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OREODONTS OF THE TICK CANYON FORMATION, SOUTHERN CALIFORNIA

by
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In 1940, Richard H. Jahns reviewed the stratigraphy of the nonmarine Mint Canyon Formation in the eastern part of the Ventura Basin and separated from it a new formation and fauna. Previous to this work, a controversy existed as to the age of the Mint Canyon Formation, for it contained vertebrates considered indicative of both the Miocene and Pliocene (Kew, 1924, Maxson, 1930, and Stirton, 1933). As a partial solution to this controversy, Jahns demonstrated the presence of an erosional unconformity low in the nonmarine sequence which indicated a shift in source area. He redefined the beds below the unconformity as the Tick Canyon Formation (Jahns, 1940, pp. 163-66).

Additional fossils discovered in the Tick Canyon Formation since Maxson's work, and certain of the forms described by Maxson, comprise the Tick Canyon fauna. Only two specimens described by Maxson are from the Tick Canyon Formation, UCMP 30046, the type of *Miolabis californicus* and UCMP 23852, a dentary fragment of a *Parahippus*. Neither of these permitted a definitive age determination. The additional fauna described by Jahns indicates an Arikareean mammalian age (early Miocene), and there is a noteworthy temporal hiatus between the Tick Canyon fauna and the overlying Mint Canyon fauna. In addition, faunas comprising three mammalian ages, late Barstovian, and earlier and late Clarendonian, are now recognized from the Mint Canyon Formation, but this is not the principal concern of this paper.

Several reviews of individual taxa from the Tick Canyon fauna describe either new genera or species (Dawson, 1958, Reeder, 1960). All the described taxa were originally restricted to the Tick Canyon Formation. Unpublished records of these taxa now occur in other California localities.

The composite Tick Canyon fauna as presently known is as follows: a heteromyid rodent, *Trogomys rupinimenthae* Reeder, 1960, a rabbit, *Archaeolagus acaricolus* Dawson, 1958, two oreodonts, *Merychyus* (*Merychyus*) *calaminthus* Jahns, 1940, and *Merychyus* (*Merychyus*) *jahnsi* (this paper), a camel, Miolabis californicus Maxson, 1930, and a stenomyline camel (previously unpublished record).

All California Institute of Technology collections are now conserved in the Los Angeles County Museum of Natural History. With the consent of this institution, the author was able to study the entire sample of oreodonts from the Tick Canyon fauna, which includes an additional maxillary fragment collected by Miss Beth Chassé, an associate of the museum.

Jahns (1940, p. 187) specified four specimens as cotypes of the species Merychyus calaminthus; CIT 1383, 1382, 1342, and 1829. Although Jahns implies that all these specimens are from a single quarry sample, CIT 201, the labels on the specimens indicate that CIT 1342 was from another locality within the Tick Canyon Formation, CIT 199. Jahns considered the specimens CIT 1383, 1382, and 1842 adults and the other juvenile. An incomplete skull, CIT 1382, entered significantly into his typification of M. calaminthus. I believe this specimen represents a distinct species and designate it the type of M. (Merychyus) jahnsi, described below.

Schultz and Falkenbach (1947, p. 188) included a discussion of the species M. (M.) calaminthus in their revision of the subfamily Merychyinae, and redefined as a single holotype LACM 1383. They concluded that the incomplete skull, CIT 1382, represented a juvenile individual with dP^4 and M^{1-2}, rather than an adult with M^{1-3}, as reported by Jahns. I agree with Jahns in regarding LACM 1382 as a young adult individual. This is based on several characters. The most anterior cheek tooth present (M^1 according to Jahns, dP^4 according to Schultz and Falkenbach) has well developed roots and the character of the enamel is identical with that of the more posterior cheek teeth. Deciduous dentitions often bear smoother and lighter colored enamel, and this is the case with the juvenile Tick Canyon specimens. Examination of the order of replacement and occlusion in the genus Merychyus, including the juvenile material in the Tick Canyon sample, shows that the dP^4 and M^1 are moderately worn before the M^2 begins to show wear facets. In LACM 1382, the most anterior tooth (M^1, this paper) is moderately worn, but the next tooth (M^2, this paper) displays very little wear. This second tooth should be moderately worn if it is M^1 as inferred by Schultz and Falkenbach. In addition, an unerupted bud of permanent P^4 would be expected to exist below this anterior-most tooth if it is the dP^4. On the contrary, this anterior tooth is strongly rooted and well socketed in the maxillary bone.

