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PLIOCENE LAKE BEDS NEAR DORRIS, CALIFORNIA

G Dallas Hanna and G. Clark Gester *

California Academy of Sciences

ABSTRACT

The lake beds exposed by faulting on the northeast side of Butte Valley near Dorris, Siskiyou County, California, are believed to be Pliocene in age. Abundant and well preserved mollusks were collected and are described with illustrations. Eight species were found, four of which are believed to be new; one of these seems to represent a new genus. The deposits are correlated with the Yonna Formation of southern Oregon.

GENERAL GEOLOGY

The geologic history of the ancient, as well as some of the present lakes of northeastern California and southeastern Oregon present many interesting problems. These are very closely related to the volcanic history of that region since many of these lake basins were formed as the result of diastrophic and volcanic activity. One very interesting phase of this problem is the age and sequence of geological events which produced the landscapes as we now find them.

The objectives of this paper are (a) to identify, describe, and determine as accurately as possible the geologic age of a number of fossil mollusks which occur in outcrops of lake sediments near the town of Dorris, Siskiyou County, California, and (b) to outline briefly some of the more salient geolo-

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gical conditions which obtain in that area, and to correlate these with those found in closely adjacent areas, particularly to the north in the Klamath River Basin, Oregon, as described by Moore (1937, pp. 1-180) and Newcomb (1958, pp. 41-48). The overall problems are broad and cannot be solved within a small area alone, but it is hoped that the data presented herein will serve to augment the geological knowledge of the entire region.

The town of Dorris is situated on U.S.Highway 97, between Weed, California, and Klamath Falls, Oregon. It is about 21 miles south of the City of Klamath Falls, and a little over 2½ miles south of the Oregon-California boundary line. Dorris is in the northwestern part of the U.S.Geological Survey Dorris quadrangle (1950 edition), and lies in the extreme northeastern part of Butte Valley, a flat, ancient lake basin, having an elevation of approximately 4200 feet. Meiss Lake, a shallow, marshy area, which is at times filled with water, occupies about two square miles of area in the lower western part of the Macdoel quadrangle, the geology of which was described by Williams (1949).

According to Williams, Butte Valley is: "a huge structural trough almost encircled by youthful fault scarps and several flat-floored grabens, including Sam's Neck and Pleasant Valley, which project beyond the main depression between parallel horsts." Williams also stated (p. 54) that whereas Shasta Valley, a structural depression to the southwest of Butte Valley, was probably formed at the close of the Miocene and prior to the growth of the Pliocene shield volcanoes, Butte Valley itself and the adjoining fault scarps were formed much later and: "Butte Valley itself is a complex down-faulted basin deepest along its western side." That is, the down-dropped blocks that effect Butte Valley are tilted toward the west. This is borne out by the presence of the fossiliferous Pliocene lake beds which outcrop a short distance southeast of Dorris and their apparent absence elsewhere around the valley.

Butte Valley was once a broad relatively deep lake which probably has persisted as a basin since early Pliocene time. Williams (p. 54) gave the following information:"Between Macdoel and Dorris, in Sec. 23, T.47N., R.1W., a well passed through 18 feet of sandy soil, then through 175 feet of clay before entering a bed of cinders. A well at Mount Hebron station ended in sediments at a depth of 184 feet. But apparently the full thickness of valley fill has nowhere been penetrated by borings." Although no fossils are reported to have been found in these wells, 175 feet of "clay" suggests lacustrine deposition.

The surface of Butte Valley is very flat and is immediately underlain by a fine sandy or silty soil. No evidence of tilting was observed in the surface beds of the valley, but the location of Lake Meiss, on the extreme western side suggests a possible low tilting to the southwest as described by Williams (1949, p. 54).

Two faults, one along the western base of the hills to the southeast of Dorris, and the other along the western side of Cedar Point south of Dorris, are apparently responsible for the elevation of the lake sediments. These faults are in the immediate vicinity of fossil localities, A, B, C, and D, shown on figure 1. The areas of old lake sediments in which the fossils are found are small. Ten separate collections of fossils from this area have been obtained by the Academy. The four localities shown by letters on figure 1 are the most important.

