A Vertebrate Fauna from late Tertiary Beds near Frazier Mountain, California

Thesis by

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In Partial Fulfillment of the Requirements

For the Degree of

Master of Science

California Institute of Technology

Pasadena, California

1951

Abstract

From 1932 to 1950 vertebrate fossils were collected in the Hungry Valley area located in the northern half of the Black Mountain quadrangle, California. The fauna described in this paper was found between horizons approximately 350 feet below and 600 feet above the division established by Crowell separating the Hungry Valley formation and the Peace Valley beds. Fragmentary fossils and nature of the beds in which found suggest lake and alluvial fan deposits.

The fauna is a typical plains fauna except for the absence of carnivores which were presumably present but found easy prey on grasslands well removed from the sites of deposition. Perissodactyls, among which are at least two species of Pliohippus (including the new species P. crowelli), a Neohipparion?, a tapir and a rhinocerotid, dominate the assemblage. Artiodactyls include a new species of llama-like camel, Tanupolama? montis, as well as a larger camel and an antilocaprid.

The vertebrate-bearing strata overlie beds dated by Axelrod as middle Pliocene on the basis of plant remains. Crowell regarded the Peace Valley beds as middle Pliocene and the Hungry Valley formation as largely upper Pliocene.

P. crowelli, although apparently more advanced than P. spectans, is regarded as belonging to the Hemphillian

stage. Largely on this basis, the Peace Valley beds and several hundred feet at the base of the Hungry Valley formation are referred to middle Pliocene; the bulk of the Hungry Valley formation is presumably upper Pliocene. This conclusion is in accord with the view that North American rhinoceroses became extinct by the close of the Hemphillian stage.

Table of Contents

	Page
Introduction	1
Acknowledgments	4
Occurrence of Fossils	4
Accumulation and Preservation of Fossils	5
Fauna	7
Faunal List	8
Environment of Fauna	9
Age and Correlation of Fauna	10
Description of Material	
Pisces	13
Testudinata	14
Mastodon, gen. and sp. indet.	14
Pliohippus crowelli, n. sp.	14
Pliohippus cf. *tantalus*	18
Limb Elements of *Pliohippus*	24
Pliohippus? sp.	24
Pliohippus sp.	25
Neohipparion? sp.	25
Tapir, gen. and sp. indet.	26
Rhinocerotid	28
Tanupolama? *montis*, n. sp.	28
Camelid, large	31
Antilocaprid, gen. and sp. indet.	32

	Page
Literature Cited	33
Explanation of Plate	36
Plate	37

List of Illustrations

Figure		Page
1.	Map showing location of the Hungry Valley area and geographical distribution of California Institute of Technology Vertebrate Paleontology localities.	2
2.	Columnar section and approximate stratigraphic positions of fossil localities.	6
3.	Rhinocerotid. Labial wall of upper deciduous molar, x 1.	29

Plate		
I.	Labial and occlusal views of upper cheek teeth.	37

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Introduction

The Hungry Valley region as considered in this paper is located in the northern half of the Black Mountain quadrangle[1], California. The vertebrate-bearing beds

1. War Department, Corps of Engineers, U. S. Army.

occur on either side of U. S. highway 99, but are to be seen principally on the west side (figure 1).

Fossils were first found in the area by students of the California Institute of Technology, during the summer field camp held under the direction of Dr. John P. Buwalda, in 1932[2]. At that time fossil vertebrates were discovered

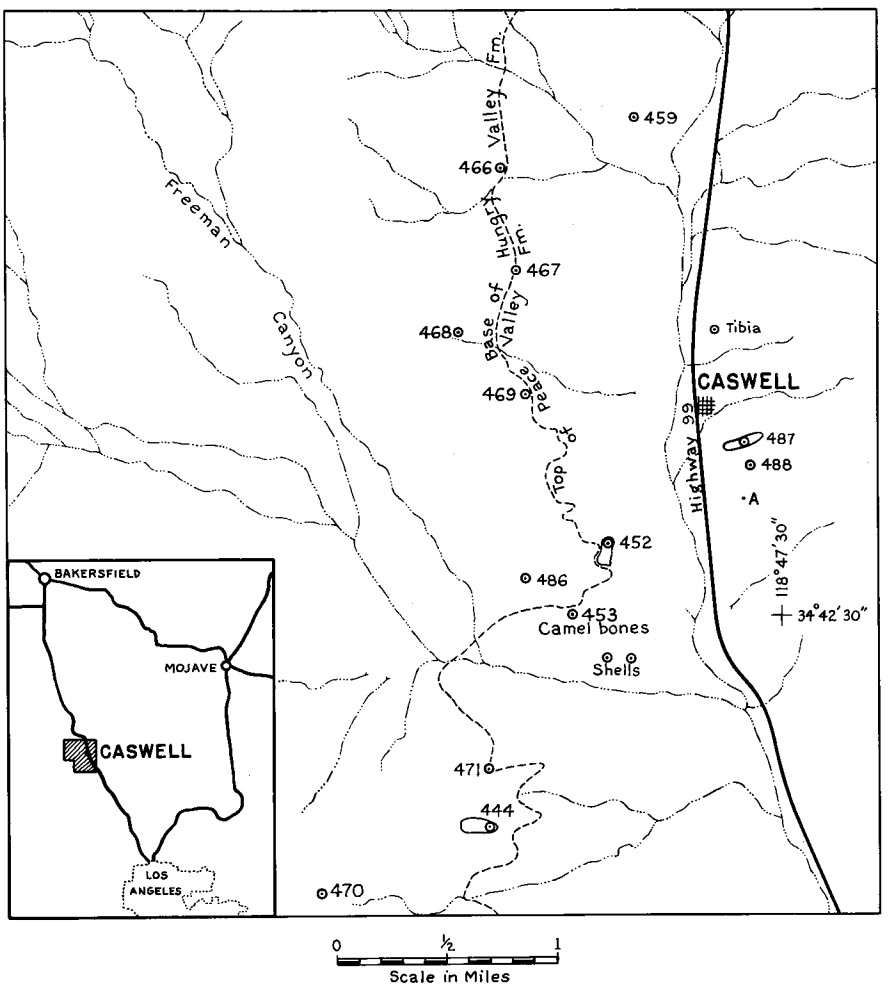
2. Personal communication by Dr. John P. Buwalda.

