or smoothness of an outlet channel, the presence of natural dams over which the water drips, pools where the water is brought to a stand-still, or the amount of gas that escapes from the springs, prevent or determine the deposition of travertine.

Finally, in the absence of limestone, topographical features, by controlling the local supply of ground water and the depth to which it penetrates, bring about such radical diversities of type as we see between sulphate areas on the one hand and geyser basins on the other.

* Important parts of this article are taken from a forthcoming book: Hot Springs of the Yellowstone National Park, by E. T. Allen and Arthur L. Day. Microscopic examinations by H. E. Merwin.

[1] By thermal dissociation of bicarbonate in springs of high temperature, where the rising carbon dioxide is very slight, some carbonate is formed.

MICROSYOPSINÆ AND HYOPSODONTIDÆ IN THE SESPE UPPER EOCENE, CALIFORNIA

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Introduction.—Occurring in association with the recently described tarsiid,[1] *Dyseolemur pacificus*, in the Eocene deposits, north of the Simi Valley, California, is a new genus of the subfamily Microsyopsinæ and a new species of the genus *Hyopsodus*. Aside from the interest inherent in the new types, the presence of these forms gives added reason for regarding the faunal assemblages now being uncovered at locality 180 and stratigraphically related localities in the Sespe as definitely older than that known from locality 150. Moreover, these types suggest again a post-Bridger and an upper Eocene age for this stage in the succession of faunal horizons of the Sespe.

MICROSYOPSINÆ

Craseops sylvestris, n. gen. and n. sp.

Type Specimen.—Three associated right upper molars, No. 1580 Calif. Inst. Coll. Vert. Pale., plate 1, figure 1.

Paratype.—Fragment of right lower jaw with $M\overline{2}$ and $M\overline{3}$, No. 1399, plate 1, figures 2, 2*a*.

Locality.—Tapo Ranch, Sespe Upper Eocene deposits north of the Simi Valley, California, Locality 180 Calif. Inst. Tech. Vert. Pale.

