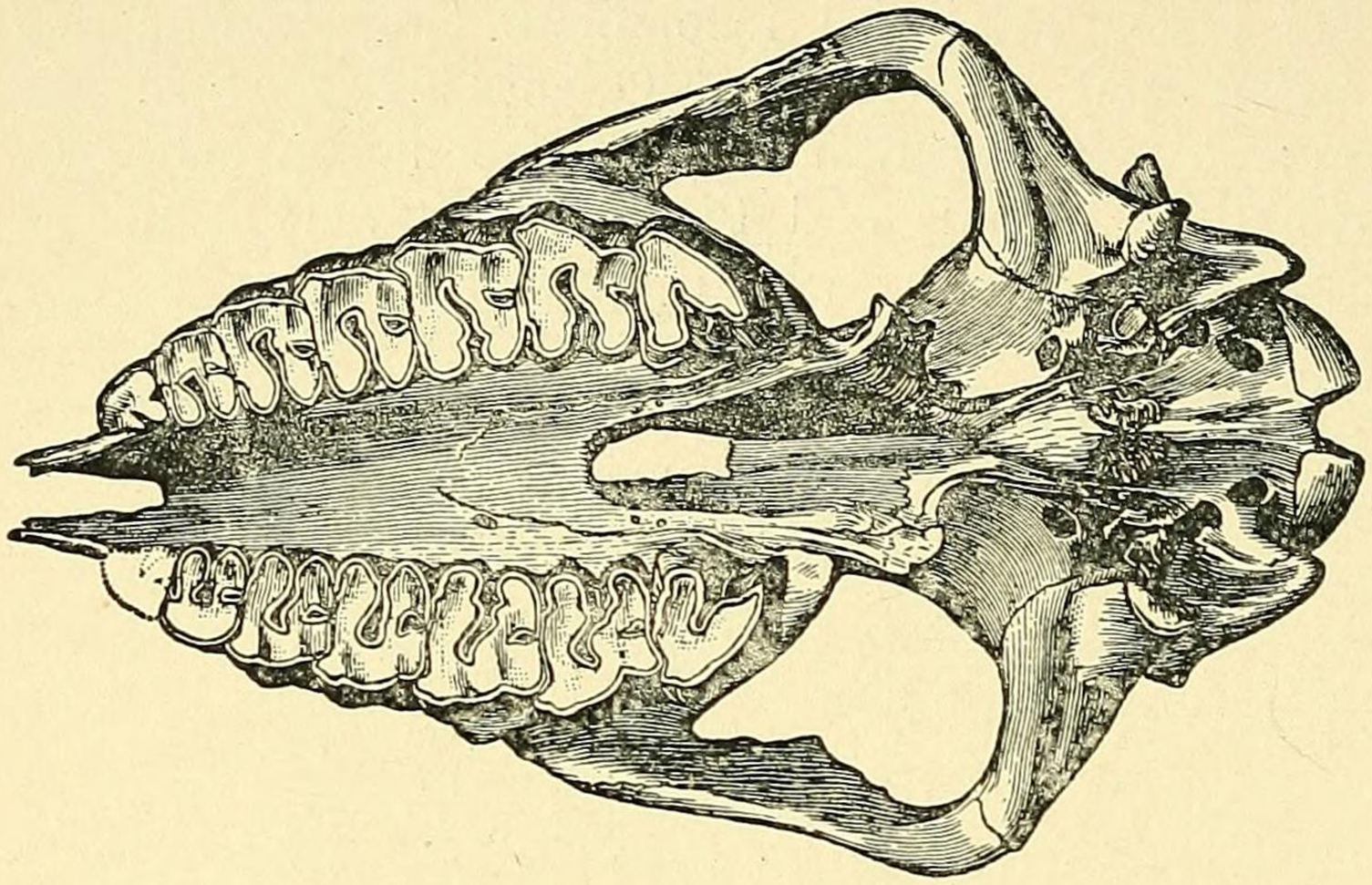

FIG. 182.

Aphelops megalodus Cope. Lower Pliocene (Loup Fork beds), Colorado. Skull from below. 1/6. (After Cope.)