in these deposits by R. W. Wilson. Clements (1937, p. 218)[3] named the Ridge Route formation, which he

3. Numbers in parentheses indicate references cited at end of present paper.

regarded as probably lacustrine in origin. He mentioned the occurrence of fresh water mollusca and of fossil

Figure 1



Map showing location of the Hungry Valley area and geographical distribution of California Institute of Technology Vertebrate Paleontology localities.

vertebrate material in these beds. Eaton (1939, pp. 544-548) mentions the discovery of an unidentified horse tooth and remains of fresh water mollusca and ostracods in the Fourth Division of the stratigraphic sequence recognized by him in the Ridge Basin. In the spring of 1947, Crowell discovered vertebrate fragments in deposits he later named the Hungry Valley formation (1950, p. 1631), and submitted the paleontological materials to Dr. Chester Stock of the California Institute. John F. Lance and William Otto, in the fall of 1947, and the vertebrate paleontology class of 1949 collected in the area for the Institute. Brock Parker added to the California Institute collection in the summer of 1949, and the latest collections were obtained by the author in the summer of 1950.

Dr. John C. Crowell (1950) in a geologic study of the area divided the stratigraphic sequence of the Hungry Valley region into the Peace Valley beds which are in part lacustrine, and the conformably overlying Hungry Valley formation which is largely made up of coarse alluvial fan material. His divisions will be followed in this paper.

Horse tooth measurements were taken according to the system proposed by Merriam (1913, p. 409). Dental nomenclature of horses is largely after Stirton (1941).

Acknowledgments

It is a pleasure to acknowledge the services of the late Dr. Chester Stock who suggested the present problem and whose advice and critical reading of the manuscript have been of much assistance. I am also indebted to Dr. John F. Lance for helpful suggestions, to William Otto for preparation of the fossil material, and to David P. Willoughby for the illustrations. To Dr. John P. Buwalda and Dr. John C. Crowell I wish to extend my thanks for data on previous work in the area. Dr. R. A. Stirton of the University of California kindly assisted in the identification of some of the vertebrate remains from the Hungry Valley area.

Occurrence of Fossils

The fauna was collected from beds situated between a horizon approximately 350 feet below and another approximately 600 feet above the division established by Crowell between the Hungry Valley formation and the Peace Valley beds. Most of the fossils are found in strata occurring astride the division, and decrease in number in either direction. Upward in the section the rocks become coarser, and the few fossils found are represented by small isolated fragments. The deposition of the beds was apparently rapid, so that the assemblage represents a relatively short period of evolution, and all forms may be

considered as essentially contemporaneous. Approximate stratigraphic position of the fossil localities is shown in figure 2.

The fossils are found principally as float fragments dispersed on hillsides of the present terrain. Sometimes these can be traced to their source and a few of the bones found in situ were located in this way. All invertebrates and plants were taken directly from their original locations.

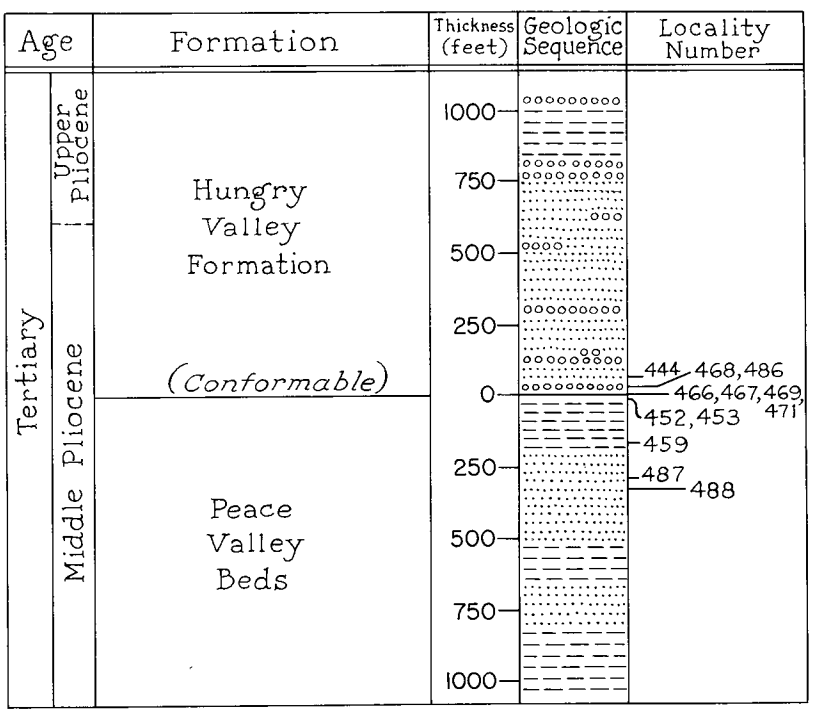
Accumulation and Preservation of Fossils

No articulated limb elements, vertebrae or skull parts were found. The most common fossils were fragmentary and scattered limb bones of ungulates and the shell fragments of tortoises.

