

and whitish in the male. Face, pronotum and tegmina marked with white ( $\delta$ ) or dirty yellowish white ( $\varphi$ ). Head with three fuscous and three lighter bands, the inner face of mandibles and tibiae and tarsi reddish on inner edges, gray on outer side.

Length,  $\varphi$ , 39mm.; of antennae,  $\delta$ , 6.5mm.;  $\varphi$  8mm.; of vertex, pronotum,  $\delta$ , 8mm.,  $\varphi$ , 12.30mm.; of tegmina,  $\delta$ , 8.5mm.,  $\varphi$ , 10.75mm.,  $\varphi$ , 15.2mm.

Collected by Bailey, April, and Argus Mountains, May, 1891.

Other specimens of the genus *Dracotettix* have been taken in Arizona, at Fort Huachuca, and at Gilroy, Calif. Among the material thus gathered several species are represented.

Stearns

REPORT ON THE LAND AND FRESH-WATER SHELLS COLLECTED IN CALIFORNIA AND NEVADA BY THE DEATH VALLEY EXPEDITION, INCLUDING A FEW ADDITIONAL SPECIES OBTAINED BY DR. C. HART MERRIAM AND ASSISTANTS IN PARTS OF THE SOUTHWESTERN UNITED STATES.

By ROBT. E. C. STEARNS, Ph. D.,  
Adjunct Curator of the Department of Mollusks, U. S. National Museum.

The present report treats of the land and fresh-water shells collected in 1891 by the several subdivisions of the Death Valley Expedition, in Southern California and Nevada, between latitude 34° and latitude 35° N. The routes followed by several of these parties led them into regions previously unexplored by naturalists, and specimens were secured from numerous thermal and mineral springs in the arid deserts of the southern part of the Great Basin, within the Colorado drainage area. The most interesting forms obtained were the two species heretofore referred to *Tryonia*, until recently regarded as obsolescent or absolutely extinct, but which were found to be living, as elsewhere remarked. *Helix magdalenensis*, another interesting species described from examples collected in the Mexican State of Sonora in 1889-'90 by Mr. Bailey, of Dr. Merriam's Division of Biological Exploration, was detected by Fisher and Nelson several degrees of latitude farther to the north than the habitat of Bailey's original examples and at a very much higher altitude. This latter, by its presence at this northerly station, contributes to our previous knowledge and data bearing upon the relations between the geographical distribution of species and environmental conditions or influences; and two fresh water forms, not before known, were added to the molluscan fauna of the region traversed by the expedition.

In addition to the desert material, small collections were made in the High Sierra and other parts of California, and a few species are included from Arizona, New Mexico, and Texas, collected by Dr. C. Hart Merriam and assistants, while engaged in biological surveys of these regions under the Department of Agriculture. This latter material is important, as illustrating the geographical distribution of the species concerned.

## LIST OF SHELLS.

<i>Glandina decussata.</i>	<i>Limnaea nuttalliana.</i>
<i>singleyana.</i>	<i>humilis.</i>
<i>texasiana.</i>	<i>bulimoides.</i>
<i>Streptostyla sololensis.</i>	<i>Planorbis lentus.</i>
<i>Limax campestris.</i>	<i>liebmanni.</i>
<i>Patula striatella.</i>	<i>parrus.</i>
<i>Helix (Arianta) magdalencensis.</i>	<i>trivoleis.</i>
<i>coloradoensis.</i>	<i>Physa gyrina.</i>
<i>mormonum.</i>	<i>heterostropha.</i>
<i>tudiculata.</i>	<i>Carinifer newberryi.</i>
<i>cypreophila.</i>	<i>Amnicola micrococcus, sp. nov.</i>
<i>arrosa.</i>	<i>porata.</i>
( <i>Praticola</i> ) <i>griseola.</i>	<i>Tryonia clathrata.</i>
<i>berlandieriana.</i>	<i>Fluminicola fusca.</i>
( <i>Mesodon</i> ) <i>thyroides.</i>	<i>merriami.</i>
( <i>Polygyra</i> ) <i>texasiana.</i>	<i>fusca minor.</i>
<i>bicruris.</i>	<i>nuttalliana.</i>
<i>Pupa (Vertigo) pentodon.</i>	<i>Helicina chrusocheila.</i>
<i>Bulinulus dealbatus.</i>	<i>tropica.</i>
<i>alternatus.</i>	<i>Anodonta nuttalliana.</i>
<i>serpenterus.</i>	<i>Unio anodontoides.</i>
<i>Succinea luteola.</i>	<i>berlandieri.</i>
<i>oregonensis.</i>	<i>Pisidium occidentale.</i>
<i>Limnaea caperata.</i>	