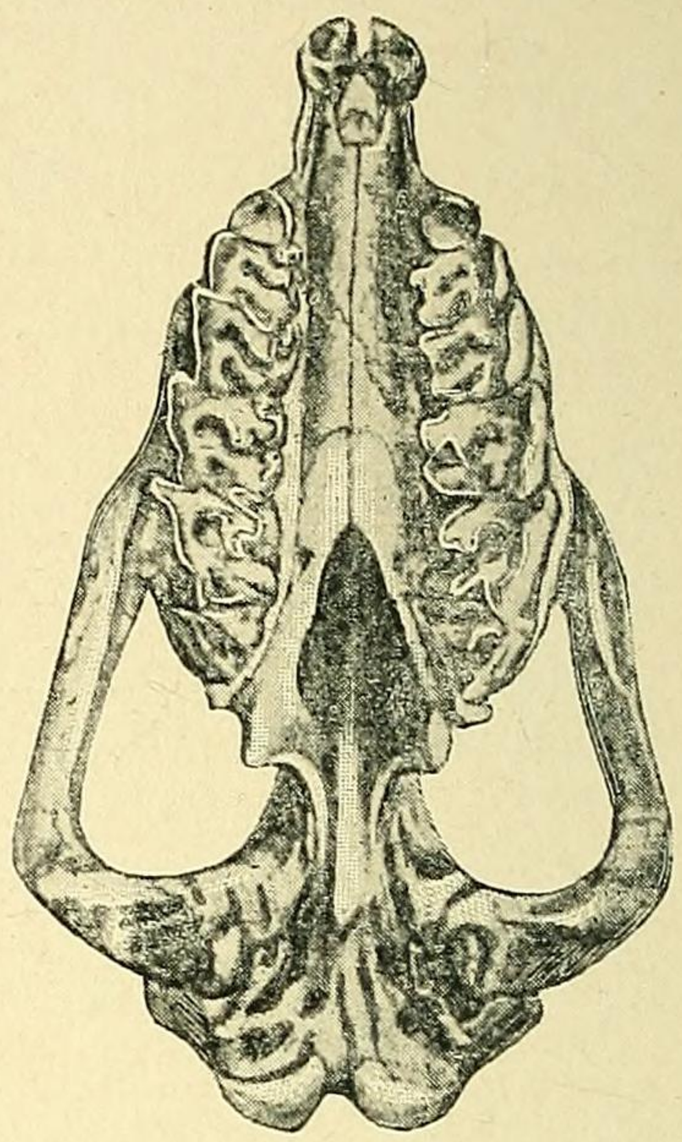

FIG. 183.

Teleoceras fossiger Cope. Lower Pliocene, Kansas. Skull from below. 1/10. (After Marsh.)

proavitum Hatcher. Lower Miocene; John Day beds, *D. armatum* and *nanum* Marsh. Lower Harrison beds, Nebraska, *D. cooki* and *niobrarense* Peterson.

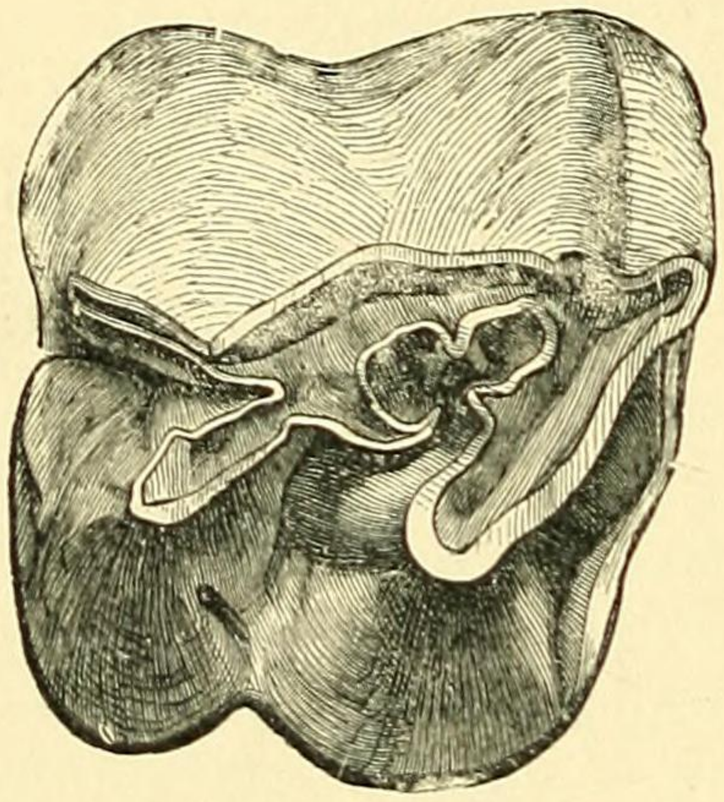

FIG. 184.

Ceratorhinus schleiermacheri Kaup sp. Lower Pliocene, Eppelsheim. Upper molar. 2/3.

(*g*) *Brachypotherium* Roger. $\frac{1.0.4.3.}{1.0.3.3.}$. Brachycephalous. Premolars more simple than molars; all superior cheek teeth very simple, brachyodont with antecrochet only; short diastema in lower jaw. Skull without horn. Extremities short and robust. Middle Miocene; Europe. *B. aurelianense* Noulet. Upper Miocene, *B. brachypus* Lartet. Lower Pliocene, *B. goldfussi* Kaup. *B. perimense* Lydekker from India. *B. pugnator* Matsumoto from Japan.

(*h*) *Teleoceras* Hatcher (Fig. 183) and *Aphelops* Cope (Fig. 182). The first with a small horn at the top of the nasals, the latter hornless. Dental formula: $\frac{1.0.\ 3.\ 3.}{1.0.2\text{-}3.3.}$. Crowns of teeth high; superior molars with well-developed crochet and antecrochet. Brachycephalous. Extremities short and robust. Habit more like *Hippopotamus* than *Rhinoceros*. Upper Miocene and Lower Pliocene, North America, *A. megalodus* Cope. Lower Pliocene, *T. fossiger* Cope.

(*i*) *Ceratorhinus* Gray (*Dihoplus* Brandt) (Fig. 184). Dental formula: $\frac{2\text{-}0.0.4.3.}{1\text{-}0.0.3.3.}$. Upper inner incisor low, with vertically compressed crown, some-

times with an adjacent smaller incisor; inferior incisor small, second incisor triangular, long, horizontal. Cheek teeth brachyodont. Premolars often molariform and superior premolars and molars with crista, antecrochet, and crochet. Brachycephalous. Nasal bones standing out prominently, broad anteriorly, with a rough protuberance for a horn; often a horn on the frontal bone. The older forms possessed incisors that are lacking in later forms; the latter with a bony nasal septum. Lower Miocene, *C. tagicus* Roman. Upper Miocene of Europe, *C.* (*R.*) *simorrensis* and *C. sansaniensis* Lartet; Lower Pliocene, *R. schleiermacheri* Kaup, as well as the existing *C. sumatrensis* Linn., all with incisors. *R. hundsheimensis* Toula, from the older Pleistocene of Lower Austria, probably belongs to *Ceratorhinus*, in which genus also *R. etruscus* Falconer, and *R. mercki* Jäger, referred to *Coelodonta*, could best be placed, notwithstanding the absence of incisors and the presence of a bony nasal septum, for they are doubtless connected genetically with *C. sansaniensis*, etc., while *R. antiquitatis* may be traced back to one of the Pliocene Asiatic species of *Rhinoceros*, probably *R. platyrhinus* Lyd.