Coarseness of much of the sedimentary section, fluviatile cross beds, and the fragmentary state of the organic remains, apparently confirm Crowell's belief that much of the section, especially the upper part, accumulated as alluvial fan material (1950, p. 1639). The animals died or were washed onto the fans, and their skeletons were apparently dismembered and worked over by frequent floods. Rounded bone fragments indicate considerable transportation and abrasion. Ungulates, and possibly carnivores, living near streams where many of the animals succumbed or were killed, probably facilitated some

Figure 2

FIG. 2.—COLUMNAR SECTION* AND APPROXIMATE STRATIGRAPHIC POSITIONS OF FOSSIL LOCALITIES



* Crowell, 1950, fig. 5, p. 1629.

dismemberment and breaking of bones. Fresh water lakes served to accumulate both vertebrate and invertebrate remains. In these basins, wave action may have caused some rounding of the bone fragments.

Many fossils were found in coarse sandstone concretions in the Hungry Valley formation. At locality 486, each of approximately 25 concretions yielded a fossil. These were identified as horse, camel, tortoise and possibly rodent bones. Such a varied aggregation suggests the presence of eddies and pockets in streams that effected for the most part the concentration of large or heavy objects. After deposition, the bone fragments probably served as nuclei about which mineral matter was laid down, cementing the concretionary masses. It is possible that after their formation, the concretions were reworked and subsequently concentrated in certain horizons.

On the whole, the collection is fragmentary and incomplete material, yet sufficient to permit understanding of the conditions of accumulation and to shed light upon age of the occurrence.

Fauna

Complete lack of carnivores in the fauna is a striking feature. The assemblage is typically a plains fauna except for this notable absence. From this lack

in representation one may conclude that the carnivores found easy prey on nearby plains and were not forced to hunt or feed at water holes, streams and lakes. The transportation of bones from the places where the animals were killed to the sites of deposition affords explanation for part of the destruction of the fossil material. Rodents are uncertainly recorded, but the conditions of accumulation appear to have been such that their small, fragile bones may well have been broken and hence unrecognizable when found.

Faunal List

Pisces

Testudinata

Rodentia?

Proboscidea

Mastodon, gen. and sp. indet.

Perissodactyla

Equidae

Pliohippus crowelli, n. sp.

Pliohippus cf. *tantalus*

Pliohippus? sp.

Pliohippus sp.

Neohipparion? sp.

Tapiridae

Tapir, gen. and sp. indet.

Rhinocerotidae

Rhinocerotid

Artiodactyla

Camelidae

Tanupolama? *montis*, n. sp.

Camelid, large

Antilocapridae

Antilocaprid, gen. and sp. indet.

Environment of Fauna

The finely bedded strata of the Peace Valley deposits suggest an accumulation, at least intermittently, in quiet waters of a fresh water lake. The freshness is indicated by the presence of relatively numerous invertebrates representing fresh water species and of Charophyta. Popenoe, for example, identified the strictly fresh water pelecypod genus *Anodonta* as well as gastropods which are probably *Lymnaea* (Crowell, 1950, p. 1638). The author likewise discovered two fresh water gastropod types associated with vertebrate material at locality 487, the smaller one of which resembles a pulmonate type. Associated with clams, probably *Anodonta*, in the Peace Valley beds, less than 50 feet stratigraphically below Locality 487, the author found Charophyta which are strictly fresh water plants (Shimer and Shrock, 1944, pp. 712-713). The clams have thin, fragile, mother-of-

pearl-like shells, typical of fresh water species. Both Crowell and the author found smooth-shelled ostracods associated with other invertebrate fossils.

The lake subsequently disappeared and the fine beds gave way to coarse, presumably fan deposits, according to Crowell (1950, p. 1639). Throughout the time of this varied environment, brushy and wooded areas probably existed near streams and lakes, and were occupied by mastodons and tapirs. The relative abundance of grazing horses suggests nearby grasslands, while the camels likewise probably inhabited open plains. The grasslands appear to have been more frequently occupied by the grazing horses than by antilocaprids. The presence of a rhinoceros suggests both wooded and open country. Tortoises are found today in arid and semi-arid regions, and the types from this region presumably had similar habits. They were probably to be found on alluvial slopes.

Age and Correlation of Fauna

The fauna has no identifiable species in common with other assemblages of known age, so that faunal correlations are in part reached by inference.