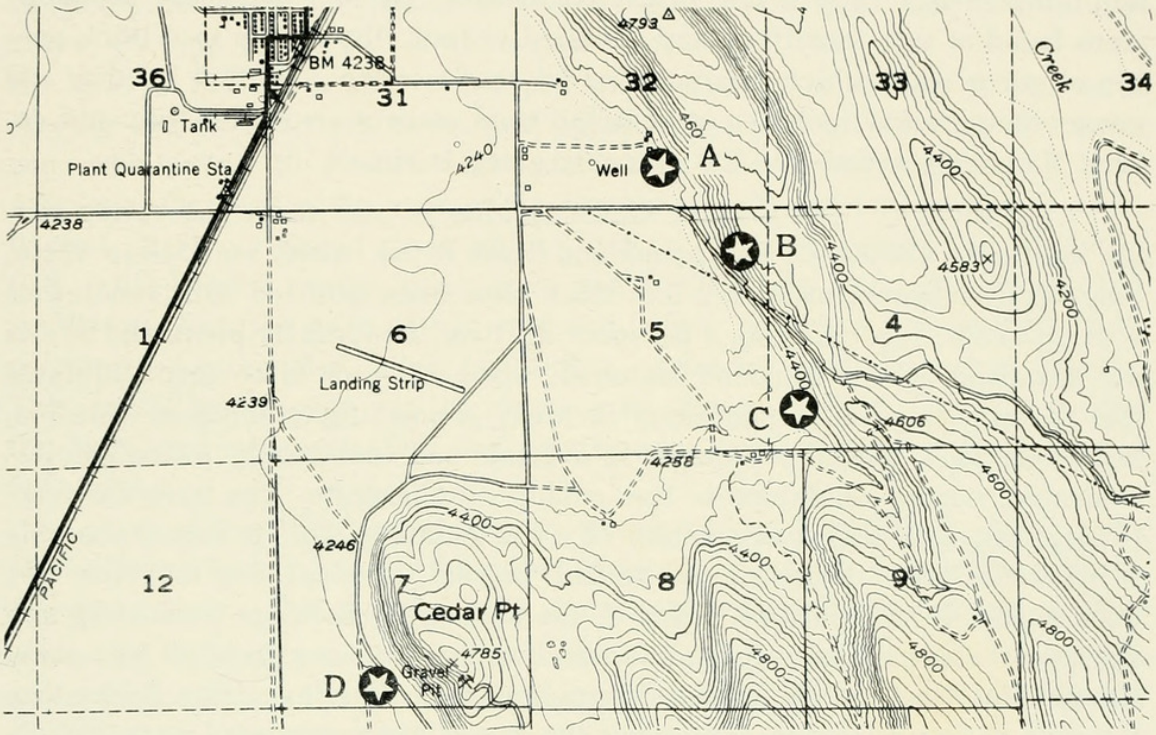

Figure 1. Reproduction of a portion of U. S. Geological Survey Topographic Map, Dorris, California, Quadrangle, edition of 1950. Fossil collecting localities A, B, C and D are shown on portions of Townships 47 and 48 N., Ranges 1 E. & 1 W., M.D.B.&M., Siskiyou County.

LOCALITY A. This is on the north side of a paved road which leads eastward from Dorris. Some poorly preserved shells have been exposed in small excavations a short distance south of the farm house of W. H. Moore. Here the shells are intermixed with gravel and coarse water-worn sand consisting in large part of volcanic material. The whole mass is lightly cemented with secondary calcite which has also encrusted the fossils to some extent. Three small excavations have been made here, which expose a total thickness of not over 30 feet. The beds are nearly horizontal with a questionable dip of 2° to 3° to the northwest. Two strata-bearing fossils are exposed and are sep-

arated by a few feet of nonfossiliferous coarse sandstone and volcanic detritus. Only two species were found in these strata, *Parapholyx packardi* and *Hannibalina dorrisensis*, both of which are found with others at Localities C and D.

Locality B. A roadside gravel pit is located here just to the north of the same county road and about one-half mile southeast of Locality A. Locality B is 80 feet or more higher topographically than Locality A and may represent a higher part of the lake-bed section. The intervening distance, however, is completely covered by volcanic detritus from the steep slope of the adjoining hills. Only a few scattered fossils, all of *Parapholyx packardi*, were found at this locality. They occurred in fine silty layers in a thick pebble or gravel zone which was quarried for road material. At this locality and some others nearby, pebbles of obsidian were present among the volcanic debris. No nearby source for this volcanic glass is known.

Locality C. The De Vier Ranch locality is just above the valley margin east of an abandoned farm house and south of the county road. Here white, limy lake sediments about six feet thick have been quarried and tunneled on a small scale, reportedly as a prospect for lime. Beautifully preserved shells are abundant in the exposed material, some of which is so unconsolidated that the only preparation necessary for study is washing on screens. This fossiliferous zone, almost a coquina, is overlain and underlain by a firm calcite-cemented, coarse sandstone or fine pebbly conglomerate. The beds are practically flat, with just a suggestion of a low easterly dip. It was impossible to trace the fossil zones on the surface beyond the localities in which they were exposed. At localities A and C, the underlying beds are masked by soft sandy soil, but their elevation on a bench or terrace some 20 to 40 feet above the general level of the valley floor suggests underlying strata firmer than the soft valley alluvium. Similarly, the immediately overlying beds are obscured by soft sandy soil and recent detrital material. The lacustrine section is so covered by soil and detritus derived from the lava covered steep hills which rise above, that an estimate of their total thickness is difficult. Some nodules of limy material scattered about the quarry consist of well formed tufa similar to that seen in such basins as Pyramid Lake, Nevada, and Salton Sea, California. An attempt was made by us to separate the "coquina"-like, white or cream-colored lime in which the quarrying was done from the overlying sandy beds. It was thought that perhaps they represented two distinct periods of deposition. However, upon concentrating the fossils from each they were found to be the same, species for species except for the rare *Lymnaea*. If the two layers do represent different periods, then the fossils in the sandy beds may have been reworked from the lime. We saw no clear-cut evidence that this was the case.