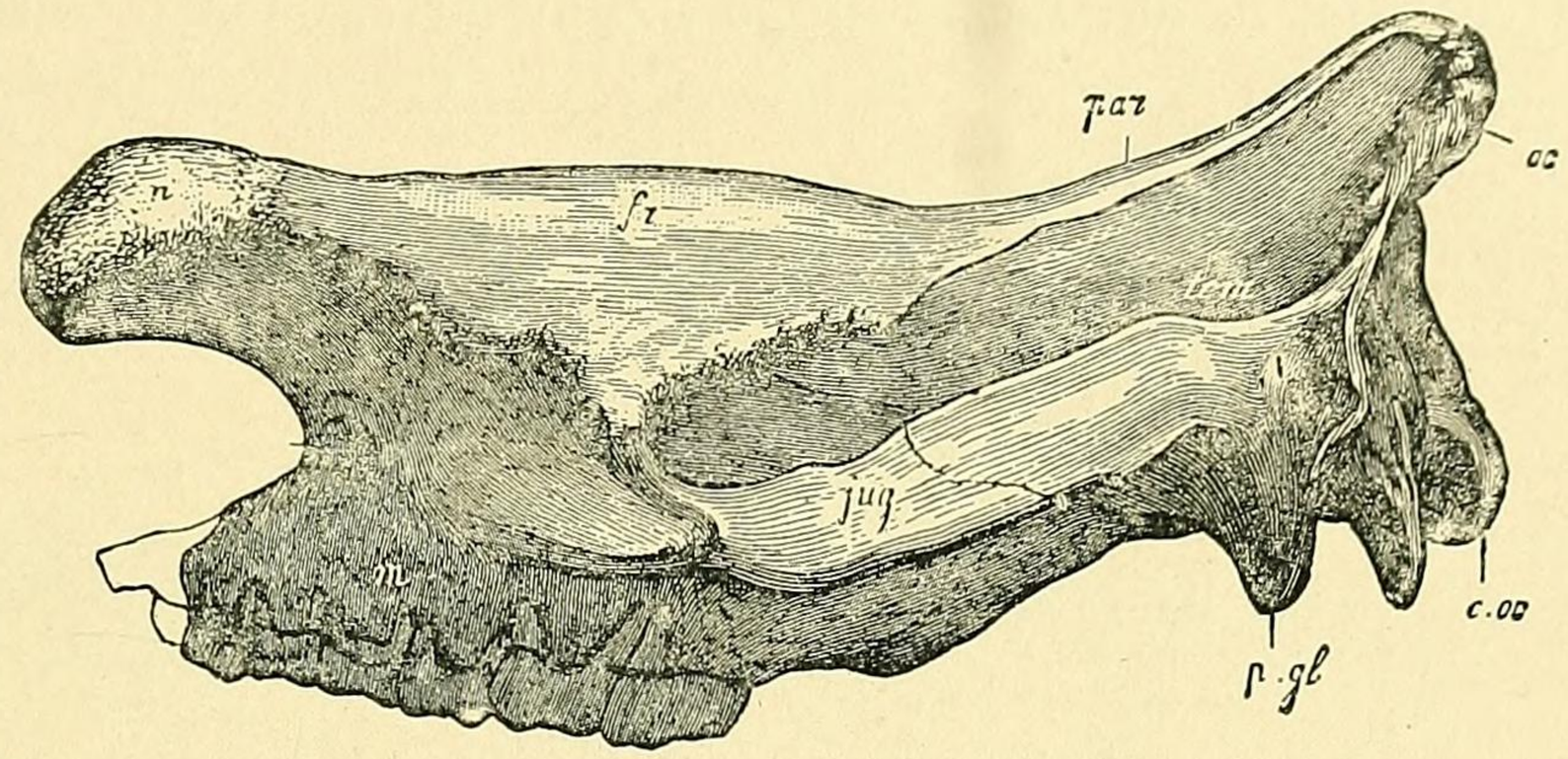

FIG. 185.

Atelodus pachygnathus Wagner sp. Lower Pliocene, Pikermi, Greece. Skull. 1/7. (After Gaudry.) *c.oc*, Occipital condyle; *fr*, frontal; *jug*, jugal; *m*, maxilla; *n*, nasal; *oc*, occipital crest; *p.gl*, postglenoid process; *par*, parietal; *tem*, temporal fossa.

