12. *Arthrocardia* Areschoug, in J. G. Agardh Species Algarum. 2, sect. 2: pp. 547–553, 1852.

Type of the genus: *Arthrocardia corymbosa* (Lamk.) Areschoug, in J. G. Agardh Species Algarum, 2, sect. 2: pp. 550–551, 1852.

Type locality: "ad littora Americae," *fide* Lamarck; "ad oram Capensem praesertim in sinu Tabulari nec non Algoensi non infrequenter," *fide* Areschoug.

bb. Conceptacular pores slightly lateral (slightly below the apices),

13. *Duthiea* gen. nov.

Frondes fragiles, pinnato-cymoideae; segmentis basi compressis aut cylindricis, supero compressis; geniculis unizonalibus; filamentis medullaribus intergeniculorum rectis, cellulis in zonis transversis equalibus positis; conceptaculis in ordine cymoideo-terminalibus, poris oblique-lateralibus.

Type of the genus: *Duthiea Setchellii* sp. nov.

Frondibus erectis, 4–6 cm. altis, parte vegetabili opposite pinnatis aut tripinnatis, fructifera cymoideo-ramosis; conceptaculis apicalibus in intergeniculis terminalibus, intergeniculis conceptaculiferis e marginibus superioribus intergeniculorum fertilium in ordine, more cymarum oriendis, poris lente oblique-lateralibus, tetrasporangiis in fundo et lateribus cavernarum conceptaculorum positis.

Species type: tetrasporic, Blauwklip, near the mouth of Grote River, South Africa (Herb. Univ. Calif. No. 545765; Duthie No. 8012).

AN EOCENE TITANOTHERE FROM SAN DIEGO COUNTY, CALIFORNIA, WITH REMARKS ON THE AGE OF THE POWAY CONGLOMERATE

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Introduction.—The occurrence of Eocene vertebrates in the Poway Conglomerate of San Diego County, California, was first brought to my attention several years ago when, in the course of excavations north of La Mesa and approximately 10 miles east and slightly north of the city of San Diego, fragmentary remains of vertebrates were encountered at a depth of 40 feet. Examination of this material, permitted through courtesy of Director Clinton G. Abbott of the San Diego Museum of Natural History, elucidated the information that several mammals found

at this locality are either closely related to or identical with forms recognized in the upper Eocene fauna from the Sespe deposits, north of the Simi Valley, Ventura County.

Further field investigations conducted in the area have uncovered additional fossil vertebrate localities and at one of these, during the past summer, was found the titanothere to be described in this paper. The specimen is noteworthy because it permits a comparison with related types from the North American Eocene, so comprehensively discussed by Osborn[1] in his monograph on the Titanotheres. In addition, the presence of this material in the Poway Conglomerate, a deposit containing marine lenses from which Hanna[2] obtained an invertebrate fauna tentatively correlated with the Tejon Eocene, offers excellent opportunity to compare the age determination of the Poway based on a study of the titanothere with that derived from a study of the marine mollusks.

DESCRIPTION OF MATERIAL

SUBFAMILY DOLICHORHINAE

Metarhinus(?) pater, n. sp.

Type Specimen.—The right half of the muzzle of a skull from the anterior part of the orbit to the anterior end of the maxillary with the canine and $P\underline{1}$–$M\underline{3}$; No. 2037 Calif. Inst. Tech. Coll. Vert. Pale.; Plate 1. Specimen collected by Jack Dougherty.

Locality.—Sandstones of the Poway formation, exposed in west bank of the San Diego River, approximately one-quarter mile north and east of the Mission San Diego; Calif. Inst. Tech. Vert. Pale. Loc. 249.

Specific Characters.—Muzzle elongate; naso-maxillary recess deep and reaching back of antorbital foramen; antorbital foramen large and situated above anterior border of $M\underline{2}$. $P\underline{1}$ and $P\underline{2}$ small; $P\underline{4}$ relatively long in comparison to its width. Size larger than *Metarhinus fluviatilis* and *M. riparius*, similar to that of *M. earlei* and smaller than *Mesatirhinus superior*.