On the eastern side of the hills, a little over a mile from Locality B, and at a similar elevation, the lake beds again crop out. Here they are gener-

ally composed of soft siltstones, stratified sandstones, diatomaceous ash, and impure diatomite. They are overlain by an olivine basalt, which is in part vesicular and scoriaceous.

LOCALITY D. Cedar Point is a small basaltic cinder cone, two miles south of Dorris. Near the top of the cone, on the southern side, is an open pit from which large quantities of red cinders have been quarried for surfacing roads. Part way up the road to the pit, old lake beds are exposed in the road cuts on the eastern side for a distance of a half mile or more. These are lacustrine sediments composed of light-colored siltstones, ashy sands, and clays, that dip 20° to 30° in an easterly direction. They also outcrop along the road on the south side of the pit, where the dip is southerly, at a much steeper angle. The lake beds were apparently raised at the time the cinder cone was formed. No fossils were found along the road to the cinder pit; however, near the base of the cone on the southwest side and just west of a county road, is an old gravel pit in which there are exposed some 40 to 50 feet of firm, well bedded coarse sandstones and pebble beds which dip 30° to the southwest. Near the base of this sand and pebble zone is a fine-grained, soft, calcareous-impregnated sand containing numerous well preserved fossils. This fossiliferous zone may be as much as four to six feet in thickness but the beds from which most of the fossils were collected are only about one foot thick.

Similar conditions exist here as were noted at localities A and C. The fossiliferous beds could not be followed laterally beyond the confines of the pit excavation. The western edge of the pebbly sandstone is only a little above the valley floor, and the eastern and lowest part of the exposed section is covered with sandy soil. This soil cover extends eastward about 200 yards to the base of the steep detritus slope of basalt from the cone.

CORRELATION. Except for the fossils found in the Pliocene Tulare Lake beds of the San Joaquin Valley, shells found in the Dorris localities are the best preserved freshwater forms which have thus far been found in California. However, the lakes of this period were widely distributed in the western states and an extensive literature has accumulated. Some of this literature is referred to in the paleontological discussion below, but it is felt that more work in the field and laboratory is required before much can be said as to exact correlation of localities.

The nearest basin to Dorris is that of Klamath Falls, described by R. C. Newcomb (1958). He gave a good account of the extensive diatomite and other deposits of that area and named them the Yonna Formation. In this is included the diatomite previously mapped by Moore (1937) which was believed to be middle Pliocene. We think the Dorris fossils are definitely Pliocene, but at this stage of investigation hesitate to make a closer age determination.

Actually,the basin of Lower Klamath Lake lies only about six miles due east of Butte Valley and the two are separated by a range of low hills. They may very well have been connected during the Pliocene. Both Moore's description (1937, pp. 34-51) of the diatomite localities of the Klamath diatomite district and Newcomb's (1958) account of the Yonna Formation of the Klamath River basin indicate lacustrine deposits in these areas similar to those near Dorris. Moore assigned a Pliocene (?) age to the diatomite deposits and Newcomb (p. 46) stated that two collections of freshwater mollusks from a locality near Yonna, Oregon (NW ¼ of NW ¼ Sec. 34, T.37S., R 11¼ E.) were determined by G Dallas Hanna of the California Academy of Sciences in 1952 and Ten-ChenYen of the U. S. Geological Survey in 1958. These determinations indicated a Pliocene age of the beds. This information seems to justify correlating the Dorris deposits with the Yonna Formation, at least for the present.

Most of the Pliocene lake basins of the western states are characterized by extensive deposits of freshwater diatoms, and it may well be that a study of these minute fossils will furnish the basis for final age determination. Localities in the region which contain fossil mollusks are extremely scarce and when found the preservation is often very poor. Nevertheless, at the present time they have furnished the most reliable means available for correlation.

Pleistocene and Recent freshwater mollusks are fairly well known in the western states. The deposits and lakes usually contain such genera as *Lymnaea, Physa, Anodonta,* and *"Planorbis."* Some of the lakes which appear to have had a relatively long geological history contain genera of restricted western distribution, such as *Carinifex, Parapholyx, Lanx,* and *Pyrgulopsis,* and there seems to be sufficient evidence now to warrant the belief that they have lived in the area continuously since the Pliocene. It may well be that such organisms as mollusks were unable to live on a lake bottom of accumulating diatom ooze. This situation exists at present in Upper Klamath Lake, Oregon, at least to some extent. An attempt to dredge Mollusca there several years ago failed to yield results, yet shells were found in abundance close to the shore where waves kept the rocks and bottom relatively clear of diatoms.

Acknowledgments. The Dorris deposits (Locality C) were first brought to our attention by James M. Kirby, geologist, Standard Oil Company of California, who presented the California Academy of Sciences with a small collection of fossils in September, 1930. Another small lot was received October 21, 1940, from F. W. Shook of Klamath Falls, Oregon. Another lot (Locality A) was received by the California Division of Mines in June, 1956, from W. H. Moore of Dorris. We are indebted to these men for their interest and to the following who have aided us in the field and laboratory: Charles W. Chesterman, J. W. Durham, C. W. Jennings, A. G. Smith, and L. G. Hertlein. We also wish to thank Margaret M. Hanna for the drawings shown on plate 1.