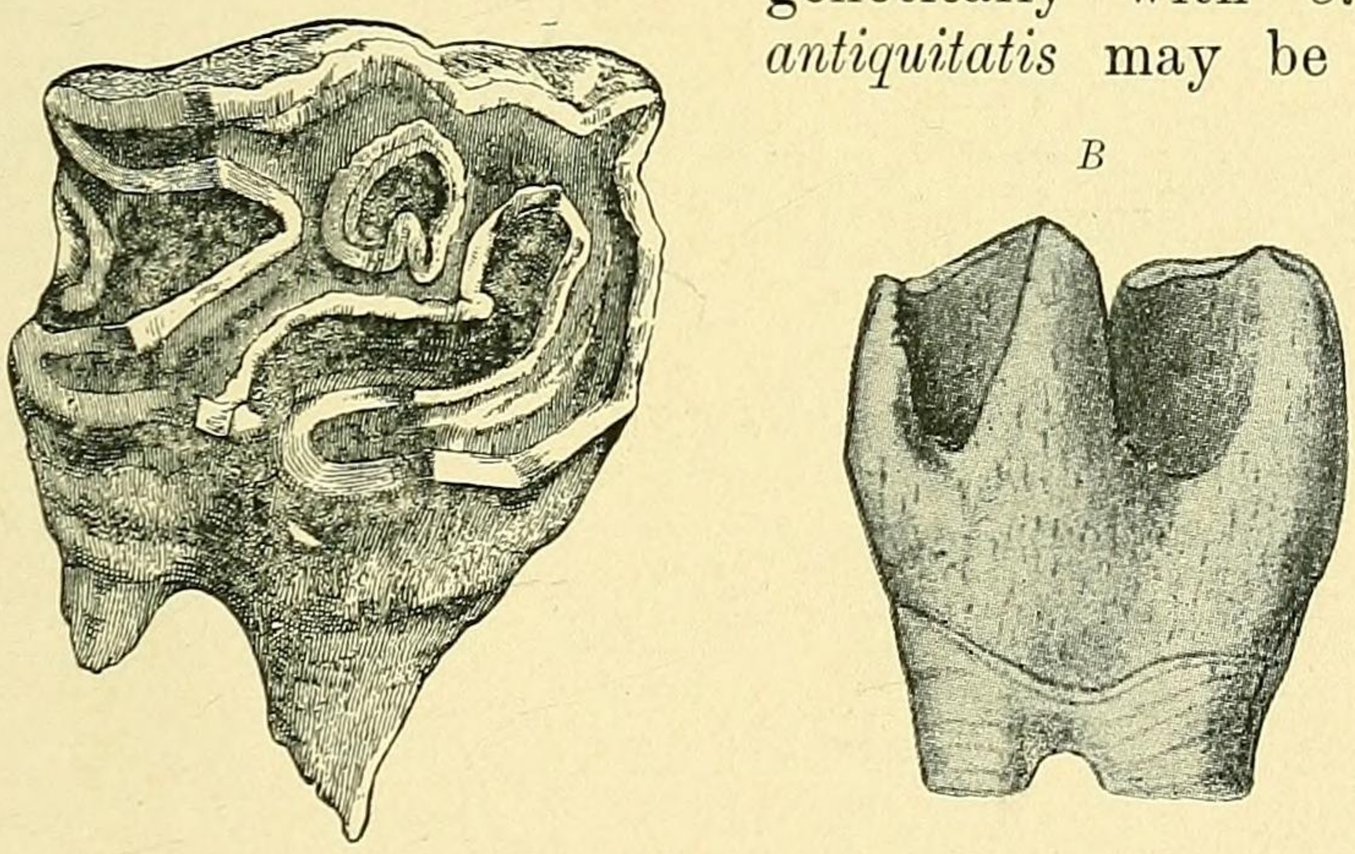

FIG. 186.

Coelodonta antiquitatis Blumenb. sp. Pleistocene, Kent's Cavern, Torquay. *A*, Upper molar. 2/3. *B*, Lower molar, inner view. 1/2. (After Owen.)

(*k*) *Rhinoceros* s.str. Gray (*Zalabis* Cope). $\frac{1.0.4.3.}{1.0.3.3.}$. Cheek teeth mainly hypsodont. Nose with but one horn. Occiput inclined forward. Post-tympanic and postglenoid processes anchylosed. Now living in southern India (*R. sondaicus* Horsf.). Fossil in the Siwalik beds, *R. palaeindicus* and *sivalensis* Falconer; Pleistocene of India and Borneo.

(*l*) *Atelodus* Pomel (*Diceros* Gray) (Fig. 185). $\frac{0.0.4.3.}{0.0.3.3.}$. Nose with two horns. Occiput inclined backward; external auditory meatus open below. Premolars molariform. Now living in Africa, *R. bicornis*, Linn. Fossil in the Lower Pliocene, *R. pachygnathus* A. Wagner; Upper Pliocene, *A. morgani* Mecquenem, *R. megarhinus* Christol; and oldest Pleistocene of

Europe, *R. leptorhinus* Cuvier; India, *R. deccanensis* and *karnuliensis* Lydekker; and of China, *R. sinensis* Owen.

(*m*) *Coelodonta* Bronn (Figs. 186-188). $\frac{0.0.4.3.}{0.0.3.3.}$. Nasal bones very well developed, in old forms supported by an ossified mesethmoid. The anterior