Comparison with Metarhinus.—The principal point of difference between No. 2037 and skulls of *Metarhinus* is presented in the great backward extent of the naso-maxillary notch as seen in side view. The ascent of the lower border of this notch in its posterior course is more gradual than in skulls of *Metarhinus* with which comparison has been made and, moreover, extends farther behind the level of the antorbital foramen than in these specimens. Above and to the inner side of the foramen is a broad platform of bone which is grooved longitudinally. This forms the posterior part of the floor of the recessed area, the roof of which was formed by the nasal bones, unfortunately not preserved in the Poway specimen. A similar platform is seen in the skull of *Metarhinus fluviatilis*, but the lateral

recess extends back to a point above and in front of the antorbital foramen. The lateral wall of the maxillary in front of the antorbital foramen shows no indentation or groove. The medial dorsal contact of the premaxillaries is long in fore and aft direction.

A deep naso-maxillary recess occurs in the skull of *M. riparius*, the recess reaching nearly to the level of the inner anterior border of the orbit. No. 2037 from the Poway differs principally in greater elongation of snout as expressed by greater length in front of orbit and by a longer

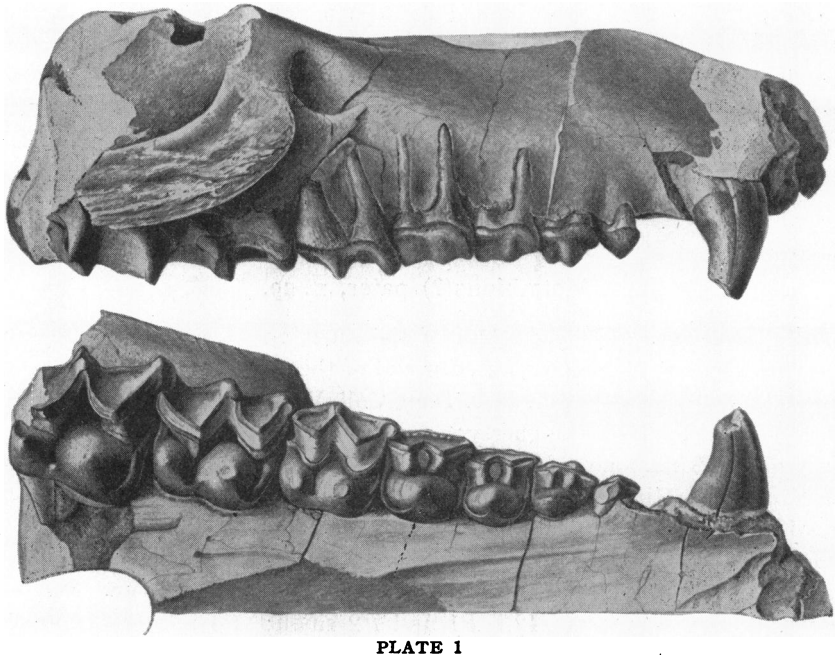

PLATE 1

Metarhinus (?) *pater*, n. sp.

Type specimen, No. 2037, Calif. Inst. Tech. Coll. Vert. Pale. Ventral and lateral views, × 1/2.

Poway Conglomerate, San Diego Co., California. Upper Eocene.

diastema between $P\underline{1}$ and canine. In *M. riparius* the lateral face of the snout curves inward more gradually in its upward course and a small platform extends forward from the antorbital foramen.

The surface of the maxillary below the orbit in No. 2037 shows that the jugal has been broken away along the plane of the suture. Examination of the specimen leads to the impression that the infra-orbital shelf was fully as well developed as in *Metarhinus* and thus differed from that in *Rhadinorhinus*.