## Class GASTROPODA.

## Order PULMONATA.

## Suborder GEOPHILA.

*Glandina decussata* Pfr.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123571), William Lloyd, March, 1891.

These examples, three in number, are not decussated, but are sculptured *only* by the longitudinal incremental lines; they have the usual glossy or semipolished surface characteristic of the group. These specimens are rather between the variety *singleyana* and the typical *decussata*, and indicate what is exhibited in other related forms, conspicuously in the shells of *G. truncata* of Florida, a considerable range of variation.

*Glandina singleyana* W. G. B.

? = *G. decussata* Pfr., variety.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123572); also Monterey, Mexico (Mus. No. 123906), Feb., 1891, William Lloyd.

Two examples very close to *G. texasiana*, the principal difference being the curve and form of the termination of the columella. This seems to be the form that Mr. Binney refers to as collected by Prof. Wetliery in Bexar County, Tex., which he figures and calls *decussata* var. *singleyana* in Bull. Mus. Comp. Zool., Vol. xxii, No. 4, Pl. 1, Fig. 4, pp. 163-203.

F SHELLS.

- Limnaea nuttalliana*.
- humilis*.
- bulimoides*.
- Planorbis lentus*.
- liebmanni*.
- parrus*.
- trivoltis*.
- Physa gyrina*.
- heterostropha*.
- Carinifer acceberryi*.
- Ammicola microcoelus*, sp. nov.
- ovata*.
- Trygonia clathrata*.
- Fluminicola fusca*.
- merriami*.
- fusca minor*.
- nuttalliana*.
- Helicina chrysocheila*.
- tropica*.
- Anodonta nuttalliana*.
- Unio anodontoides*.
- berlandieri*.
- Pisidium occidentale*.

TROPODA.

MONATA.

TEOPHILA.

123571), William Lloyd, March, 1891. They are not decussated, but are sculptured with spiral and concentric lines; they have the usual characteristics of the group. These species, like *singleyana* and the typical *decussata* described in other related forms, conspicuous in Florida, a considerable range of

123572); also Monterey, Mexico (Mus. No. 123571). *texasiana*, the principal difference in the determination of the columella. They refer to as collected by Fisher which he figures and calls *decussata* in Zool., Vol. XXII, No. 4, Pl. I, Fig.

*Giardina texasiana* Pfr. Brownsville, Tex. (Mus. No. 123573), William Lloyd.

Two specimens. An ample series of the above, and the west Mexican *G. albersi* of the same author, might result in the reduction of the first to a synonymous position.

*Streptostyla sololensis* C. & F. Solola, Tamaulipas, Mexico (Mus. No. 123574), William Lloyd, March 30, 1891.

"In the Sierra." Though both examples are dead, and one broken, they are sufficient to validate the above determination. The species was described by Crosse and Fisher from Sololo (Guatemala) specimens.

*Limax campestris* Binney. South Fork of Kern River, California (Mus. No. 123575), Vernon Bailey, July 8, 1891.