COLLECTING STATIONS FROM THE RECORD BOOKS OF THE DEPARTMENT OF GEOLOGY, CALIFORNIA ACADEMY OF SCIENCES

2250. Freshwater fossils from 2½ miles S. 40° E. of Dorris, Siskiyou County, California. Collected by J. M. Kirby, September, 1930.

31287. Freshwater shells and vertebra from Dorris, Siskiyou County, California. Received, October 21, 1940, from F. W. Shook.

34806. Freshwater shells received by California Division of Mines from W. H. Moore, "Flying Zebra Ranch," June, 1956. Sec. 32, T. 48 N., R.1E., MDB&M, 1¼ miles E. of Dorris, Siskiyou County, California.

34807. Freshwater shells from NE.¼, Sec. 5, T.47N., R.1E., MDB&M. 2 miles SE. of Dorris, Siskiyou County, California. Collected by G D. Hanna and G. C. Gester, June, 1956, inside tunnel.

34808. Same locality as 34807 except material came from the slope just outside of tunnel and contained much volcanic sand. Additional material was added to these collecting stations, June, 1958, by the same collectors.

35029. Freshwater shells from 2½ miles E. of Dorris, Siskiyou County, California, from lowest bed exposed in south tunnel, north of paved road. Collected by C. W. Chesterman, J. W. Durham, and C. W. Jennings, March 25, 1958.

35030. Same locality as 35029 except from highest exposed beds.

35096. Freshwater shells from gravel pit just south of Cedar Point, 3 miles SSE. of Dorris, Siskiyou County, California, S. center, Sec. 7, T.47N., R.1E., MDB&M. Collected by G D. and M. M. Hanna and G. C. Gester, June, 1958.

35097. Freshwater shells and obsidian pebbles from gravel pit on N. side paved road, 2½ miles SE. of Dorris, Siskiyou County, California. NE.¼, Sec. 5, T.47N., R.1E., MDB&M. Collected by G. D. Hanna and G. C.Gester, June, 1958.

36173. Same locality as 35096. Collected by G. C. Gester, C. W. Chesterman, A. G. Smith, and G D. Hanna, September, 1958.

Referring to figure 1, lettered localities are equivalent to the following numbers:

A	B	C	D
34806	35097	2250	35096
		31287	36173
		34807	
		34808	
		35029	
		35030	

Descriptions of Fossils

Pisidium sp.

(Plate 2, figures 1-4.)

This species was found to be more abundant in the volcanic sand outside of the tunnels than inside (CAS Localities 35807, 34808). Variation in shape is considerable; young individuals tend to be more circular than older ones which are somewhat extended posteriorly. The gross dental pattern of the hinge is characteristic of most species of the genus. In the right valve the two cardinals are of about equal height with the posterior being somewhat bluntly conical; the anterior is narrower and curves slightly upward and around the posterior; the two laterals are of about equal size. In the left valve the two cardinals are united above by a narrow plate in most adults; sometimes, especially in young shells, the connection is very weakly developed; the two anterior laterals are narrow and blade shaped; the two posterior more rounded. In some right valves there is a slight rise of the hinge ridge just anterior to the one mentioned; this gives the impression, when best developed, of a third cardinal; it is often absent.

Externally some shells are very smooth with faint growth lines only; in others the umbones are marked by heavy concentric ridges and grooves; in extreme cases these cover most of the shell.

These notes may indicate the extreme variation present in a series of shells which could hardly be reasoned to represent more than one species. They illustrate the situation in this greatly over-named genus. In some hands each specimen could well be called by a separate name, a procedure which cannot serve a useful purpose from a geologist's standpoint. There are now so many names from which to choose that any one assigned to any lot is little if any better than guesswork. Since no meaningful name can be applied to members of the genus at present under current rules of nomenclature, it seems best to record fossil species merely as *Pisidium* sp. and give by illustration and (or) description such characters as appear to be pertinent.

Little is known of the effect of environment on members of this genus. It is well known that they have great ability to move from one body of water to another because they are often found soon after reservoirs are established and even appear in temporary pools. Birds have been suspected to be one transport agency.

Since the above was prepared, an important revision of this group of living species has been published by Herrington (1962). In this 128 named species have been reduced to 34. Fossil forms in general are not treated. Rather than attempt to make a specific identification of the Dorris shells at this time it seems best to leave them under the designation given above.

Parapholyx packardi Hanna.

(Plate 1, figures 9-12, 15, 16.)

Parapholyx packardi HANNA, Univ. Ore. Publ., vol. 1, no. 12, August, 1922, p. 6, pl. 2, figs. 1-5. Type locality: "Warner Lake beds, eastern Oregon, Pliocene."

Parapholyx packardi corrugata F. C. BAKER, Nautilus, vol. 55, no. 4, 1942, p. 132, pl. 8, fig. 19. Type locality: "North end Summer Lake, Lake County, Oregon, from drilled well at a depth of 1080 feet. Thought to be of Pliocene age."