Since LACM 1382 represents an adult individual, comparison can be made with the holotype of *M.* (*M.*) *calaminthus*. This comparison reveals several morphological differences and an average size difference of 15 per cent.

Order ARTIODACTYLA

Family Merycoidodontidae

Subfamily Merychyinae

Merychyus (*Merychyus*) *calaminthus* Jahns (restricted)

Type: Part of a skull with P^1 to M^3, LACM 1383.
Referred material: Badly crushed fragment of left mandible with P_3 to M_3 inclusive, LACM 1342.
Type locality: CIT 201; west side of small canyon in southwest corner of Section 2~~4~~5, T5N, R15W, San Bernardino Baseline and Meridian, Humphreys Quadrangle (1932), United States Geological Survey (Jahns, 1940, p. 187).
Amended diagnosis: Size slightly smaller (less than two per cent) than *M.* (*Merychyus*) *crabilli* Schultz and Falkenbach; skull apparently with deep antorbital fossa, but prelacrimal vacuity small, if present; malar depth moderate, single large infraorbital foramen above P^4; dentition hypsobrachyodont, superior tooth row straight and closely spaced, superior premolars with fairly complicated patterns, only moderately reduced anterior lophs of P^{3-4}; P^{1-2} set at slight angle to alveolar border; external styles of superior molars moderately prominent.
Discussion: In addition to the above mentioned characters, Jahns noted the presence of a small lingual spur projecting into the fossette in P^4. Schultz and Falkenbach attribute this character to individual variation, however an oreodont skull fragment in the collection of the University of California, Riverside, from an undescribed Arikareean fauna in the Mojave Desert displays this character also. The P_{3-4} in the referred mandible are well worn, but still bear remnants of lingual fossettes, suggesting similar complexity to the upper premolars. Jahns (1940, p. 189-90) also figures

and describes a left pes. This specimen was not definitely associated with any of the skull remains, so it cannot be unquestionably referred to either species.

<u>Merychyus</u> (<u>Merychyus</u>) <u>jahnsi</u> sp. n. Figure 1

<u>Type</u>: Part of a skull with M^{1-3}; figured as a cotype of <u>M.</u> (<u>Merychyus</u>) <u>calaminthus</u> by Jahns, 1940, plate 2, figure 2 and 3a; LACM 1382. The LM^1 was absent in the original figure but was found in the collection and replaced on the specimen.

<u>Referred material</u>: Nearly complete skull and mandibles of a juvenile, LACM 1829; incomplete skull and mandible of young juvenile, LACM 1384, and juvenile maxillary fragment with C erupting and with dP^{1-4}, LACM 13431.

<u>Locality</u>: Same as for <u>M.</u> (<u>Merychyus</u>) <u>calaminthus</u>.

<u>Etymology</u>: Named in honor of Professor Richard H. Jahns, in recognition of his original work on the Tick Canyon fauna.

<u>Diagnosis</u>: Smallest recognized species of the genus <u>Merychyus</u>, a number of measurements averaging 15 per cent smaller than <u>M.</u> (<u>Merychyus</u>) <u>crabilli</u> (Fig. 2); low flat skull, supraoccipital wings widely spread; shallow antorbital fossa, small prelacrimal vacuity with triangular outline; lightly constructed malar; paired infraorbital foramina above P^3, superior molars subhypsodont.

<u>Description</u>: <u>Skull</u>: By combining the type and the referred fragment of cranium, LACM 1829, a description of nearly the entire skull is possible.

> Jahns (1940, p. 187): The dorsal surface of the skull, as seen in CIT 1382, is low and flattened, with its highest point at the postorbital constriction. The brain case has a nearly circular horizontal cross section, and its upper surface is marked by two broad, very low temporal ridges. These ridges unite just in back of the glenoid fossae to form a short, narrow sagittal crest that is clearly defined but not prominent. The occipital crests are sharp and well developed.
>
> (p. 188) The malar is of medium build, but the zygomatic arches are light. The elevated orbits are rather small and only slightly elongated

> anteroposteriorly. From the orbits, the lacrimals project forward to occupy a rather extensive area on the face;...The short nasals are widest at their anterior ends. These elements appear to be slightly constricted at the middle, and are rounded posteriorly. The frontals, flat to gently convex, rise to a low ridge at the orbital rim.