At an elevation of 2,700 feet; a single example. This may be Ingersoll's *L. montanus* or a variety thereof, which he obtained in Colorado. Ingersoll's *montanus* and *montanus* var. *castaneus*, Binney's *ingersolli* and Heynemann's *wienlandi* may be regarded, or at least strongly suspected, of close relationship to Binney's *campestris*, which latter may perhaps include Cooper's *L. var. occidentalis*.

*Patula striatella* Anth. Kern River region, California (Mus. No. 123577), Vernon Bailey.

Numerous living examples at an altitude of 2,700 feet.

*Helix (Arionta) magdalenensis* Stearns. Johnson Cañon, Panamint Mountains, California (Mus. No. 123578), April 11, 1891, Dr. A. K. Fisher; also additional specimens in the same region (Mus. No. 123579), April 18, 1891, Dr. Fisher and E. W. Nelson.

The foregoing species was described by me in the Proc. U. S. National Museum, Vol. XIII, pp. 207-208, from a few examples collected at or near the town of Magdalena, State of Sonora, Mexico, November 6, 1889, by Mr. Vernon Bailey. He detected it on a hill or mountain at an elevation of about 1,000 feet above the town. The latitude of Magdalena is about 31° N. The investigations of the Death Valley Expedition have carried it far to the north of the above, to the Panamint region of California, where both Dr. Fisher and Mr. Nelson obtained numerous living individuals. This discovery extends the area of the distribution of *H. magdalenensis* northerly between six and seven degrees of latitude. The place where these specimens were found in Johnson Cañon has an elevation of about 6,000 feet above the sea; the first lot (Mus. No. 123578) were mostly bleached shells. The Fisher-Nelson series (Mus. No. 123579) subsequently collected, is from a still higher elevation, over 8,000 feet; here twenty-five living examples were obtained, most of them mature. The Mexican locality may ultimately prove to be about the southerly limit of its distribution.

*Helix (Arionta) coloradoensis* Stearns. Mustang Springs, California (Mus. No. 123907), Vernon Bailey, February 12, 1891.

A single example, either alive when collected or quite fresh, was detected by Mr. Bailey, who found it among rocks on a dry hill 900

*Bulimulus serperastrus* Say.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123595), William Lloyd.

Three good examples of this pretty species, the largest 25<sup>mm</sup> long. Like other species of the group, it varies considerably. Some individuals are much slenderer than others; hence, quite likely, the following synonyms from Binney's Land and Fresh Water Shells of North America (Part I, fig. 335, p. 192):

*Bulimus liebmanni* Pfr.

*Bulimus ziehmanni* Rve

*Bulimus nitelinus* Rve.

I agree with Binney; he is no doubt correct in the above inclusion. Perhaps the *californicus* of Reeve, Conch. Icon., 378, is a geographical aspect of *serperastrus*.

*Succinea luteola* Gould.

Hidalgo, Mexico (Mus. No. 123596), William Lloyd.

Three examples of fresh specimens.

*Succinea oregonensis* Lea.

Keru River, California (Mus. No. 123597), Vernon Bailey.

The four living examples were detected by Mr. Bailey at an elevation of 2,700 feet.

Suborder *HYGROPHILA*.*Limnæa caperata* Say.

Ash Meadows, Nevada (Mus. No. 123598), Dr. A. K. Fisher.

Numerous specimens, all dead and bleached. Some of these are moderately angulated on the upper part of the basal whorl following the suture; others strongly malleated; all of them are rather solid, and the surface in many instances nearly smooth; in some examples the incremental lines are sharply defined; in one the basal whorl is quite shouldered above and malleated below, with hints of interrupted threadlike keels (lire), on the same whorl near the columella. Cooper (Geog. Cat. No. 348) credits this species to 'S. F. to Oregon; Eastern States.' Hemphill includes it (No. 91) in his little catalogue of the land and fresh water shells of Utah. Call credits it living to 'Warm Springs Lake' in the Bonneville Basin, Bull. U. S. Geol. Survey, No. 11, 1884. My remarks relating to *Limnæa palustris* in Proc. U. S. National Museum, Vol. XIV, 1891, are also applicable to the foregoing species.