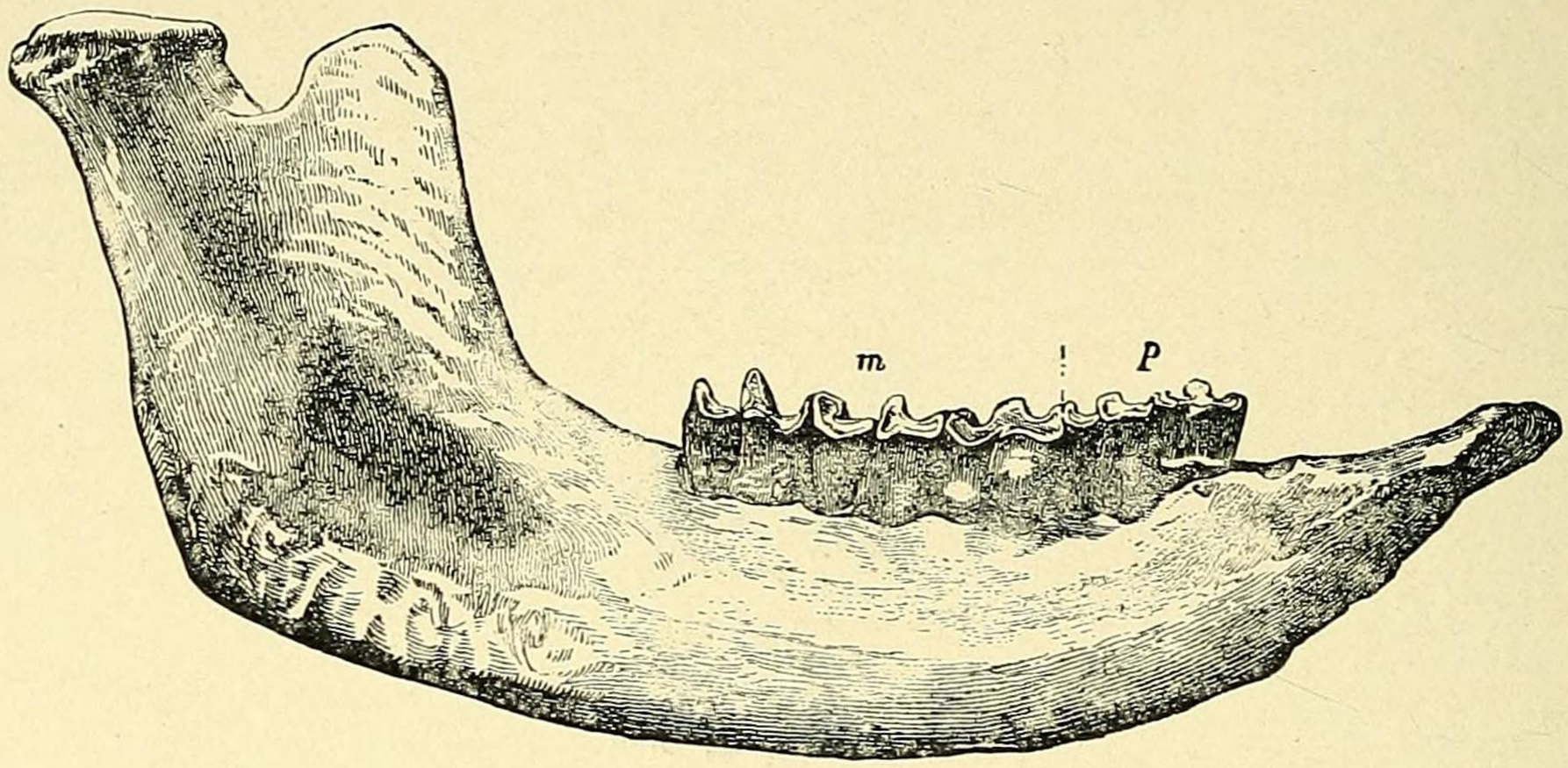

FIG. 187.

Coelodonta antiquitatis Blumenb. sp. Pleistocene, Wirksworth, Derbyshire. Right ramus of lower jaw, outer view. 1/6. (After Owen.)

of the two horns stands on a prominent rough protuberance of the fused nasal bones; the smaller posterior horn, on the frontal bone. In the later Pliocene, *R. etruscus* Falconer, probably a descendant of *R. schleiermacheri*, and in the Pleistocene of North Asia and Europe, *R. mercki* Jäger, in China replaced by *plicidens* Koken, and *R. antiquitatis* Blumenbach (*R.*