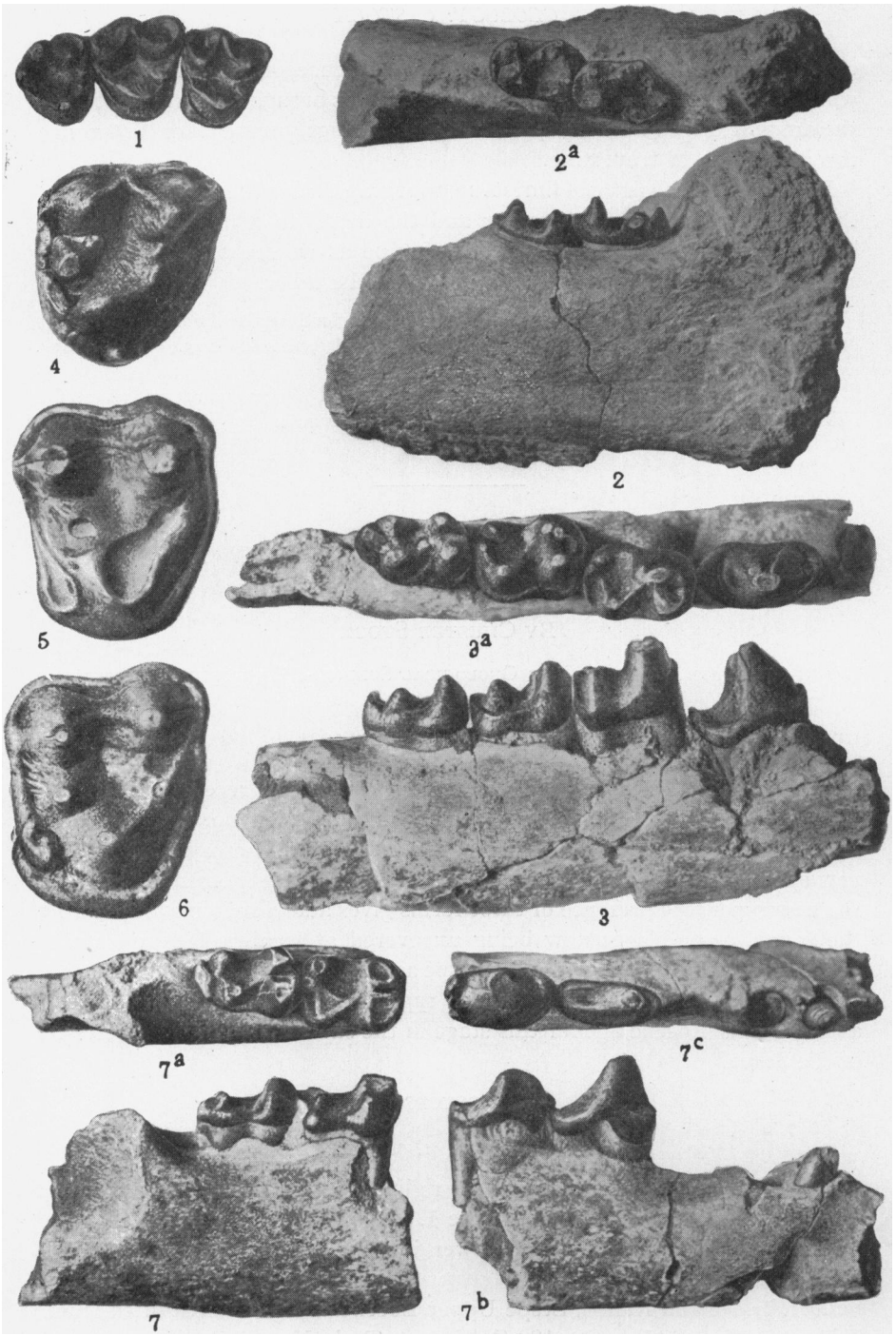

PLATE 1. (Description on opposite page.)

Generic and Specific Characters.—Distinctly larger than *Microsyops annectens*. Differs from *Microsyops* and *Cynodontomys* in more inwardly placed paracone and metacone with more prominent development of parastyle and especially the mesostyle, and broader ledge at outer base of external cusps. Lower molars similar to those in *Microsyops*.

Discussion.—*Craseops* shows a progressive advance in size beyond the earlier representatives of the Microsyopsinæ. The apices of the paracone and metacone have been pushed inward farther in the upper molars of the Sespe type than in those of either *Microsyops* or *Cynodontomys* and the crests which each cusp possesses outline an external *V*-shaped embayment. This is particularly striking in the first molar and least developed in the metacone of $M\underline{3}$, figure 1. The mesostyle is a distinctly more prominent feature in the molars of *Craseops* than in those of either *Microsyops* or *Cynodontomys*. The external cingulum is likewise better developed and a broad ledge swings around the antero-external corner of each tooth, making this region more prominent than in teeth of the antecedent forms. The protoconule is distinctly developed but the metaconule shows decidedly more reduction in the Sespe genus, being vestigial or obsolete in the anterior molars. The hypocone becomes progressively reduced in the molars from $M\underline{1}$ to $M\underline{3}$ inclusive. As in *Microsyops*, $M\underline{2}$ is the largest tooth of the molar series, but narrows more internally than in the former. $M\underline{3}$ exhibits no greater reduction in size with reference to the anterior molars, in our form than in *Microsyops annectens*.

Aside from a difference in size, the two posterior molars ($M\overline{2}$ and $M\overline{3}$) in No. 1399, figures 2, 2*a*, are strikingly similar to comparable teeth in *Microsyops*. In the trigonid region of these teeth the paraconid is crest-like and low and resembles that seen in *Microsyops* in lack of prominence as a distinct cusp. In *Cynodontomys*, a still earlier form, the paraconid crest ends internally in a small cusp-like enlargement.

DESCRIPTION OF PLATE 1

Craseops sylvestris, n. gen. and n. sp.

Figure 1, type specimen, $M\underline{1}$–$M\underline{3}$, No. 1580, occlusal view; ×2.
Figures 2, 2*a*, paratype, No. 1399, inner and occlusal views; ×2.

Hyopsodus egressus, n. sp.