*Limnæa nuttalliana* Lea.

= *L. palustris* Mull., var.

Panamint Valley, California (Mus. No. 123599), Dr. C. Hart Merriam.

Several examples with an unusually acute drawn-out spire; the largest a nearly typical *nuttalliana*; nevertheless, this, like many other so-called species of *Limnæa*, is but a local expression or variety of the world-wide *palustris*.

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 o (Mus. No. 123595), William Lloyd.  
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 e group, it varies considerably. Some individ  
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 3, p. 192):

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*va*, is but a local expression or variety of the

Attention is called to my remarks under *Limnaea lepida* of the pre-  
 vious year's collection (1890), in Proc. U. S. National Museum, Vol.  
 IV, 1891.

*Limnaea humilis* Say.

Elton, Utah Territory (Mus. No. 123600), Vernon Bailey, November 7, 1891.

One specimen in the "dry clay wash, about 100 feet above the level  
 of the lake."

*Limnaea bulimoides* Lea.

Mohave River, near Daggett, Mohave Desert, San Bernardino County, Calif. (Mus.  
 No. 123910), Dr. C. Hart Merriam, March 31, 1891.

Six examples of this rather rare form, all dead and bleached.  
 Described by the late Dr. Lea, in 1841, from examples collected by  
 Nuttall in Oregon. Since found at many places in the Pacific States  
 and in the Yellowstone region by Hayden's Survey.

*Planorbis lentus* Say.

Meadows, Nevada (Mus. No. 123601), F. Stephens, March 2, 1891. Same region  
 (Mus. No. 123602), Dr. A. K. Fisher, March 15, 1891. Panamint Valley,  
 California (Mus. No. 123603), Dr. C. Hart Merriam. Brownsville, Tex. (Mus.  
 No. 123604), William Lloyd.

Only a few examples of the above are mature or full grown; these,  
 though of rather rude growth compared with specimens from more  
 southerly and less arid regions, are much closer to what Say describes  
*lentus* than to his *trivolvis*.

*Planorbis liebmanni* Dkr.

Saltillo, Tamaulipas, Mexico (Mus. No. 123606), William Lloyd, March, 1891.

Numerous examples of this easily recognizable species.

*Planorbis parvus* Say.

Mohave River near Daggett, Mohave Desert, San Bernardino County, Calif. (Mus.  
 No. 123911), Dr. C. Hart Merriam, March 31, 1891.

Three examples, bleached.

*Planorbis trivolvis* Say.

Fresno, Calif. (Mus. No. 123605), Vernon Bailey, September 22, 1891. Keeler, Calif.  
 (Mus. No. 123615), T. S. Palmer, June 1, 1891. Daggett, Calif. (Mus. No.  
 123912), Dr. C. Hart Merriam, March 31, 1891.

Mr. Bailey's Fresno shells were collected by him in an irrigation  
 ditch. The specimens, of which there are several, were found living.  
 Some of them are adult, being most of them but half grown; at this  
 stage they might be labeled *P. tumens* Cpr. Palmer's Inyo County  
 examples are dead shells, none adult, being about the same age as  
 Bailey's. All of the above are simply young *trivolvis*. Dr. Merriam's  
 locality is in the Mohave Desert, near the river of the same name,  
 in San Bernardino County. Some of the examples are nearly typical  
*trivolvis*, others exhibit the *corpulentus* aspect. In both the growth  
 lines are quite conspicuous. The latter are listed herein as *P. trivolvis*  
 var. (Mus. No. 123913.)

*Physa gyrina* Say.