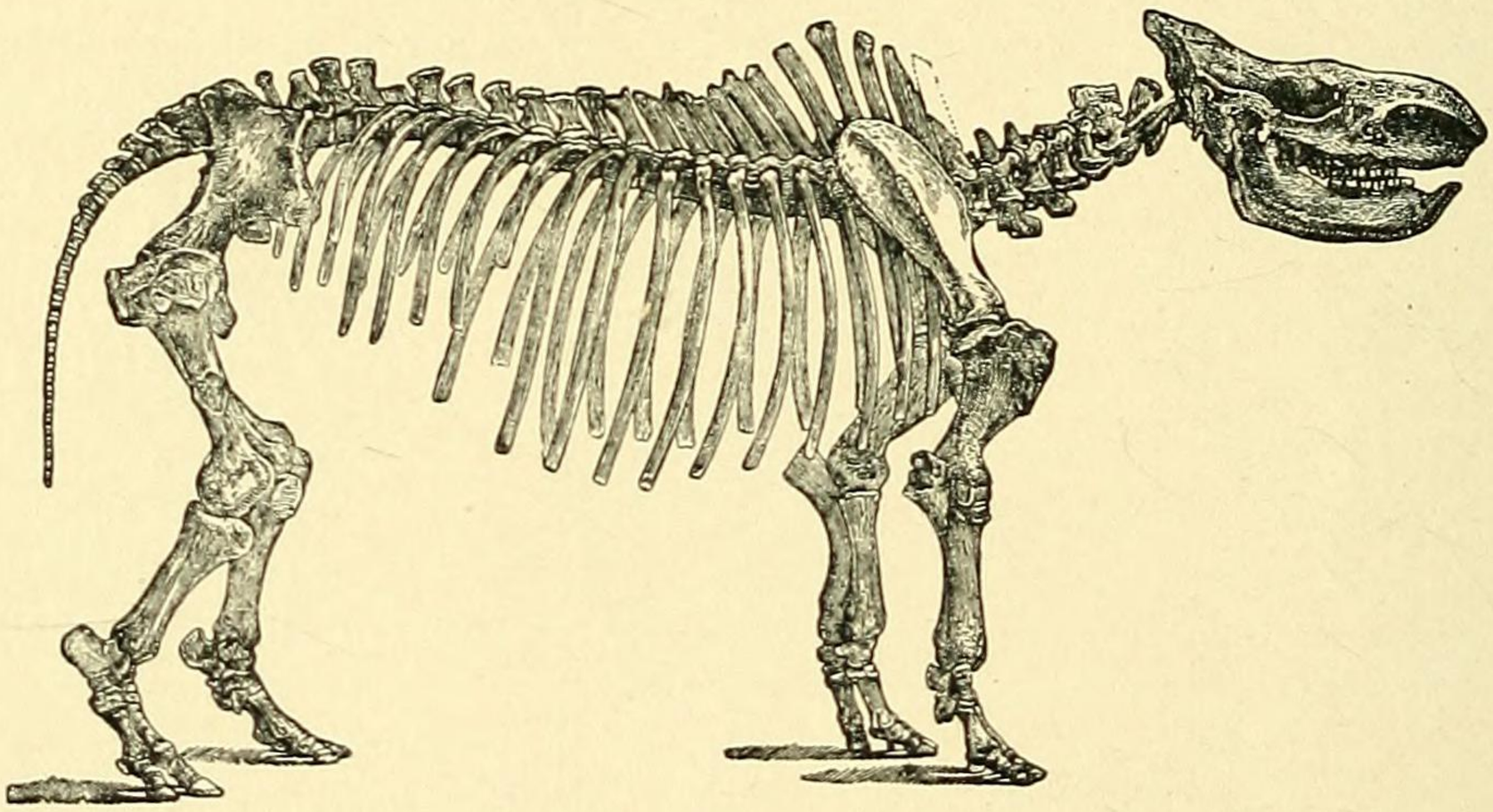

FIG. 188.

Coelodonta antiquitatis Blumenb. sp. Pleistocene loess, Kronberger Hof, near Kraiburg, Upper Bavaria. Skeleton, much reduced.

tichorhinus Fischer). Entire carcasses of *R. mercki* and also of *R. antiquitatis*, with skin, hair and well-preserved tissues, have been found in the frozen ground between the Jenisei and Lena rivers in Siberia and in the ozokerite earth of Starunia, Galicia. They were covered with thick woolly hair. The depressions of the cheek teeth contained particles of food, which pertained to conifers and willows. *R. mercki*, however, became extinct in Europe just before the end of the glacial period, while *R. antiquitatis* appeared

later, but continued on into postglacial time. It seems to be allied to *R. platyrhinus.*

Subfamily 4. Elasmotheriinae Gill.

Skull elongated, with tapering pointed snout and much elevated, rugose, hemispherical protuberance on the frontal bone. Nasal bones slender, with a small rough surface on the most anterior portion only. Dental formula: $\frac{0.0.2.3.}{0.0.2.3.}$. *Cheek teeth prismatic, rootless; superior molars composed of ectoloph and two oblique transverse crests; inferior molars with two crescents; enamel elaborately crimped. Premolars above and below smaller and somewhat simpler than molars. Skeleton robust. Manus and pes tridactyl.*