Clements (1937) questionably assigned a Pliocene age to the Ridge Route formation which, by reference to vertebrate material found in it north of the area he

mapped, implies inclusion of the beds herein under consideration. As Eaton (1939, p. 548) points out, Clements did not define the upper limits of the Ridge Route formation, which apparently includes the Third and Fourth divisions and possibly part of a lower division as defined by Eaton. Eaton tentatively dated his Third and Fourth divisions of the lacustrine section of Ridge Basin as upper Pliocene and lower Pleistocene, respectively. Crowell (1950, p. 1628) did not use the name Ridge Route formation because a type section for it was not described by Clements. He pointed out that Eaton's Third division roughly corresponds with the Peace Valley beds and the Fourth division with the Hungry Valley formation. Stock, in a letter to Crowell (1950, p. 1638) stated that horse material suggested a late middle or early upper Pliocene age for the Hungry Valley formation. Axelrod (Crowell, 1950, p. 1636), on the basis of fossil plants found at a locality stratigraphically below the Peace Valley beds, dated the former as middle Pliocene. Crowell also assigned to the middle pliocene the Peace Valley beds which lie between the plant locality and the Hungry Valley formation which he regards as largely upper Pliocene (1950, p. 1638).

The presence of a camel close to Tanupolama suggests that the Hungry Valley faunal stage is near that of

previously known occurrences of this genus. Schultz questionably assigns a camel from the Coso Mountains, California to Tanupolama (1937, p. 102). Known California occurrences of the genus, with the possible exceptions of the specimens from the Coso Mountains and Hungry Valley[4], are all Pleistocene in age. Therefore,

4. Tanupolama blancoensis Meade was described from the Rexroad formation, Kansas, by Hibbard (1949, p. 855). This formation is regarded as either late Pliocene or early Pleistocene (Hibbard, 1950, pp. 179-183).

if the Hungry Valley accumulation were regarded as not far removed from the Pleistocene, the indirect faunal evidence might be presented in support of such a late Tertiary age for this stage.

The tooth fragment referred to a rhinoceros was found as float and was not given a locality number. However, from information supplied by William Otto who found the specimen, it can be concluded that the approximate location lay in the Peace Valley beds. If, as is commonly held, the North American rhinoceroses became extinct by the close of the Hemphillian stage, the Peace Valley beds are middle Pliocene; otherwise rhinoceroses existed later in geologic time in this section of California than elsewhere in North America.

P. crowelli, which is apparently more advanced than P. spectans, was found approximately 50 feet above the

base of the Hungry Valley formation. This suggests that the Hungry Valley form represents a later stage in the development of pliohippine horses than that of the Rattlesnake fauna. P. crowelli is, however, likewise regarded as Hemphillian in age. On the other hand, Pliohippus cf. tantalus from Hungry Valley suggests the survival of a more primitive species than P. crowelli.

The preceding considerations lead to the conclusion that the Peace Valley beds, and at least several hundred feet of strata at the base of the Hungry Valley formation, are middle Pliocene; the bulk of the Hungry Valley formation is therefore presumably upper Pliocene.

Description of Material

Pisces

Piscine remains from a locality between 100 and 150 feet stratigraphically below Locality 453 represent two tusk-like teeth with crowns recurved. Numerous fragments of vertebrae were also found. At the base of the exposed enamel, the teeth are approximately 25 mm. long and 14 mm. wide, and the largest vertebra is at least 33.5 mm. in diameter. The large size suggested by the remains may be interpreted to mean that the lake in which the fish lived was of considerable size and duration.

Testudinata

Tortoise shell fragments are common in the Hungry Valley area, but none is sufficiently complete to be of diagnostic value.

Mastodon, gen. and sp. indet.

A cuboid and an acetabular fragment, Nos. 4010 and 4011 C.I.T., were found at Locality 444 and indicate the occurrence of a mastodon. The proximal face of the cuboid is gently convex, while the distal face is flat and triangular in outline. Measurements (in millimeters) of the cuboid are as follows: anteroposterior diameter 76.8; maximum width 79.3; maximum proximo-distal length 35.7.

Pliohippus crowelli, n. sp.

Type specimen.- P3 and P4, No. 3924, Calif. Inst. Tech. Vert. Paleont. Coll. from Calif. Inst. Vert. Paleont. Locality 444; plate I, figures 3 and 4; collected by William Otto. This species is named for Dr. John C. Crowell, Department of Geology, University of California at Los Angeles, who called attention to the occurrence of fossil remains in the Hungry Valley area.

Specific characters.- Large size, comparable to P. nobilis; premolars with antero-posteriorly directed protocone and hypocone. These cusps have lingual faces flattened; styles heavy; mesotyle flattened and set

posteriorly with respect to the level of the center of the protocone; angularly crescentic fossettes; moderately curved crown.

Description and comparison.- The most noteworthy feature of the type specimen is the large size of P3 and P4. The crowns of these teeth are moderately curved and poorly cemented on their outer surfaces. The enamel pattern is simple.

The protocone is oval, flattened lingually, and with no anterior projection beyond the isthmus. This cusp in P4 is longer than that in P3; and it is possible that this feature was even more pronounced in the molars. The pre-protoconal groove is not pronounced, leaving a broad isthmus to connect the protocone and protoselene. The post-protoconal valley is deep and narrow. A double pli caballin is present in P3, a single large one occurs in P4. The hypocone is flattened lingually. The inner cusps are aligned in P3, but the protocone projects lingually farther than the hypocone in P4. The protocone and hypocone remain separate to the base of the crown. The post-hypoconal groove is deep, and directed anteriorly, but becomes shallower with wear and disappears near the base.