Hot Springs, Panamint Valley, California (Mus. No. 123607), April 22, 1891; Pahranagat Valley, Nevada (Mus. No. 123608), May 25, 1891; Daguerre Point, California, March 31, 1891 (Mus. No. 123914), Dr. C. Hart Merriam. Garlick Springs, San Bernardino County, Cal. (Mus. No. 123916); Keeler, Inyo County, Calif. (Mus. No. 123610); June 1, 1891; Gorman Station, 8 miles south of Fort Tejon, Cal., July 2, 1891 (Mus. No. 123612); T. S. Palmer. Kern River, California (Mus. No. 123613), and Fairfield, Utah (Mus. No. 123614), June 25, 1890, Vernon Bailey. Hidalgo, Tamaulipas, Mexico (Mus. No. 123614); Monterey, Mexico (Mus. No. 123915), William Lloyd.

Dr. Merriam's Hot Springs examples of the above are fine large dark-colored shells; they vary considerably in elevation of spire. In the shorter spired individuals there is a tendency to tabulation or flattening of the upper part of the body whorl, following the suture, suggesting the shouldered aspect of *Physa humerosa*, a common form on the surface of the Colorado Desert. His Pahranagat Valley lot are paler and more elongated, with a higher and more acute spire, suggestive of *P. hypnorum*.

Palmer's Garlick Springs shells are nearer the typical form; taken as a whole, in size, color, and general facies; some of them hint of Tryon's species *diaphana*, a local varietal aspect of *gyrina*, found in the neighborhood of San Francisco Bay. His Keeler examples, from the shores of Owens Lake, are few in number; two of these are over rather than of the usual size, and two are hardly adult; all are characteristic forms considered. The Gorman Station lot, of which there is a large number, also collected by Palmer, at a point 8 miles south of Fort Tejon, are exceedingly uniform in size, color, and proportions; they are all adults, of medium size, rather slenderer on the whole than the typical form, but not as slender as Merriam's Pahranagat examples. Bailey's five specimens from the South Fork of Kern River, at an elevation of 2,700 feet, are apparently adults of a dwarfed form, less than half the size of average typical adults; his Fairfield specimens were found in a spring. At the first Mexican locality Mr. Lloyd found a single individual; at Monterey, seven specimens; these latter exhibit the modifications in texture, solidity, etc., which so frequently characterize northerly forms of this and allied groups, where the distribution extends into southerly or warmer regions.

*Physa heterostropha* Say.

Bennett Spring, Meadow Valley, Nevada (Mus. No. 123616), Dr. C. Hart Merriam, May 20, 1891. Owens Valley, Inyo County, Calif. (Mus. No. 123617), F. Stephens, July 7, 1891. Hot Springs, Panamint Valley, California (Mus. No. 123618), Vernon Bailey, January 9, 1891. Brownsville, Tex. (Mus. No. 123619), William Lloyd.

Dr. Merriam's Bennett Spring shells were found by him at a point 7 miles west of Meadow Creek, at an elevation of 6,000 feet; they range from adolescent to mature, the largest being rather under than

ornia (Mus. No. 123607), April 22, 1891; also (Mus. No. 123608), May 25, 1891; *Pagzetta*, arch 31, 1891 (Mus. No. 123914), Dr. C. Hart in Bernardino County, Cal. (Mus. No. 123920), Inyo County, February 9, 1891 (Mus. No. Calif. (Mus. No. 123610), June 1, 1891; *Castro*, Tejon, Cal., July 2, 1891 (Mus. No. 123911), California (Mus. No. 123612), and *Fairfield*, 5, 1890, Vernon Bailey. *Hidalgo*, Tamaulipas, Monterey, Mexico (Mus. No. 123915), *Whitson*,

samples of the above are fine large, considerably in elevation of spire. There is a tendency to tabulation or flat body whorl, following the suture, such as *Physa humerosa*, a common form on the Pahranagat Valley lot are paler and more acute spire, suggestive of

specimens are nearer the typical form; taken as all facies; some of them hint of Tryon's aspect of *gyrina*, found in the neighborhood. His Keeler examples, from the shore; two of these are over rather than hardly adult; all are characteristic, forming a lot, of which there is a large number, about 8 miles south of Fort Tejon, and proportions; they are all adults, on the whole than the typical form. Pahranagat examples. Bailey's lot of Kern River, at an elevation of of a dwarfed form, less than half the size. Fairfield specimens were found in a locality Mr. Lloyd found a single individual; these latter exhibit the modification which so frequently characterize northern forms, where the distribution extends into