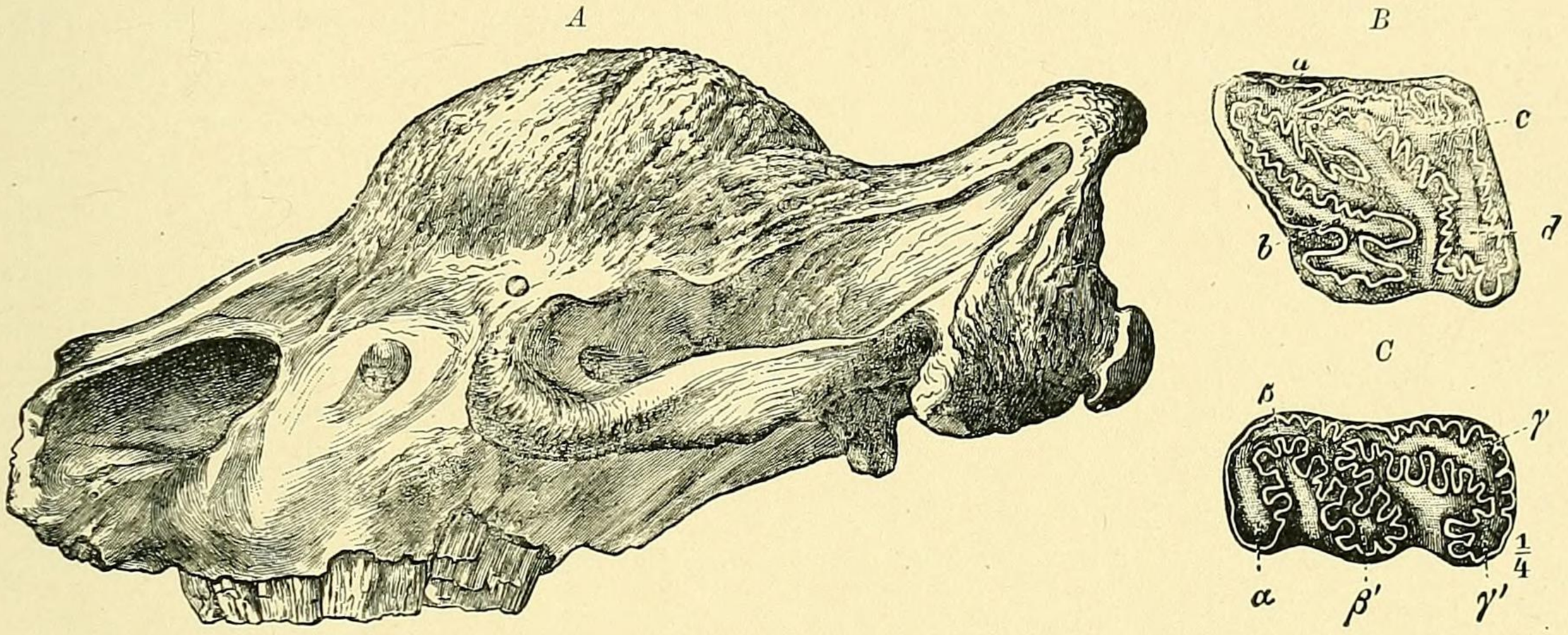

Fig. 189.

Elasmotherium sibiricum Fischer. Pleistocene, Siberia. *A*, Skull, lateral aspect. 1/10. *B*, *C*, Upper and lower molars, crown view. 1/4. (After Brandt.)

Elasmotherium Fischer (Fig. 189). *E. sibiricum*, the only species, is found in the older Pleistocene of southern Russia and Siberia; very rarely, also, in Germany.

Sinotherium Ringström. Ancestral to former genus. Pliocene, Shansi, China.

Subfamily 5. Baluchitheriina Osborn.[1]

Head relatively small and neck much elongated, the cervical vertebrae being of very light construction. Skull much elongated, and nasal bones slender without horn. Dental formula: $\frac{1.0.3\text{-}4.3.}{1.0.3\text{-}4.3.}$; *upper incisor caniniform; lower incisor procumbent. Feet much elongated, tridactyl, the middle metapodial longest and stoutest.*

Gigantic long-limbed and long-necked rhinoceroses, found in Oligocene or Miocene formations in Asia. Probably including the largest known land mammals.

[1] *Borissiak, A., Indricotherium*, n.g. Mém. Acad. Sci. Russie [8], vol. xxxv., no. 6, 1923.—*Cooper, C. Forster, Baluchitherium osborni.* Phil. Trans. Roy. Soc. Lond., ser. B, no. 392, 1923. On the Skull and Dentition of *Paraceratherium bugtiense. Ibid.*, no. 399, 1924.—*Osborn, H. F., Baluchitherium grangeri.* Amer. Mus. Novitates, no. 78, 1923. Also Natural History, New York, vol. xxiii., no. 3, 1923.

Baluchitherium Cooper (Fig. 190). Four upper premolars, the first comparatively small and simple. *B. osborni* Cooper, the type species, known by the cervical vertebrae and limb bones from the Lower Miocene of Baluchistan. *B. grangeri* Osborn, known by a skull 1·3 metres in length, from the Upper Oligocene or Lower Miocene of Mongolia. Height of highest part of back about 4 metres.

Paraceratherium Cooper. Three upper premolars. Skull less swollen over the frontals than in *Baluchitherium*. Lower incisors sharply conical. *P. bugtiense* Cooper. Lower Miocene, Baluchistan.