The fossettes are angularly crescentic, simple in outline, and narrow; the patterns are almost alike in

both teeth, but all plications are more pronounced in P4. The pli protoconule is prominent; a pli hypostyle is present in P4; a faint fold extending from the median part of the metaloph into the postfossette is present in both teeth.

The styles are heavy. The parastyle in each tooth is somewhat flattened anteriorly. The mesostyle, which lies posterior to the level of the center of the protocone, is broad and flattened, the flat surface facing outward and forward. The mesostyle shows a slight tendency to be grooved near the occlusal surface.

Pliohippus crowelli closely resembles P. nobilis in size. Its enamel pattern is similar to that of more worn teeth in the type of the latter species (Osborn, 1918). The protocone and hypocone are similar to the comparable cusps in P. nobilis, but are directed more lingually than in the latter species. In P. nobilis the fossettes are broader with somewhat different though still simple plications. The parastyle in P. crowelli is flatter anteriorly. The mesostyle in P. crowelli is flatter and heavier, but this probably results from a less advanced stage of wear in the teeth of the Californian species.

The teeth of P. crowelli differ from the type (Osborn, 1918) and referred specimens of P. spectans

(Merriam, Stock, Moody, 1925; Stirton, 1939) in larger size, heavier styles, less flattened parastyle and flatter mesostyle, and slightly narrower fossettes. Comparison between the two species is unsatisfactory because of a pronounced wear of the crowns of all available teeth of P. spectans. However, the molars of P. spectans show greater resemblance to the premolars of P. crowelli than do the premolars of the former species. The premolars of P. crowelli have shorter protocones than the molars of P. spectans, but the protocones and hypocones of the former are similarly directed antero-posteriorly. The premolars of P. spectans have round, more lingually directed cusps.

P. crowelli has larger teeth with heavier, flatter styles, a less elongate protocone, a broader isthmus, and a less strongly curved crown than P. interpolatus. The protocone of the latter generally exhibits an anterior projection, and projects lingually slightly farther than the hypocone. P. crowelli presents similar but less pronounced plications on the borders of the enamel lakes than P. interpolatus, but the fossettes of the latter have been shown to vary from narrow (Matthew and Stirton, 1930) to broad (Osborn, 1918).

P. crowelli appears to be comparable to P. nobilis in stage of development. P. interpolatus is more advanced

in enamel pattern in the direction of Equus, but is more primitive in size and degree of curvature of the crown. While P. crowelli appears to be a later form than P. interpolatus, it nevertheless appears to belong to an extinct branch of horses that separated from the line leading to Equus prior to the time of appearance of P. interpolatus. To judge from its morphological similarity, the relationship of the species to P. spectans among the several horses of western North America may be particularly close.

The changes which take place in the character of the protocone and in the plication of the fossette borders in P3 and P4 suggest that the molars were probably even more advanced. In this respect and the size of the crown, the lines leading to Plesippus and P. crowelli exhibit parallel evolution.

Measurements (in millimeters) of P. crowelli, n. sp., No. 3924 C.I.T.

	P3	P4
Length	30.2	30.0
Width	29.5	30.6
Length of protocone	8.8	9.7
Height of mesostyle	49.5	57.4

Pliohippus cf. tantalus

Referred material.- P4, No. 3956 from Locality 452,

Calif. Inst. Tech. Vert. Paleont.; P4, No. 3925 from Locality 459; M3, from Locality 466; plate I, figures 1 and 2.

Description and comparisons.- A second species of Pliohippus from strata at the base of and below the Hungry Valley formation is recognized as related to Pliohippus tantalus.

The specimen from Locality 452 is little worn, that from Locality 459 is moderately worn. Their crowns are poorly cemented, moderately curved and show a pronounced though irregular anteroposterior tapering toward the base of the crown. The length of No. 3956 decreases from 26.5 mm. to a little more than 21 mm. from occlusal surface to base. No. 3956 is a narrow tooth; No. 3925 is more nearly square throughout its length.

No. 3956 lacks most of the protocone and in No. 3925 both protocone and hypocone are completely absent. Enamel remnants on No. 3956 suggest an oval protocone projecting farther lingually than the hypocone, a narrow isthmus, and a narrow protoconule. An enamel remnant on No. 3925 suggests a lack of an anterior projection on the protocone. The post-protoconal valley almost reaches the prefossette, and a single prominent pli caballin is present. The hypocone is narrow and rounded (plate I, figure 1), and projects lingually to a slight extent.

The post-hypoconal groove rapidly becomes less distinct with wear of the tooth.

The fossettes are narrow, simple in outline, lunate in shape, and angularly lunate in No. 3956. The prefossette in No. 3956 is moderately broad. Although its crown is more worn, No. 3925 has fossettes that are more complex than those of No. 3956, suggesting considerable individual variation. Both teeth show a prominent pli protoconule and a pli hypostyle which is more prominent in No. 3956 than in No. 3925. The former specimen likewise shows a fold which projects from the median portion of the metaloph into the postfossette. In No. 3925 a prominent pli crochet is present and a fold from the metaloph extends into the prefossette above the pli crochet.