California (Mus. No. 123616), Dr. C. Hart Meriam Inyo County, Calif. (Mus. No. 123617), Hot Springs, Panamint Valley, California (January 9, 1891. Brownsville, Tex. (Mus. No.

shells were found by him at a point at an elevation of 6,000 feet; the largest being rather under than

up to the usual adult mean. Stephens' specimens are all of one size, smaller rather than up to the average mean of adults, and of that perplexing aspect so frequently exhibited in the fresh-water snails, that make the use of one specific name instead of another simply an arbitrary matter. They would pass as subspecies of the above, or *gyrina*. The numerous examples were detected at Moran's, near Benton, Calif. at an altitude of 5,000 feet. Bailey's Panamint Hot Springs specimens are hardly more characteristic; they point suggestively to the *humerosa* form, of the Colorado desert. Lloyd's two Texas examples are dark amber colored and rather solid shells.

*Caenifex newberryi* Lea.  
Keeler, Inyo County, Calif. (Mus. No. 123620), T. S. Palmer.

Numerous examples, in a bleached and semi-fossilized condition. These exhibit, as is not unusual with this form, considerable variation. As additional information comes to us from time to time, the great range of this species, first detected by Dr. J. S. Newberry, in the Kincaid Lake region of northern California, near the Oregon line, and described by Dr. Lea in 1858, becomes exceedingly instructive and interesting. Hemphill collected it living in the neighborhood of Keeler, which is near the margin of Owens Lake, several years ago. Dr. Edward Palmer obtained it in Utah Territory, near Utah Lake, in the Wasatch Mountains, and it has been found in the Tertiaries of Nevada (King's Survey). "In the Lahontan Basin it ranges from the shores of Walker's Lake, north to Button's Ranch, Christmas Lakes, Oregon, where it is found semi-fossil" [Call]. Utah Lake is the easternmost locality as yet known.

Order PROSOBRANCHIATA.

Suborder PECTINIBRANCHIATA.

Section TAENIOGLOSSA.

*Amnicola micrococcus* Pilsbry, sp. nov.

Shell minute, globose, with short conic spine and narrow umbilicus. Whorls 3½, convex, especially below the sutures, the apex very obtuse. Surface smooth, light olive colored. Aperture ovate, about half the length of the entire shell, bluntly angled above; the inner lip is either free from the preceding whorl, or in contact only at the upper part. Alt. 1.5, diam. 1.3mm.

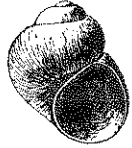


Fig. 1. *Amnicola micrococcus*.

A smaller species than *A. granum* Say, with oval instead of round aperture and shorter spire.

Type from small spring in Oasis Valley, Nevada (Mus. No. 123622), Dr. C. Hart Meriam, June, 1891. Collected also in Death Valley by Nelson and Bailey, February 4, 1891 (Mus. No. 123904).

Several examples of this quite minute shell were detected in a small spring. This is a form not heretofore observed and an exceedingly

interesting little species. It was referred to Mr. Pilsbry for determination and description.

*Amnicola porata* Say.

Kelton, Utah (Mus. No. 123625), Vernon Bailey, November 7, 1891.

Two examples in the dry clay wash about 100 feet above the lake.

*Bythinella protea* Gould (Stearns).

= *Amnicola protea* Gould, 1855.\*

= *Melania exigua* Conrad, 1855.