The most constant distinguishing character of this species is the presence of a blunt tooth or ridge on the columella; otherwise it is extraordinarily variable. The shell may be smooth (except for growth lines), lightly ribbed, partly ribbed, or heavily ribbed. It may be imperforate or narrowly umbilicate. The spire may be flattened or elevated. The shell is much thicker and heavier than Recent species and also larger than usual. Hypotypes from CAS Locality 34807 from 2½ miles southeast of Dorris, Siskiyou County, California. Collected by the authors. Pliocene.

The species is very abundant at Locality 34807 and also at Localities 34806, 35096, and 36173. Ribbed and smooth shells are about equally common. According to some standards, at least, a dozen species could be named from the present lots, but this procedure would serve no useful purpose in geology.

At locality 36173 this is an exceedingly abundant shell and the range of variation is even greater than noted at 34807. In some individuals the spire is flattened as in some forms of *Carinifex*, and there is a well developed carina around the body whorl. If it were not for the presence of a good series showing stages of intergradation into the more normal form, this carinate shell would certainly be thought to be a distinct species or even genus. The blunt tooth or ridge on the columella, however, is even here well developed.

F. C. Baker described the subspecies "*corrugata*" from a well in southern Oregon. From the description and figures, it is evident that the supposed differences can be duplicated in the Dorris collection.

Carinifex newberryi (Lea).

(Plate 1, figures 6-8.)

Planorbis newberryi LEA, Proc. Acad. Nat. Sci. Philadelphia, vol. 10, 1858, p. 41. "Klamath Lake and Canoe Creek, California." LEA, Proc. Acad. Nat. Sci. Philadelphia, vol. 16, Jan. [April] 1864, p. 5. [Description amplified and *Megasystropha* provisionally proposed as a genus for the species.] LEA, Journ. Acad. Nat. Sci. Philadelphia, n.s. vol. 6, 1866, [Sept. 1867], p. 153, pl. 23, fig. 68.

Carinifex newberryi (Lea), BINNEY, Smithsonian Inst., Syn. of air-breathing mollusks of North America, [Misc. Checklist], Dec. 9, 1863, p. 11. [Listed in classification adjacent to and in the same family with *Planorbis*.]

Plate 1

Figure 1. *Lanx kirbyi* Hanna and Gester, new species. Paratype no. 12451 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality 34807 (CAS), 2½ miles southeast of Dorris, Siskiyou County, California. Length 20.5 mm.; width 18 mm.; height 12.3 mm.

Figure 2. *Lanx kirbyi* Hanna and Gester, new species. Paratype no. 12452 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality as in figure 1. Length 20.5 mm.; width 17.9 mm.; height 11.3 mm.

Figures 3, 4. *Lanx kirbyi* Hanna and Gester, new species. Holotype no. 12453 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Length 21 mm.; width, 16.5 mm.; height 11.1 mm.

Figure 5. *Lanx kirbyi* Hanna and Gester, new species. Paratype no. 12454 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Length 16.3 width 15.3 mm.; height 7.2 mm.

Figures 6, 7, 8. *Carinifex newberryi* (Lea). Hypotype no. 12455 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 20.7 mm.; height 13.3 mm.

Figure 9. *Parapholyx packardi* Hanna. Hypotype no. 12456 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 11.4 mm.; height 9.9 mm.

Figure 10. *Parapholyx packardi* Hanna. Hypotype no. 12457 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 10.5 mm.; height 11.4 mm.

Figure 11. *Parapholyx packardi* Hanna. Hypotype no. 12458 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 11.3 mm.; height 10.8 mm.

Figure 12. *Parapholyx packardi* Hanna. Hypotype no. 12459 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 10.7 mm.; height 7.4 mm.

Figure 13. *Lymnaea palustris* (Müller). Hypotype no. 12461 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 9.8 mm.; height 16.0 mm.

Figure 14. *Hannibalina dorrisensis* Hanna and Gester, new species. Holotype no. 12462 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Length 5 mm.; width 4.5 mm.; height 2.5 mm.

Figure 15. *Parapholyx packardi* Hanna. Hypotype no. 12460 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 12.6 mm.; height 10.5 mm.

Figure 16. *Parapholyx packardi* Hanna. Same specimen as figure 11.