The parastyles are heavy and flattened, their flat surfaces exhibiting an incipient grooving for nearly the entire length of the crown. The mesostyle on these teeth is acutely rounded and narrow, but prominent.

In M3 the post-protoconal valley touches the prefossette; a faint pli caballin is present. The angularly crescentic fossettes are simple in outline, presenting only a pli protoconule. The prefossette is broad, the postfossette narrow, probably due to the backward taper of the tooth. The crown is poorly cemented.

The inadequate preservation of this specimen does not permit its identification with species nearly situated geographically. The specimens available are as close to Pliohippus leardi and to P. spectans as they are to P. tantalus.

The premolars from Hungry Valley agree with those of P. tantalus (Merriam, 1919) in tooth size and pattern of the enamel lakes. In the superior cheek-tooth series, No. 22308, U. C. Mus. Pal., P4 exhibits a considerable tapering of the crown; however, the parastyle in this tooth is a more slender, rounded buttress than the parastyle in the premolars from Hungry Valley. The post-hypoconal groove is not present in this specimen of P. tantalus, but the tooth is well worn, and in a comparable stage of wear the groove may presumably be absent in teeth from Hungry Valley. M3 of this dentition has a pli crochet as well as a pli protoconule, an open prefossette, and a lighter mesostyle than does M3 from Hungry Valley. P. tantalus presents a range of variation which might well include the stage seen in the teeth from Hungry Valley.

The premolars closely resemble those of P. leardi (Drescher, 1941) in the degree of curvature and sharp tapering of crown, shape of hypocone and size and shape of fossettes. In both forms fusion of protocone and

hypocone does not occur until the wear of the crown is pronounced. One of the major differences is presented by the smaller size of the teeth from Hungry Valley. M3 from Hungry Valley is in all respects, except the possession of a heavier mesostyle, like M3 of P. leardi, No. 302 C.I.T. from the Comanche Point locality, in the Tejon Hills, California. No. 3956 has a larger pli caballin than P4 of P. leardi.

The premolars from Hungry Valley are similar to those of P. spectans (Osborn, 1918; Merriam, Stock, Moody, 1925) except in smaller size, flatter parastyle, narrower fossettes with occasional simpler outline, and small amount of cement. The crown of P4 in P. spectans tapers less and more irregularly, if at all, than the crowns of the premolars of P. cf. tantalus. In P. spectans (Merriam, Stock, Moody, 1925), M3 may have a slender or heavy mesostyle, open or closed postfossette, and enamel lakes of simple or moderately complex outline. This range of variation could include the enamel pattern seen in M3 from Hungry Valley.

The teeth from Hungry Valley bear some resemblances to the type and cotype, which are molars, of P. supremus (Osborn, 1918), but comparison is restricted because corresponding teeth are not available.

The premolars are like those of P. fairbanksi

(Merriam, 1919) in size, and like the latter possess narrow, lunate fossettes with simple borders. The mesostyles are more slender and the parastyles are heavier and flatter than in P. fairbanksi. The hypocone of P. fairbanksi is directed anteroposteriorly and differs in shape from that of No. 3956.

P4 of P. cf. tantalus resembles that of P. nobilis closely, but is smaller. Drescher (1941) pointed out the proximity of P. leardi to P. nobilis and showed that in early stages of wear P. leardi may be larger in cross section.

The premolars of P. cf. tantalus present styles, hypocone and curvature of crown similar to those in P4 of P. coalingensis (Osborn, 1918), but the parastyle of the former is flatter. However, P4 of P. coalingensis lacks the tapering of its crown. In this species, too, the fossettes are narrower and the tooth is larger.

Measurements (in millimeters) of teeth of Pliohippus cf. tantalus

	P4, No. 3925 C.I.T.	P4, No. 3956 C.I.T.
Length	24.7	26.5
Maximum width (labial cusps broken)	24.5	23.5
Height of mesostyle	49.3	56.2

Limb Elements of Pliohippus

To Pliohippus are referred numerous limb elements, some of which may be conspecific with P. cf. tantalus. They include the distal ends of a tibia, a radius, and a proximal phalanx; the anterior half of an ectocuneiform; and a patella. The fragments of the tibia and radius are definitely not referable to Neohipparion, but closely resemble pliohippine material with which comparison has been made.

The fragments of radius, phalanx and ectocuneiform are smaller than corresponding elements of P. leardi in the Tejon Hills collection. The tibial fragment is of larger size.

Measurements (in millimeters) of limb elements referred to Pliohippus

Tibia, width of distal end	65.0
Proximal phalanx, width of distal end	28.8
Radius, width of distal end	49.3
Ectocuneiform, maximum transverse diameter	36.2
Patella, maximum height	60.5
Patella, maximum width	56.7

Pliohippus? sp.

A symphyseal portion of a jaw (No. 4009 C.I.T.) containing all incisors and the canine of the right side and fragments of the crowns and roots of corresponding

teeth of the left side was found at California Institute of Technology Locality 469 and is tentatively assigned to Pliohippus. The teeth are well worn. The incisors are procumbent and the canines are large. The diastema between $I\overline{3}$ and $\overline{C}$ is approximately 4.5 mm. in length.

Measurements (in millimeters) of symphysis, No. 4009 C.I.T.