= *Tryonia protea* Binney et auct.

+ *Bythinella seemani* Frau. (Pilsbry).

= *Hydrobia seemani* Frau. 1863.†

Saratoga Springs, Death Valley (Mus. No. 123905); January 30, 1891, E. W. Nelson, February 4, 1891, Vernon Bailey.

Several hundred living specimens were obtained at the springs by Mr. Nelson and a large number in a marsh near the springs by Mr. Bailey. Associated with them were a few examples of *Amnicola micrococcus* Pilsbry before mentioned.

In explanation of the foregoing synonymy it should be stated that *Bythinella protea* is an exceedingly variable form, including examples that have a perfectly smooth surface, and others that are variously sculptured. In all, whether sculptured or otherwise, *the apex whorls are smooth*. The smooth form, like those referred to below, has the appearance in every respect of an attenuated, slender drawn out *Bythinella*, like *ntekliniana*, described by the late Dr. Lea in 1839, and it, *protea*, may ultimately be regarded as belonging to Lea's species.

*B. seemani* as identified by Mr. Pilsbry appears to be the smooth variety or aspect of Gould's *Tryonia protea* (= *Melania exigua* Conrad).

Frauenfeld's description is based upon examples from Durango, Mexico. The National Museum contains a number of specimens from Andocutira in the State of Michoacan, Mexico, from the bed of an ancient lake. These latter are no doubt the same as the Durango shells; they are perfectly smooth, of a porcellaneous whiteness and texture, and in no way different from the smooth form of *B. protea*, with which they have been repeatedly and carefully compared. The Michoacan region is nearly 1,800 miles south of the Colorado desert.

The granulose form or variety agreeing with figs. 141 and 142 of Binney,‡ was detected near the line of the Southern Pacific Railroad in June, 1888, by Mr. C. R. Orcutt, of San Diego. He found them living in pools at Indian or Fish Springs, some 15 miles northwest of the station on said road, known as Salton. The pools, of which there are several, varying from 10 to 20 feet across, are situated at the base of the San Jacinto range of mountains. They are only a few feet deep and are

\* Pacific Railroad Reports, v, 1855, p. 332.

† Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien, Jahrgang 1863, p. 1025.

‡ See Land and Fresh Water Shells of North America, Smithsonian Misc. Collections 144, Sept. 1863, p. 72.



It was referred to Mr. Pilsbry for determination.

Vernon Bailey, November 7, 1891.

clay wash about 100 feet above the lake.

(ns).

1855.\*

1855.

at anct.

(Pilsbry).

1863.†

(Mus. No. 123995); January 30, 1891, E. W. Nelson and Vernon Bailey.

specimens were obtained at the springs by Vernon Bailey in a marsh near the springs by Mr. Pilsbry. They were a few examples of *Ammicula* as mentioned.

In regarding synonymy it should be stated that there is a seemingly variable form, including examples with smooth surface, and others that are variously sculptured or otherwise, the apex of the whorls being more or less flattened. The form, like those referred to below, has the appearance of an attenuated, slender drawn out *Bythinella*. It was first described by the late Dr. Lea in 1839, and it, probably, belonged as he thought to Lea's species.

The form described by Mr. Pilsbry appears to be the smooth form of *Tryonia protea* (= *Melania exigua* Conrad) which is based upon examples from Durango, Mexico. The Durango form contains a number of specimens from the bed of a river of Michoacan, Mexico, from the bed of which there are no doubt the same as the Durango form. It is very smooth, of a porcellaneous whiteness and very different from the smooth form of *B. protea*, with which it has repeatedly and carefully compared. The Michoacan form is about 1,800 miles south of the Colorado desert. It agrees with figs. 141 and 142 in the plate of *Tryonia* near the line of the Southern Pacific Railroad in California. It was first described by Mr. Pilsbry, of San Diego. He found them living in the Indian Springs, some 15 miles northwest of the station at Salton. The pools, of which there are several scattered across, are situated at the base of the Salton Mountains. They are only a few feet deep and are

ns, v, 1855, p. 332.