There is a shallow, elongate antorbital fossa. The antorbital fossae in M. (M.) calaminthus are not preserved, but a sharp infolding of the lacrimal anterior to the orbit suggests that the fossae were much deeper than in M. (M.) jahnsi. The malar is of somewhat lighter build in M. (M.) jahnsi than in M. (M.) calaminthus.

Schultz and Falkenbach (1947, p. 188) describe the basicranial region, an important area in their distinction of species, as follows:

> ...supraoccipital wings widely spread, possibly less fan-shaped occipital region than in average Merychyus examples...

Jahns (1940, p. 188) describes the remainder of the skull as follows:

> In spite of local crushing, several foramina are clearly visible in the basicranial region. A large foramen ovale is situated internally with respect to the glenoid fossa, and a small, round foramen lacerum anterius is completely concealed in ventral view by a marked overhang of the pterygoid. There is no trace of the foramen rotundum, and an alisphenoid canal is not present; instead, the carotid artery appears to have been carried in a short, moderately narrow, but very deep groove. This groove is bounded exteriorly by a stubby pyramidal process situated on the posterior outer edge of the alisphenoid, and interiorly by one of the ventrally diverging pterygoids.
>
> A portion of the rim of the foramen lacerum medium is preserved posterointernally to the foramen lacerum posterius in back of the space occupied by the tympanic bulla.
>
> The infraorbital foramina lie above the middle part of P^3, and the [anterior] palatine foramina occupy positions opposite P^4...

The infraorbital foramen is paired with a smaller foramen lying posterior to and slightly below the principal infraorbital foramen.

No adult mandibles are represented in the sample of this species. The juvenile mandibles, LACM 1829, bear no apophysis below the condyle as is found in the subgenus Metoreodon Schultz and Falkenbach.

Dentition: The type is the only adult available for study, and the specimen bears only the molars. No permanent P^2, P^3, P^4, incisors or inferior canine are available for study. However, P^1 and the superior canine erupt early and are present in two juvenile specimens, LACM 1829 and 1384. These teeth do not differ markedly from those in M. (M.) calaminthus or M. (M.) crabilli. The mandibles of the juvenile LACM 1829 bear early wear M_{1-2} and an unerupted M_3. These teeth seem to be narrower in relation to length than any other described species of the genus Merychyus.

Deciduous dentition: Both referred specimens bear deciduous dentitions which permit a unique opportunity for study of these less commonly described teeth. The dP^4 is molariform and square in outline. It bears a well-developed parastyle, mesostyle, and metastyle. In addition, it appears to bear a small protoconule and hypoconule as low distinct cusps on the labial margins of the fossettes. The posterior loph of the dP^3 is also molariform, except that it lacks the styles. There is also a small hypoconule on the labial margin of the fossette in this tooth. The anterior loph is somewhat reduced, but bears two shallow, anteriorly opening fossettes. The dP^2 is two-lophed, as long as the dP^3, but only as broad as the anterior loph of the latter. The labial surface bears no styles, and any fossettes that may have been present are completely worn away.

The dP_2 and dP_3 do not differ markedly from the permanent P_2 and P_3 in M. (M.) crabilli, except for smaller size. The dP_4 is three-lophed with an increase in loph size from the anterior to the posterior loph. There is no lingual cingulum, but weakly developed labial cingula are present at the base of the crown between the lophs.