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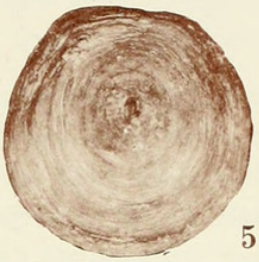
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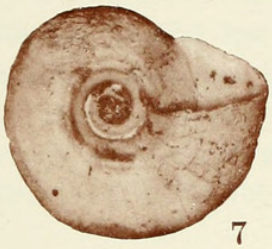
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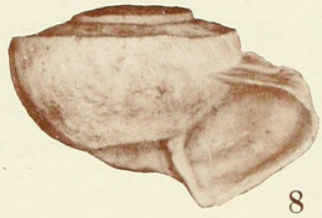
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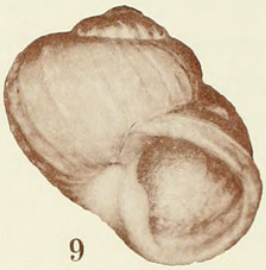
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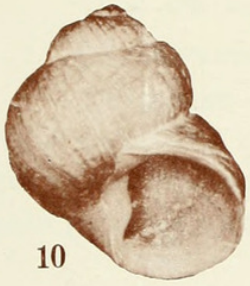
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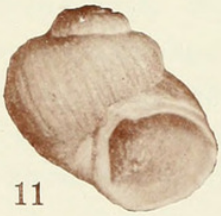
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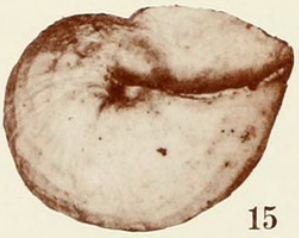
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This abundant species has the largest of the shells found in the Dorris deposits. The lots collected have been compared with many series from other places, living and fossil, and we feel obliged to refer this form to *C. newberryi*, the first species to be described. The original location was given as "Klamath Lake and Canoe Creek, California." The latter is now known as Hat Creek and from all information which can be gleaned from the narrative part of the Pacific Railroad Reports, it seems reasonably certain that the place of collection is now known as "Rising River" because of the large springs serving as a source. Shells from there correspond closely with figures of Lea and Binney. The height of the spire varies from almost flat to elevated and the carinae on the shoulder and the base range from strong to almost rounded. The same range of variations found in the Dorris fossils.

The shells found in Upper Klamath Lake, Oregon, are generally called *C. ponsonbyi* Smith. Possibly Newberry collected there also and if the shells which finally reached Lea came from there they were undoubtedly juveniles. The young of *C. ponsonbyi* are difficult to distinguish from *C. newberryi*, but the adults are much larger with an aperture expanded outwardly. Since there was also a Lower Klamath Lake in California when Newberry was on his trip with the Pacific Railroad Survey, it is possible he may have collected there. This lake has now been drained in large part. In view of the uncertainty of this record, Rising River, near Cassel, Shasta County, California, might be chosen as a lectotype locality. The narrative of the overland expedition accompanied by Newberry was written by Abbot, 1857 (see pp. 59-61).

Hannibalina Hanna and Gester, new genus.

TYPE SPECIES. *H. dorrisensis*, monotypic.

DESCRIPTION. Same as for the species.

The genus is named in honor of Mr. Harold Hannibal, who, for many years prior to a serious illness, was an indefatigable worker with western freshwater mollusks. We knew him in his prime and his energy and sincerity were most commendable.

Hannibalina dorrisensis Hanna and Gester, new species.

(Plate 1, figure 14; plate 2, figures 7-9.)

Shell crepiduliform, nearly circular, about two whorls, sinistral; body whorl evenly rounded and smooth except for fine growth lines; apex smooth and light brown as preserved. Aperture with a smooth deck interrupted on the left side by the convexity of the second whorl. Length 5 mm.; width 4.5 mm.; height 2.5 mm.; measured with aperture lying flat on scale.

HOLOTYPE no. 12462, paratypes nos. 12463, 12464 (California Academy of Sciences, Department of Geology Type Collection) from CAS Locality 34807, 2½ miles southeast of Dorris, Siskiyou County, California, G. C. Gester and G D. Hanna, collectors. Pliocene.

This remarkable shell is very common in the Dorris deposit. The shape naturally recalls *Payettia* but on close examination they differ greatly. Other than the fact that the two differ in direction of coiling, the shell structure of *Hannibalina* is even, with no indication of the rugosity which is so prominent in *Payettia*. Relationships of such shells must remain somewhat conjectural until more information becomes available. *Payettia* is usually associated with the Ancylidae although Dall inadvertently placed it with Planorbidae (see Henderson, 1935, p. 267). For the present, *Hannibalina* would seem best to remain in Ancylidae.

Lymnaea palustris (Müller).

(Plate 1, figure 13.)

Buccinum palustre MÜLLER, Verm. Terr., vol. 2, 1774, p. 131.

Galba palustris (Müller) F. C. BAKER, Lymnaeidae of North America, Chicago Acad. Sci. Sp. Publ., no. 3, 1911, pp. 298-322, pls. 26, figs. 17-37; pl. 33, figs. 1-25; pl. 34, fig. 20.

A single well preserved specimen of this species was found at locality 34808, 2½ miles southeast of Dorris, Siskiyou County, California, just outside of the tunnel.

Lymnaea palustris is a very widely distributed species in North America and Europe and is subject to great variation in different environments. Baker gave over five pages of references to the literature in his monograph. Since the species has not been recorded from strata older than Pleistocene age, it was thought that its presence outside of the calcareous material in which the tunnel (Loc. 34807) was dug might indicate two ages of deposition at this exposure. This may in fact be the case and the shells obtained outside of the tunnel (Loc. 34808) in the volcanic sand may be partly reworked. However, it would be unsafe to reach this decision on the basis of a single specimen of a species as highly variable as *L. palustris*.

Lanx kirbyi Hanna and Gester, new species.