Figures 3, 3*a*, type specimen, incomplete ramus with $P\overline{4}$–$M\overline{3}$, No. 1590, lateral and occlusal views, × 2.
Figures 4, 5 and 6, paratypes, Nos. 1596, 1597 and 1598, occlusal views; × 4.
Figures 7 to 7*c*, incomplete ramus with lower teeth, No. 1292, lateral and occlusal views; × 2.
California Institute of Technology Collections. Sespe Upper Eocene, California.

The time relationships of the three known genera of the Microsyopsinæ from the Eocene of North America may be indicated as follows:

Upper Eocene (Sespe)	*Craseops*
Middle Eocene (Bridger)	*Microsyops*
Lower Eocene (Wasatch)	*Cynodontomys*

COMPARATIVE MEASUREMENTS (IN MILLIMETERS)

	MICROSYOPS ANNECTENS NO. 12049 A.M.N.H.	CRASEOPS SYLVESTRIS NO. 1580 C.I.T.
$M\underline{1}$, anteroposterior diameter	4.8	6.3
$M\underline{1}$, transverse diameter	5.7	6.6
$M\underline{2}$, anteroposterior diameter	*a*4.9	6.4
$M\underline{2}$, transverse diameter	6.5	7.5
$M\underline{3}$, anteroposterior diameter	4.6	5.5
$M\underline{3}$, transverse diameter	5	6
	NO. 12050 A.M.N.H.	NO. 1399 C.I.T.
$M\bar{2}$–$M\bar{3}$, anteroposterior diameter	10.8	12.9
$M\bar{2}$, greatest transverse diameter	3.9	4.6

a, Approximate.

HYOPSODONTIDAE

Hyopsodus egressus, n. sp.

Type Specimen.—Fragment of right ramus with $P\bar{4}$–$M\bar{3}$, No. 1590 Calif. Inst. Tech. Coll. Vert. Pale., plate 1, figures 3, 3*a*.

Paratypes.—Three upper molars, Nos. 1596, 1597 and 1598, plate 1, figures 4, 5 and 6.

Referred Specimens.—Several incomplete rami with teeth, Nos. 1587, 1588, 1589 and No. 1292, plate 1, figures 7 to 7*c* inclusive.

Locality.—Tapo Ranch, Locality 180 Calif. Inst. Tech. Vert. Pale. Sespe upper Eocene deposits, north side of Simi Valley, Ventura County, Calif.

Specific Characters.—Teeth equalling or exceeding in size those of *Hyopsodus walcottianus*. *H. egressus* differs from this species and from *H. powellianus* in greater reduction in size of hypocone in upper molars. Resembles *H. simplex* in small size of hypocone, but differs from this species in decidedly larger size of teeth. $P\bar{4}$ relatively slender; deuteroconid small and appressed against principal cusp. $M\bar{1}$ and $M\bar{2}$ with double antero-internal cusp, no metastylid.

Description.—The Sespe type, although resembling in size the species *Hyopsodus walcottianus*, is more like *H. simplex* in certain significant characters of the dentition. Thus, our form, as in *H. simplex*, exhibits a considerable reduction in size of the hypocone in the molars, figures 4, 5 and 6. In this particular feature the Sespe species has carried the re-

duction farther than in *simplex*, although the difference between the two may not be great. A subdued cingular cusp is present on the anterior molar, figures 5 and 6, while the cusp is no longer observable in $M\underline{3}$, although the cingulum remains. $M\underline{3}$ in the Sespe species does not appear to have suffered quite so much reduction as the comparable tooth in *H. simplex*. At any rate, the metacone in this tooth approaches a size more like that in the anterior molars, whereas in *simplex* this cusp has lost its normal character with transverse contraction of the posterior portion of the tooth.

The cingulum is well developed in the molars and in some instances may encircle practically the entire tooth.

The intermediate cuspules of the anterior molars, when moderately worn, may show each two spurs or worn crests which diverge outward and extend toward the base of each of the principal outer cusps. Similar characters, although less marked, have been observed in molar teeth of specimens representing the species *H. paulus* in the collections of the American Museum of Natural History.