Minimum width	41.5
Depth at line of minimum width	38.3
Length	80.0
Maximum width across third incisors (double the width from the center line to $I\overline{3}$ R)	66.0
Width between points between $I\overline{3}$ and $\overline{C}$ (double the width from the center line to the point on the right side)	60.0

Pliohippus sp.

A fragmentary lower premolar (?) from Locality 486 is referred to this genus because the outer walls of the protoconid and hypoconid, the only distinguishable diagnostic characters, are rounded, showing only a faint indication of flattening.

Neohipparion? sp.

To this genus is questionably referred the lateral half of the distal end of a radius from Locality 444. The fragment is almost identical with the corresponding

art of Neohipparion leptode from the Thousand Creek beds f Nevada.

The lateral condyle, which articulates with the uneiform, is broader, and the posterior part of this ondyle, which articulates with the pisiform bone, curves rther upward than does the corresponding part in the stal end of a radius from Hungry Valley referred to iohippus. The anterior edge of that part of the stal surface which is in contact with the lunar has an gular bend, but lacks the anteriorly protruding lobe esent at this position in Pliohippus. The posterior rt of the surface that articulates with the lunar tends farther upward than does the corresponding part Pliohippus. The ridges on the anterior face of the dius, just above the distal surface, are apparently arper and more prominent than those of Pliohippus.

Tapir, gen. and sp. indet.

The presence of a tapir is indicated by an associated left lunar (No. 4006 C.I.T.) and scaphoid (No. 4005 C.I.T.) and two median phalanges (Nos. 4007 and 4008, C.I.T.) from Locality 471. The posterior part of the lunar is broken away. This marks the first recorded Pliocene occurrence of tapir material in California, all other occurrences being Pleistocene. The Hungry Valley tapir is smaller

than the Pleistocene forms.

Measurements (in millimeters) of tapir material

Lunar, No. 4006 C.I.T.	
Maximum length of anterior face	21.6
Maximum width of anterior face	21.1
Scaphoid, No. 4005 C.I.T.	
Maximum anteroposterior length	22.7
Maximum proximo-distal length	21.1
Maximum width	15.9
Median Phalanx, No. 4007 C.I.T.	
Maximum length	17.0
Maximum width of proximal end	14.4
Maximum width of distal end	13.2
Maximum anteroposterior diameter of proximal end	11.3
Maximum anteroposterior diameter of distal end	9.1
Median phalanx, No. 4008 C.I.T.	
Maximum length	14.4
Maximum width of proximal end	12.4
Maximum width of distal end	10.6
Maximum anteroposterior diameter of proximal end	10.8
Maximum anteroposterior diameter of distal end	9.0

Rhinocerotid

The presence of rhinoceros is suggested by a portion of the labial wall of a deciduous molar (No. 4012 C.I.T.), which in all respects, except the lack of a metacone column, is like that in Aphelops? cristalatus from Tonopah, Nevada. The tooth (figure 3) is short-crowned, has a prominent parastyle wall separated by a deep notch from the paracone, a paracone column, a broad external face between paracone and metacone, and a flaring posterior projection which becomes less prominent with wear.

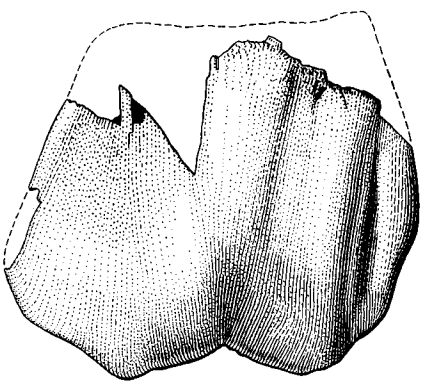
Tanupolama? montis, n. sp.

Type specimens.- $\overline{M2}$ and a well worn P4, No. 3958 and 3957, Calif. Inst. Tech. Vert. Paleont. Locality 486.

Specific characters.- $\overline{M2}$ larger than corresponding tooth in L. huanachus, relatively narrower transversely than in T. stevensi. P4 with antero-external style well developed; cingulum present on anterior and posterior faces of tooth, but none exists on the labial and lingual walls. The premolar from Hungry Valley bears a rudimentary postero-internal style that is lacking in the living and Pleistocene species.

Referred specimens.- Skeletal remains referred to this species include an astragalus, No. 3962, from Locality 452; a second phalanx, No. 3959, from Locality 444; a navicular, No. 3960, from Locality 459; and a

Figure 3



Rhinocerotid. Labial wall of upper deciduous molar, x 1.

proximal end of posterior cannon bone, No. 3961, from Locality 467; all localities are Calif. Inst. Tech. Vert. Paleont. The proximal end of the metatarsal is larger than that of L. huanachus, smaller than that of T. stevensi, and similar in structure to both.

The second phalanx from Hungry Valley is relatively shorter and broader than those of the living species and of T. stevensi, even allowing for the missing proximal epiphysis. No. 3959 has greater bulk, and does not possess the lateral depressions at the distal end that are present in the corresponding phalanges of L. huanachus and T. stevensi.

The tarsal elements - the astragalus and navicular - are provisionally referred to this species of lama. The astragalus of the Hungry Valley form is similar to those of L. huanachus and T. stevensi, though different in some details. It is larger than that of the former species and smaller than adult specimens of the species from McKittrick. The navicular shows similar size relationships.