Figure 2 is a ratio diagram of selected characters in the skull and superior and inferior dentitions of M. (Merychyus) crabilli, M. (Merychyus) minimus Schultz and Falkenbach, M. (Merychyus) calaminthus, and M. (Merychyus)

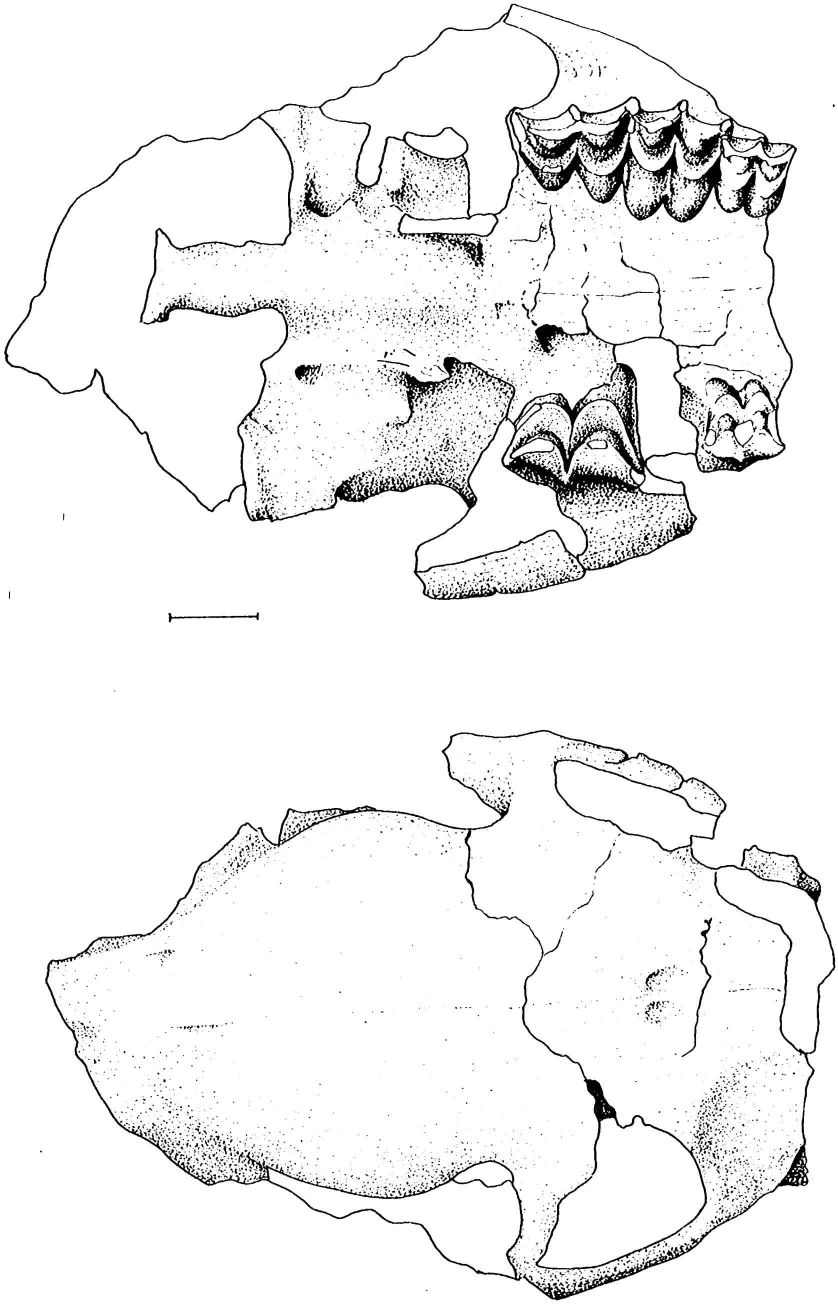

Figure 1 – *Merychyus* (*Merychyus*) *jahnsi* sp. n., holotype, LACM 1382, palatal view showing right $M^{\underline{1-3}}$ and left $M^{\underline{1}}$ and $M^{\underline{3}}$, and dorsal view. Scale equals 1 centimeter.