In the type specimen, No. 1590, and in one of the referred specimens, No. 1292, the jaw is not so deep as that of No. 14,654 A.M.N.H., representing the species *H. walcottianus* from the Lost Cabin Beds of the Wind River Basin, Wyoming, but the Sespe material is, on the other hand, more massive and the teeth are slightly larger. $P\overline{4}$ is relatively narrow with the inner median cusp (deuteroconid) appressed against the principal cusp. From the latter extend the anterior and posterior crests, which are not so well developed as in *H. walcottianus* or in *H. powellianus*. At the base of the forward crest is a small basal ledge. $P\overline{3}$, as preserved in No. 1292, is more compressed transversely than in *H. walcottianus*. Although $P\overline{2}$ is not present in No. 1292, this tooth may have been lost during the life of the individual. However, no very clear, if any, external indication of the former presence of alveoli can be determined.

Immediately in front of the alveolus for the single-rooted $P\overline{1}$ is the alveolus for, and remnant of the canine. A short diastema extends in front of the canine, reaching the broken anterior edge. An anterior mental foramen is situated below the anterior end of $P\overline{1}$. A second and very small opening is situated below $P\overline{3}$.

In the trigonid region of $M\overline{1}$ and $M\overline{2}$ the antero-internal cusp is represented by the metaconid against the forward side of which is appressed a smaller cusp. The latter is connected by the anterior transverse crest with the protoconid, while the metaconid proper is connected at its base with the oblique crest which extends forward and inward from the hypoconid. A metastylid is absent. In *Haplomylus* a very much reduced paraconid can be seen in $M\overline{1}$, but is not present in $M\overline{2}$ or in $M\overline{3}$. In *Hyopsodus simplex* a cusp is appressed against the anterior flank of the metaconid. It is of smaller size than the metaconid and the tip is lower. In the Sespe speci-

mens the hypoconulid is distinct from the entoconid and in $M\bar{1}$ and $M\bar{2}$ is situated to the inner side of the median line. In $M\bar{3}$ the hypoconulid is distinctly larger than the entoconid and encroaches more on the median posterior border of the tooth. An anterior cingulum is present on the molars. Length of molar series in type specimen No. 1590 is 22.7 mm.

Relationships.—The existence of several phyla within the *Hyopsodus* group, as recognized by Matthew, is suggested also by the relationships of the Sespe form. Evidently our type is more closely related to *Hyopsodus simplex* than to other described species of the genus in the small size of the hypocone of the upper molars. Offsetting the resemblance in this character, however, is the difference to be noted between the two species in lack of any noticeable reduction of metacone in $M\underline{3}$. In presence of distinct entoconid and hypoconulid in $M\bar{3}$, *H. egressus* presumably marks an advance beyond the stage represented by *H. simplex*. The Simi species comes closest in size to *H. walcottianus*, but the latter occurs in the Lost Cabin Beds, Wind River Basin, Wyoming, and represents a much earlier form. *H. egressus* is decidedly larger than *H. uintensis* from the Diplacodon beds of the Uinta and antecedent species of the Bridger. The type specimen of *H. fastigatus*, recently described by Russell[2] from the Swift Current Beds, Saskatchewan, is smaller than comparable teeth in specimens from locality 180 and, moreover, possesses a metastylid.

[1] Stock, C., *Proc. Nat. Acad. Sci.*, **20**, 150–154 (1934).

[2] Russell, L. S., *Trans. Roy. Soc. Canada*, 3rd ser., sect. IV, **27**, 61 (1933).

BIOLOGICAL ACTION OF SMALL DEFICIENCIES OF X-CHROMOSOME OF DROSOPHILA MELANOGASTER

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One of the interesting questions which arose out of our study of the various problems related to the action of genes was the question of what a tissue would look like if a locus is missing, viz., if the forked locus is missing, would the phenotype of the tissue be forked or would it be wild-type? Since there was reason to believe that a deficiency for even one locus is lethal for the organism an experiment was planned in such a way as to produce the deficient tissue of the desired constitution in small patches on the bodies of the flies. Minute-*n* character, which Bridges (1925) has shown to be a cause of frequent eliminations of the *X*-chromosome, was used to produce mosaics.