The foregoing evidence shows that T.? montis is smaller than T. stevensi and larger than L. huanachus, and apparently possesses shorter, stockier limbs than in T. stevensi. The Hungry Valley form appears to be near Tanupolama, but sufficient material of the former

is not at hand to definitely establish its generic status.

Measurements (in millimeters)
of teeth and skeletal elements of T.? montis

Dentition*	
P4, No. 3957, length	13.7
P4, No. 3957, width	13.2
$M\overline{2}$, No. 3958, length	20.7
$M\overline{2}$, No. 3958, maximum width	14.5
Limb elements	
Width of proximal end of posterior cannon bone	47.0
Maximum anteroposterior diameter, proximal end of posterior cannon bone	38.2
Maximum transverse diameter of navicular	29.1
Maximum width of distal end of second phalanx	21.1
Maximum anteroposterior diameter of distal end of second phalanx	16.4
Maximum length of second phalanx (proximal epiphysis missing)	31.5
Maximum length of astragalus	58.2
Maximum width of astragalus	39.1

* Measurements taken at base of crown.

Camelid, large

A fragment of a ramus, from Locality 453, contains the posterior root of $M\overline{1}$, an almost complete $M\overline{2}$, and a barely erupted anterior lobe of $M\overline{3}$, and indicates the

presence of a camel larger than Tanupolama? montis. The antero-external style in $\overline{M2}$ is faintly developed only on the upper part of the crown. The length at the base of the tooth is 32.6 mm.

Antilocaprid, gen. and sp. indet.

An antilocaprid in the Hungry Valley fauna is evidenced by a tooth fragment and a fragment of the lateral part of the distal end of a radius from Locality 471.

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Explanation of Plate

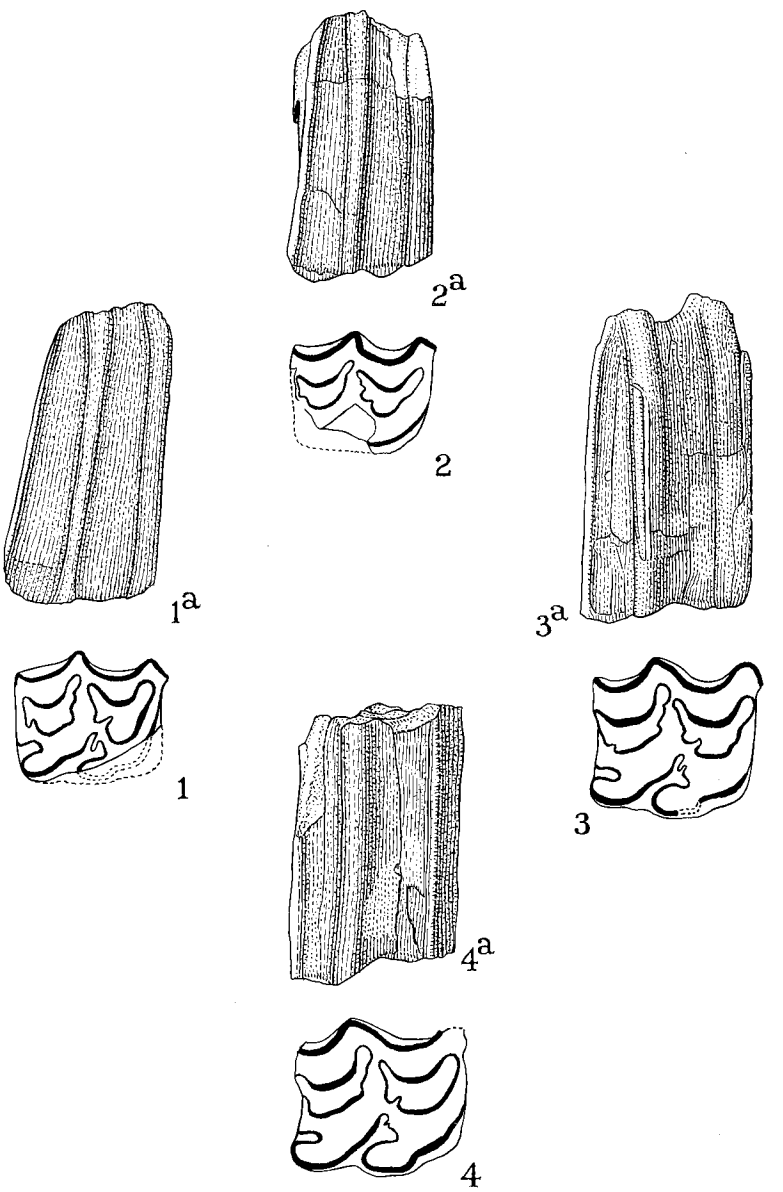
Plate I. Labial and occlusal views of upper cheek teeth.

Fig. 1. *Pliohippus* cf. *tantalus*. No. 3956, P4, slightly worn, C.I.T. Loc. 452, x .77.

Fig. 2. *Pliohippus* cf. *tantalus*. No. 3925, P4, moderately worn, C.I.T. Loc. 459, x .77.

Figs. 3 and 4. *Pliohippus crowelli*, n. sp. Type specimen, No. 3924, P4 and P3, slightly worn, C.I.T. Loc. 444. Fig. 3, P4; fig. 4, P3; both x .77.

Plate I



Labial and occlusal views of upper cheek teeth.