jahnsi. This method for graphical representation of size differences is taken from G. G. Simpson (1941) which includes a complete explanation of the construction and interpretation of this figure. The method essentially compares the relative proportions of dimensions in any number of different species (three in this case) to a single form arbitrarily picked as the standard of comparison, *M.* (*Merychyus*) *crabilli* in this case. The dimensions are converted to a geometric or logarithmic scale in order that an absolute ratio of numbers will be represented by the same distance plotted on the graph. Since we desire to ignore absolute values and represent only ratios, the differences between logarithms are plotted. The log difference scale is plotted on the ordinate and the various dimensions on the abscissa. Negative log difference values represent a ratio which is less than one, or in other words, a ratio in which the standard of comparison is larger than the form to which it is being compared. The horizontal lines plotted along the ordinate at each character are a log measure of the estimated range of that character. This estimate was obtained by taking 3.24 times the standard deviation (see Simpson, *et al.*, 1960). The small number indicates the sample size. Figure 2 reveals that *M.* (*M.*) *jahnsi* is consistently smaller than *M.* (*M.*) *crabilli*, well outside of the estimated maximum variability found in the latter. However, at least in relation to the proportion of the characters compared, *M.* (*M.*) *jahnsi* displays a close resemblance to *M.* (*M.*) *calaminthus*. The presence of long shallow antorbital fossae, paired infraorbital foramina, a relatively shallower malar and a relatively smaller M^1 serves to distinguish further *M.* (*M.*) *jahnsi* from *M.* (*M.*) *calaminthus*.

PHYLOGENETIC POSITION OF THE TICK CANYON OREODONTS

There are a number of unpublished oreodont records from Southern California which yield pertinent information about the phylogenetic position of the Tick Canyon oreodonts. The Hemingfordian Boron fauna (Whistler, University of California, Riverside, Master's thesis, 1964) contains two well represented species of *Merychyus* which display affinities with *M.* (*M.*) *calaminthus* and *M.* (*M.*) *jahnsi*. Both an unpublished Arikareean fauna in the Mojave Desert and the Hemingfordian