(Plate 1, figure 1-5.)

Shell broadly ovate, apex high, nearly central; growth lines evident, but little indication of undulations; marginal surface nearly flat. Length, 21 mm.; width, 16.5 mm.; height, 11.1 mm.

HOLOTYPE no. 12453, paratypes nos. 12451, 12452, 12454 (California Academy of Sciences, Department of Geology) from CAS Locality 34807, from 2½ miles southeast of Dorris, Siskiyou County, California.

The species is named for Mr. James M. Kirby who first brought this deposit to our attention.

Three fossil species of *Lanx* have been described in addition to the present one. The first was *L. undulatus* (Meek, 1870, p. 57; 1877, p. 186, pl. 57; 1877, p. 186, pl. 17, figs. 12, a, b), from Kawsow Mountains, Nevada, now known as Hot Springs Mountains (see Henderson, 1935, p. 49, for information on this locality); *L. moribundus* Hanna (1922, p. [9], pl. 1, figs. 8, 9. "Warner Lake beds, eastern Oregon, Pliocene."); and *L. nevadensis* MacNeil (1939, p. 360, pl. 37, figs. 16, 17. Eureka, Nevada, Cretaceous). The first two have rough sculpture but are about the same size as *L. kirbyi*. The last is smaller and nearly circular in form.

The shells are common in the Dorris deposit, especially immature forms. The shape is somewhat variable. One of our specimens, (Paratype no. 12454, plate 1, figure 5) is nearly circular and is a thicker shell. It may represent a different species, but until more material becomes available it would seem best to consider it an individual variant.

Hydrobia margaretana Hanna and Gester, new species.

(Plate 2, figure 10)

Shell small, turbonate with three whorls; apex smooth, remainder heavily ribbed parallel to growth lines; 13 ribs on last whorl; aperture nearly circular; slightly umbilicate. Height, 1.6 mm.; diameter, 1.3 mm.

HOLOTYPE no. 12472, paratypes nos. 12473-12476 (California Academy of Sciences, Department of Geology Type Collection) from CAS Locality 34807, 2½ miles southeast of Dorris, Siskiyou County, California.

Several hundred specimens of this minute species were picked out of the material collected. Variation is slight, usually indicated by less distinct ribbing which may be due to abrasion.

The systematic position of the species is difficult to determine, chiefly because of the uncertainty regarding the generic taxonomy of the minute freshwater gastropods. Therefore, we have followed Henderson (1935, pp. 194-199) in the use of *Hydrobia* for many of the fossil forms. Among those noted in the literature, however, there seems to be no heavily ribbed species such as the present one.

The species is named for Margaret M. Hanna who made the drawings to illustrate the present paper.

Plate 2

Figure 1. *Pisidium* sp. Hypotype no. 12465 (Calif. Acad. Sci. Dept. Geol. Type Coll.), from locality 34807 (CAS), 2½ miles southeast of Dorris, Siskiyou County, California. Length 3.5 mm.; height 2.9 mm.

Figure 2. *Pisidium* sp. Hypotype no. 12466 (Calif. Acad. Sci. Dept. Geol. Type Coll.), locality data as in figure 1. Length 3.4 mm.; height 3.0 mm.