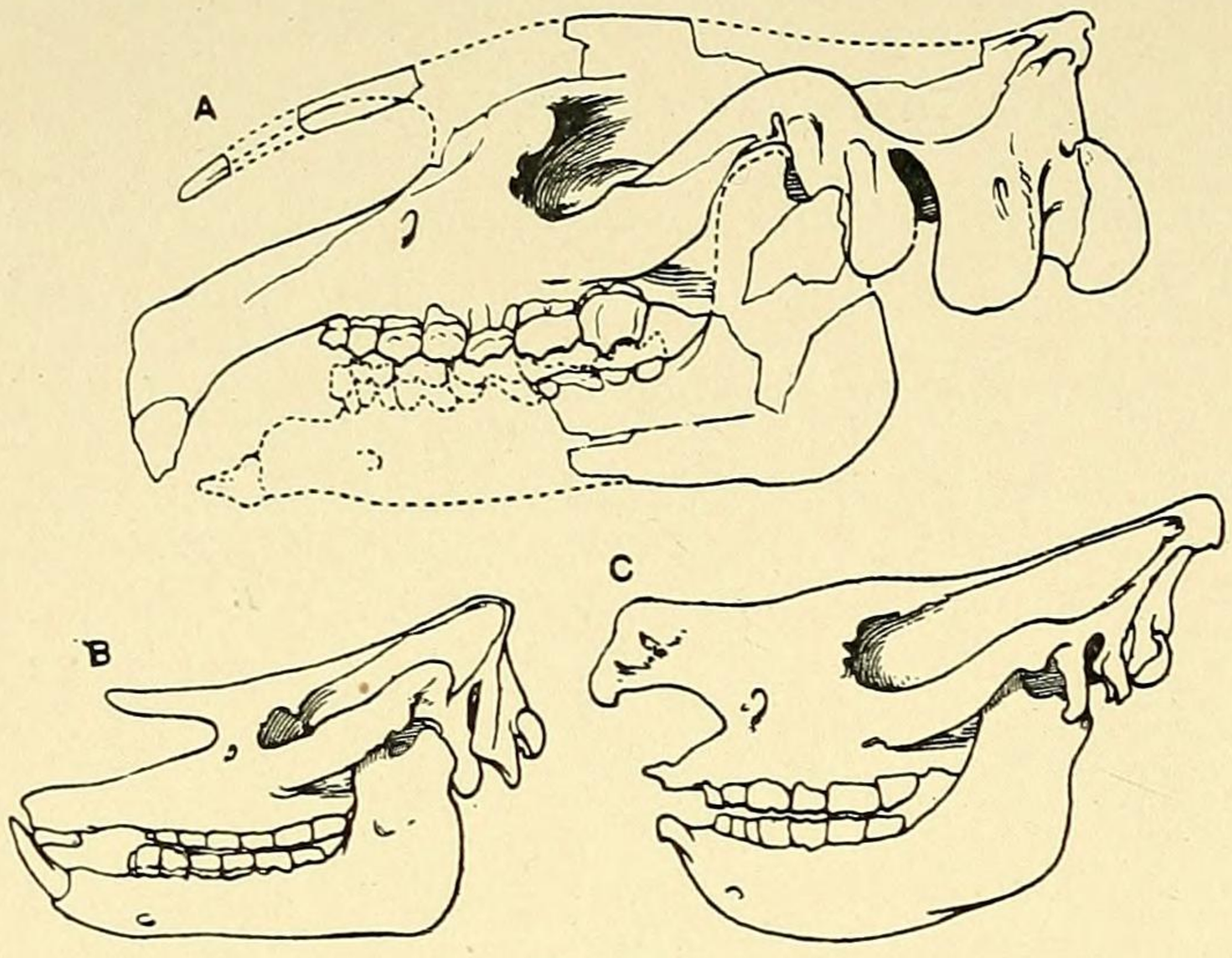

FIG. 190.

Baluchitherium grangeri Osborn. Upper Oligocene or Lower Miocene, Mongolia. *A*, Skull and lower jaw, lateral aspect. 1/22. With skulls and lower jaws of *Aceratherium incisivum* Kaup (*B*), and *Rhinoceros simus* Burchell (*C*) for comparison. (After Osborn.)

(*From a photograph kindly supplied by the American Museum of Natural History, New York.*)

Indricotherium Borissiak. *I. asiaticum*, *I. minus* Boriss. Lower Miocene, Turgai, Turkestan.

Family 3. **Equidae** Gray.[1]

Nasal bones projecting freely, pointed anteriorly, hornless. Dentition complete. Dental formula: $\frac{3.1.4\text{-}3.3.}{3.1.4\text{-}3.3.}$. *Incisors chisel-shaped. In forms the oldest geologically, premolars less complex than molars; in later species, molariform. Superior molars consisting of two external cusps as a rule joined into an ectoloph, two internal cones, and usually two conical or ridge-like elongated or crescentic intermediate tubercles. The internal and intermediate cusps as a rule connected by ridges. In the most primitive forms, inferior molars quadritubercular; generally, however, composed of*

[1] *Antonius, O.*, Phylogenet. Zusammenhang zwischen Hipparion und Equus. Zeitschr. f. indukt. Abstammungs- und Vererbungslehre, 1919. — *Burmeister, H.*, Die fossilen Pferde der Pampas Formation. Buenos Aires, 1875. Suppl. 1889.—*Cope, E. D.*, Proc. Amer. Philos. Soc., 1889, vol. xxvi. — *Depéret, Ch.*, Revision des Hyracothéridés européens. Bull. Soc. Géol. France, 1901.—*Douglass, E.*, Annals Carnegie Mus., vol. iv., 1908.—*Gidley, J. W.*, Bull. Amer. Mus. Nat. Hist. New York, 1901, 1903.—*Granger, W.*, Bull. Amer. Mus. Nat. Hist. New York, 1906, 1908.—*Huxley, T. H.*, Address delivered at the Anniversary Meeting of the Geological Society. Quart. Journ. Geol. Society, 1870.—*Kowalevsky, W.*, Sur l'Anchitherium et sur l'histoire paléontologique des chevaux. Mém. Acad. St-Pétersb., 1873.—*Forsyth Major, C.*, Beiträge zur Geschichte der Pferde, insbesonders Italiens. Abh. Schweiz. Pal. Ges., vol. iv., 1877; vol. vii., 1880.—*Marsh, O. C.*, Amer. Journ. Sci., 1879, vol. xvii.; 1892, vol. xli.—*Matthew, W. D.*, Suppl. to Amer. Mus. Journ. New York, 1903.—*Matthew, W. D.*, and *Gidley, J. W.*, Bull. Amer. Mus. Nat. Hist. New York, 1906.—*Merriam, J. C.*, Horses of Rancho la Brea; New Protohippine Horses; New Anchitheriine Horses. Univ. California Publ., vol. vii., 1913. New Horses from the Miocene and Pliocene of California. *Ibid.*, vol. ix., 1915.—*Nehring, A.*, Fossile Pferde aus deutschen Diluvialablagerungen. Berlin, 1884.—*Osborn, H. F.*, Equidae of the Oligocene, Miocene, and Pliocene of North America. Mem. Amer. Mus. Nat. Hist., n.s., vol. ii. New York, 1918.—*Reichenau, W. von*, Beitr. Kennt. foss. Pferde aus deutsch. Pleistocän. Abhandl. grossh. hessisch. geol. Landesanst., vol. v., 1915.—*Scott, W. B.*, On the Osteology of Mesohippus. Journ. of Morph., 1891, vol. iii.—*Wortman, J. L.*, Bull. Amer. Mus. Nat. Hist. New York, 1896.