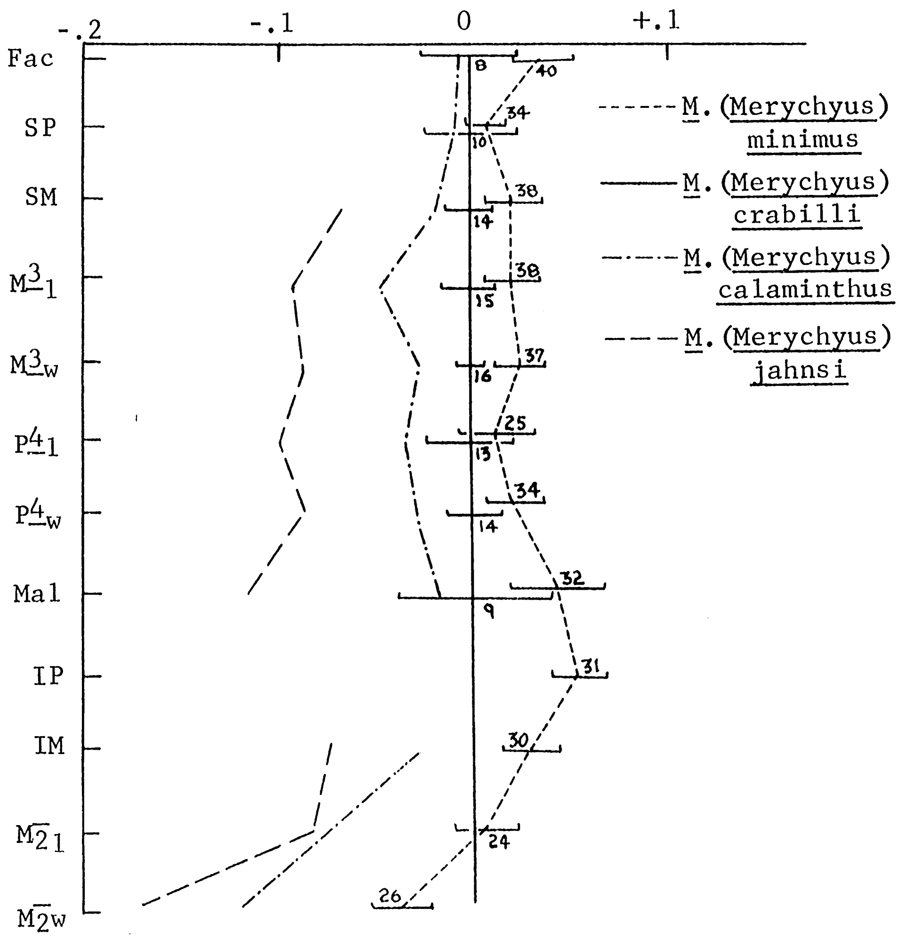

Figure 2 - Ratio diagram of various skull dimensions in M. (Merychyus) calaminthus, M. (M.) jahnsi, M. (M.) crabilli and M. (M.) minimus. Fac-distance from anterior base of canine to anterior rim of orbit; SP-length of superior premolar series; SM-length superior molar series; $M^3{}_1$-length M^3; $M^3{}_w$-width anterior loph M^3; $P^4{}_1$-length P^4; $P^4{}_w$-width P^4; Mal-malar depth; IP-length anterior premolar series; IM-length inferior molar series; $M_{2\,1}$-length M_2; $M_{2\,w}$-width anterior loph M_2. For explanation of graph, see page 6 or Simpson (1941). Data for M. (M.) crabilli and M. (M.) minimus taken from Bader (1955).

Phillips Ranch fauna (Buwalda and Lewis, 1955) contain similar oreodont species.

Therefore, two local lineages appear to be present in the Mojave Desert region. One of these lineages, *M.* (*M.*) *calaminthus*, and similar or large species, displays very little change except for an increase in size and appears to die out in the Hemingfordian.

The other lineage is best represented by the species of *Merychyus* at Boron which was referred to the subgenus *Metoreodon*. This Boron form has a shallow antorbital fossa and paired infraorbital foramina, both of which are developed in *M.* (*M.*) *jahnsi*. A specimen from the Mojave Arikareean site also bears paired infraorbital foramina. *Merychyus* (*Metoreodon*) *relictis fletcheri* Schultz and Falkenbach, a much larger and only questionably related form, occurs low in the Barstow Formation. The Barstow record is the last occurrence of the subfamily Merychyinae in Southern California.

It is premature to say with certainty, but it appears that there may be one or more endemic lineages of merychyine oreodonts evolving in the Mojave Desert region during the Miocene.

I would like to thank Mr. Karoly Fogassy who prepared the illustrations and Richard H. Tedford who supplied financial assistance and critical discussion of the manuscript.

TABLE 1

Comparative measurements in the skull of *Merychyus (Merychyus) calaminthus* and *M. (Merychyus) jahnsi*. All measurements in centimeters.

	M. (M.) calaminthus		*M. (M.) jahnsi*	
	LACM 1383	LACM 1382	LACM 1829	LACM 1384
Facial length, C to anterior rim of orbit	58*		37.0	28.0
Malar depth below orbit	13.2	10.0	9.2	
Palate width at M^1	21.3	16.1	19.0	14.4
Length P^1-P^4	28.0			
Length M^1-M^3	36.0	30.6	31*	
Length C-M^3	78*		55*	
Length P^4	7.0			
Width P^4	9.1			
Crown height P^4	10.0			
Length M^3	15.5	13.6		
Width M^3	11.8	12.0		
Crown height at mesostyle M^3	11.0	12*		
Crown height at mesostyle M^1	5.0	2.8	6.0	
Crown height at mesostyle M^2	8.7	8.0	9.0	5.9
Length dP^2-dP^4			17.8	
Length dP^2			5.5	
Length dP^3			6.7	
Length dP^4			7.2	

* Estimated measurement

TABLE 2

Comparative list of measurements in the mandible of *Merychyus* (*Merychyus*) *calaminthus* and *M.* (*Merychyus*) *jahnsi*. All measurements in centimeters.

	M. (*M.*) *calaminthus*	*M.* (*M.*) *jahnsi*	
	LACM 1342	LACM 1829	LACM 1384
Mandible depth below P_2		11*	14.1
Length of symphysis			18.1
Length M_1-M_3	35.8	31*	
Length C-M_3		56*	
Length M_2	10.0	11.1	11.4
Width anterior loph M_2	7.4	6.7	
Crown height, anterior loph M_2	3.1	1*	
Crown height, anterior loph M_1	2*	5*	6.8
Crown height, anterior loph M_3	8.0		
Length dP_2-dP_4			23.0
Length dP_2			6.2
Length dP_3		6.0	6.8
Length dP_4		11.1	11.2

* Estimated measurements

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