No. 2037 resembles species of *Metarhinus* in the close approach made by the antorbital foramen to the orbital border, in the position of the postnarial notch opposite or slightly in advance of the posterior level of $M\underline{2}$, and in the small size of $P\underline{1}$. The San Diego specimen differs in presence of a deeper naso-maxillary recess, longer snout, longer postcanine diastema, greater anteroposterior diameter of $P\underline{4}$ in relation to its transverse diameter, and in a more posterior position of the antorbital foramen since the posterior rim of this opening is situated above the anterior end of $M\underline{2}$. A well developed hypocone is present in $M\underline{3}$.

Comparison with Mesatirhinus.—The tooth-row in No. 2037 resembles in length that in the type of *Mesatirhinus petersoni* and in the type of *M. superior*, but the premolar series is shorter. The canine is larger than the comparable tooth in *M. superior* but may be similar in size to that in *M. petersoni*. $P\underline{1}$ is smaller in the San Diego specimen than in *Mesatirhinus*, but $P\underline{2}$ has the subtriangular shape seen in this genus.

In $P\underline{3}$ and in $P\underline{4}$ the internal cingulum swings around from the anterior and posterior sides of the tooth, but does not extend entirely along the inner side of the base of the principal internal cusp. $M\underline{2}$ in No. 2037 is narrower relative to its length than is the comparable tooth in *Mesatirhinus*. The postnarial notch reaches slightly farther forward than in *M. superior*, but not quite so far as in *M. petersoni*. The antorbital foramen is large, relatively more so than in *Mesatirhinus*. The distance between the lateral border of this opening and the anterior border of the orbit is shorter than in *Mesatirhinus*. The narial opening is much more deeply recessed as seen from the side than in the latter genus.

Comparison with Dolichorhinus.—No. 2037 is distinctly smaller than typical members of the genus *Dolichorhinus* and differs markedly from these in the much more deeply recessed narial opening, absence of a secondary palate, more posterior position of the antorbital foramen, decidedly shorter distance between this foramen and the orbital border, shorter postcanine diastema and in the subtriangular rather than subquadrate shape of $P\underline{2}$. In specimens of *Dolichorhinus* the cingulum is complete along the inner sides of the posterior premolars, not interrupted as in No. 2037.

Comparison with Rhadinorhinus.—The tooth-row in No. 2037 resembles in length that in the type of *R. diploconus*, but lacks the upward curvature in a vertical plane of the anterior cheek-teeth. $P\underline{2}$ is not subquadrate as in *Rhadinorhinus;* the postcanine diastema is longer; the postnarial notch is farther back; the infra-orbital shelf is better developed in the San Diego specimen. While the lateral recess of the nose is deep in *Rhadinorhinus*, the notch does not extend backward so far as in No. 2037 and the lower posterior rim of the notch is sharper. The antorbital foramen is large as in *Rhadinorhinus* and, as in this genus, is closely situated to the border of the orbit, but has a position farther back with reference to $M\underline{1}$.

MEASUREMENTS (IN MILLIMETERS) OF NO. 2037

Length from anterior end of *C* to posterior end of $M\underline{3}$	200
Length of premolar-molar series through middle	166.4
Length of molar series through middle	100.7
Length of postcanine diastema	14.4
C, anteroposterior diameter	20
C, transverse diameter	17.5
$P\underline{1}$, anteroposterior diameter	12.4
$P\underline{1}$, transverse diameter	7.2
$P\underline{2}$, anteroposterior diameter	18.6
$P\underline{2}$, transverse diameter	16.4
$P\underline{3}$, anteroposterior diameter through middle	17.4
$P\underline{3}$, transverse diameter	21
$P\underline{4}$, anteroposterior diameter through middle	20.7
$P\underline{4}$, transverse diameter	25.4
$M\underline{1}$, anteroposterior diameter through middle	27
$M\underline{1}$, transverse diameter	30
$M\underline{2}$, anteroposterior diameter through middle	33
$M\underline{2}$, transverse diameter	32.8
$M\underline{3}$, anteroposterior diameter through middle (approximate)	39
$M\underline{3}$, transverse diameter	39