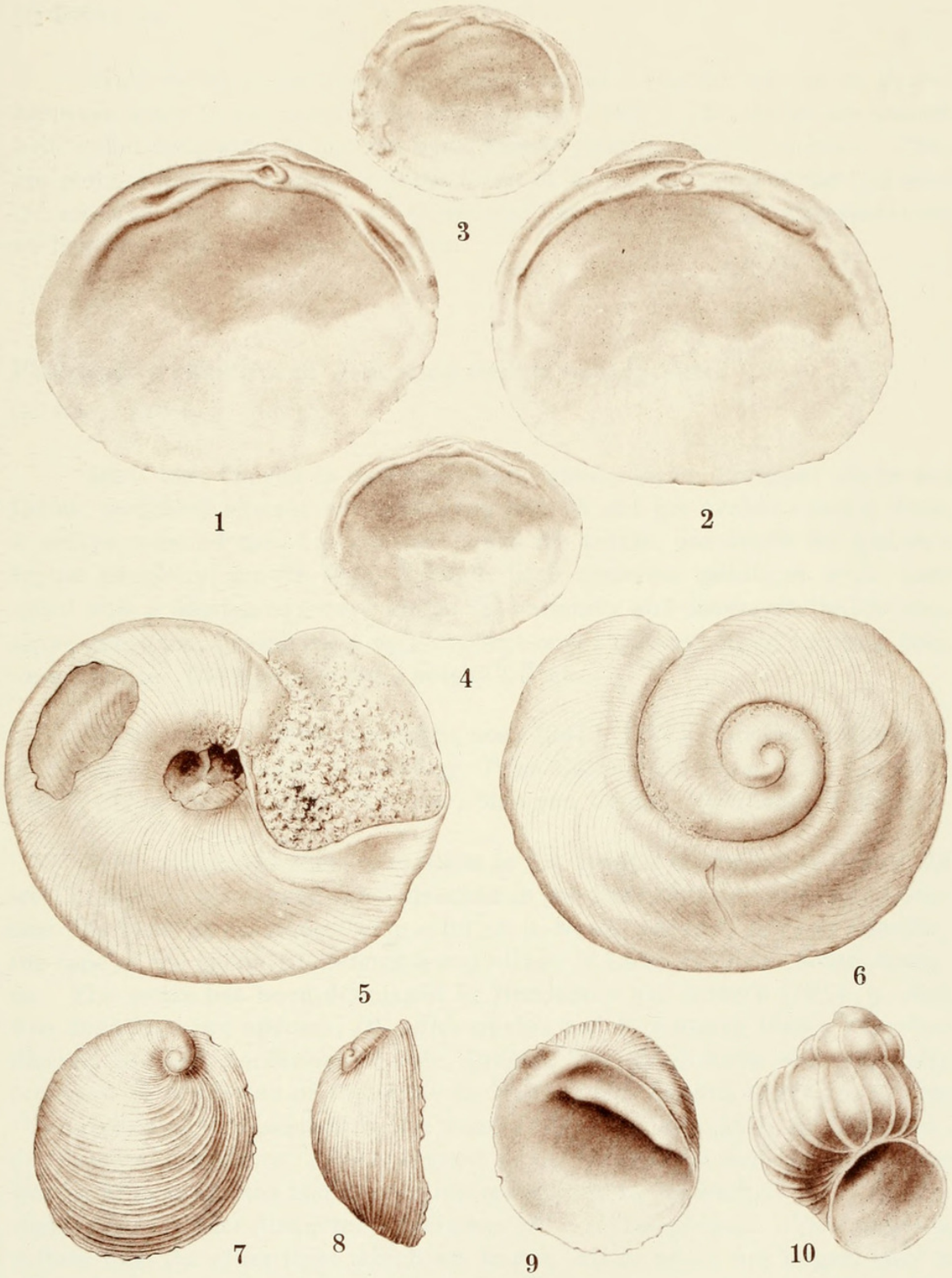
Figure 3. *Pisidium* sp. Hypotype no. 12467 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Length 2.0 mm.; height 1.7 mm.

Figure 4. *Pisidium* sp. Hypotype no. 12468 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Length 2.3 mm.; height 1.8 mm.

Figures 5, 6. *Platytaphius chestermani* Hanna and Gester, new species. Holotype no. 12469 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 2.8 mm.; height 1.0 mm.

Figures 7, 8, 9. *Hannibalina dorrisensis* Hanna and Gester, new species. Holotype no. 12462 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Length 5 mm.; width 4.5 mm.; height 2.5 mm.

Figure 10. *Hydrobia margaretana* Hanna and Gester, new species. Holotype no. 12472 (Calif. Acad. Sci. Dept. Geol. Type Coll.) locality data as in figure 1. Diameter 1.3 mm.; height 1.6 mm.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Hydrobia sp.

Eight rather poorly preserved specimens of a slender species of *Hydrobia* were found in the screenings from locality 34807. The shells are smooth with rather deep sutures and are more slender than *H. imitator* Pilsbry. They are perhaps closer to small, smooth forms of *H. protea* Gould of the Colorado Desert, California, than any other western form, but under the circumstances we hesitate to assign a name to them.

Platytaphius chestermani Hanna and Gester, new species.
(Plate 2, figures 5 and 6.)

Shell low, convex in apertural view, whorls three, flattened above and below; periphery sharply carinate; apex smooth and not sunken; suture deep; a well pronounced spiral groove just below the suture, one-fourth the distance to the periphery; growth lines distinct; base concave; umbilicus wide; body whorl with a depressed groove inside the periphery and one-fourth the distance to the umbilicus; growth lines very distinct on the concave base; aperture thin, very oblique. Diameter 2.8 mm.; height 1.0 mm.

HOLOTYPE no. 12469, paratypes nos. 12470, 12471 (California Academy of Sciences, Department of Geology Type Collection) from CAS Locality 34807, 2½ miles southeast of Dorris, Siskiyou County, California. Pliocene.

This remarkable shell is common in the deposit southeast of Dorris; 24 well preserved specimens were obtained in the finer siftings from our collection. We know of no close living relative in North America, but one species, the type of the genus *(P. heteropleurus)* lives in Lake Titicaca, South America. The genus has been discussed by Henderson and Rodeck (1934, p. 268) who described two species, *(P. malheurensis* and *P. milleri)*, from a Pliocene deposit 16 miles southwest of Vale, Oregon. The genus name was originally proposed as a section of *Planorbis* by Pilsbry and Vanatta (1924, p. 51) for *"heteropleurus,"* described by the same authors earlier, (1896, p. 562); Baker, Frank C., (1945, p. 120) concurred in the conclusion that the group was worthy of generic rank and it was thus recognized by Hubendick (1955, p. 502, figs. 128-141) who dissected specimens of *P. heteropleurus.* This species differs from the other three which are known, all of which are larger, have a sunken apex and a more rounded body whorl toward the marginal carina.

The species is named for Charles W. Chesterman of the California Division of Mines and Geology for much assistance to us on many field trips.

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