Summary of Comparisons.—Among North American Eocene titanotheres, the type, No. 2037, resembles most closely the genera *Metarhinus*, *Mesatirhinus*, *Dolichorhinus* and *Rhadinorhinus*. In its most striking character the Poway specimen resembles more closely the first and last genera than it does *Mesatirhinus*. Resemblance to *Dolichorhinus* is even more remote. No. 2037 represents a skull with elongated muzzle and with very deeply recessed naso-maxillary opening. In latter character the San Diego species is distinctly more modified than any known member of the Dolichorhinae. Nearest approach in the character of deep recess is to *Metarhinus*. In *Rhadinorhinus* the opening is also deeply recessed, but in other characters of skull and dentition this genus resembles the San Diego form less closely than does *Metarhinus*. The characters which distinguish No. 2037 from *Metarhinus* are possibly diagnostic of a new genus, but I hesitate to describe the Poway specimen as such in view of the present fragmentary material. No. 2037 may represent an offshoot of the metarhine group, later and more specialized than *Metarhinus*, in which an advance is shown particularly by the elongation and further modification of the snout and likewise perhaps by the well developed hypocone in $M\underline{3}$.

REMARKS ON THE AGE OF THE POWAY CONGLOMERATE

Hanna[3] in 1926 published the results of his geologic study of the La Jolla Quadrangle. Rocks of Eocene age exposed in this area were recognized by Hanna as comprising, in ascending order, the following: (1) Delmar Sand, (2) Torrey Sand, (3) Rose Canyon Shale and (4) Poway

Conglomerate. The three lowermost beds were grouped together as the La Jolla formation and were considered as intermediate in age between the Meganos and Tejon formations of the Pacific Coast marine Eocene. The La Jolla formation was regarded as an apparent correlative of the Domengine Eocene of the Simi Valley section, California.

The locality of occurrence of *Metarhinus*(?) *pater* is in an area mapped by Hanna as the Poway Conglomerate. The specimen was found in a sandstone stratum between conglomerate layers. In reaching an age determination of this portion of the Poway it is worthy of note that the titanotheres with which the Poway species is compared, include types that range upward stratigraphically from the Metarhinus beds of the Bridger upper middle Eocene to and into the Dolichorhinus beds representing the Uinta *B* stage of the upper Eocene, as these horizons are now recognized in the Tertiary basins of the Cordilleran Province. Relationship of the San Diego species appears to be with the metarhine titanotheres, but the former is more specialized and advanced than typical *Metarhinus*. *M.*(?) *pater* differs widely from the genera *Diplacodon*, *Eotitanotherium* and *Protitanotherium* recorded from the horizon Uinta *C* of the Uinta basin. It is distinctly less advanced and clearly an earlier type of titanothere than *Teleodus californicus*[4] from the uppermost Eocene Sespe of Ventura County, California. Thus the relationships of the San Diego titanothere suggest an age determination of the land-laid Poway as not older than the Bridger upper middle Eocene and not as late as the Uinta *C* stage of the Upper Eocene. On the other hand, the advance in structural characters which *M.*(?) *pater* exhibits in a comparison to the typical *Metarhinus* may indicate a stage of development later in time than that represented by the related forms from Uinta *B*. Thus it is possible that *M.*(?) *pater* occurred at a time when *Diplacodon* and *Protitanotherium* were present during the accumulation of the later Uinta. In either case, the San Diego titanothere points to an upper rather than middle Eocene age for the land-laid Poway.

[1] Osborn, H. F., *U. S. Geol. Surv. Mon.*, **55**, 1, 383–434 (1930).

[2] Hanna, M. A., *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, **16**, 256–263 (1927).

[3] Hanna, M. A., *Univ. Calif. Publ., Bull. Dept. Geol. Sci.*, **16**, 187–246, pls. 17–23, map (1926).

[4] Stock, C., *Proc. Nat. Acad. Sci.*, **21**, 456–462 (1935).