Monat. zool. bot. Gesellsch. in Wien, Jahrbuch, 1839, p. 141.

Water Shells of North America, Smithsonian Misc. Coll.,

surrounded and shaded by tales. The water is warm; in Mr. Orcutt's judgment not under 100° F., and tastes like the water of the Dos Palmas Spring, 6 miles north of Salton on the opposite side of the desert, at the base of the Chuckawalla or Lizard Mountains. "An analysis of the Dos Palmas Spring water gives slight traces of alum, soda and sulphur and shows that considerable salt is held in solution, but it is not too salt for use. These springs are all below the present sea level about 100 feet, judging from the fact that Salton lying in the depression between Dos Palmas and Indian Springs, is reported to be 250 feet below sea level from actual measurements." Specimens from this place kindly presented by Mr. Orcutt\* are contained in the National Museum (No. 104886).

Mr. Pilsbry remarks as to *B. seemani*, "it is indeed much like a smooth *Tryonia*. I wonder whether the *Tryonias* are not simply examples of this, isolated in a gradually evaporating basin, becoming more and more saline! However this may be, the shells you submitted to me for my determination are the real *seemani*."

Gould's name *protea* is eminently appropriate; besides the smooth form herein discussed and inclusively regarded as the same as Frauenfeld's, and Orcutt's Indian Springs granulose examples, we find other varietal aspects and the sculpture varying between faint or barely discernible, to moderately defined or conspicuous. Sometimes the shells are shouldered or angulated on the upper side of the whorls, often traversed spirally by slender liræ or threads, and these again modified by longitudinal ribs or costæ. And the proportions of the shells in shape also vary exceedingly; sometimes drawn out, elongated, attenuated, and slender, again short and robust. The mouth smaller or larger; the whorls varying in convexity and all of these aspects of sculpture and form, are seen, when hundreds of specimens are examined, to intergrade or blend together in a greater or less degree. Occasionally there is an example that hints of Stimpson's *clathrata*, but I have not thus far been able to connect the two forms. Again referring to Mr. Pilsbry's note, writing of *seemani* he says "it is no doubt a *Bythinella*† related quite closely to our *nichliniana*."

Without here considering the niceties of generic distinction between *Hydrobia*‡ (in which Frauenfeld placed his species *seemani*), and *Bythinella*, it will readily occur to the reader, that a form so variable, would be likely in some phase of its variation to closely approach if not absolutely and inseparably resemble individuals of other species belonging to more or less intimately related, though geographically widely separated groups.

\*See Orcutt's notes in West American Scientist, September, 1888, and May, 1889.

†Agreeing with Mr. Pilsbry on this point, it will be seen that I have adopted the generic name, *Bythinella*, for Dr. Gould's species.

‡Vide Stimpson's Researches upon the Hydrobiinae, etc., Smithsonian Misc. Coll., 261, August, 1865.

The suggestion that arises from the study of the forms above reviewed, and the regions and conditions to which they are related, point to the causes that induce variation, and to the permanency of species and genera, or to the mutability of the same, as dependent on environmental factors, forces, or conditions. If we are warranted in assuming or to indulge in the speculation, that with volume of water ample or *maximum* and *chemical proportions as related to volume minimum* the *Tryonias* would be smooth; and that the smooth form that so largely prevails or dominates in the various species of the *Bythinellas* and related groups is in a conventional sense of the word, normal, then we may reasonably assume that upon the reversal of these conditions which are environmental and apparently fundamental, with volume of *water minimum* and with *chemical proportions as related to volume of water maximum*, these phenomena of variation may be attributed, because they are so generally coincident with the latter or alternative character of the environment, though temperature conditions probably have more or less influence.\*

At times, no doubt, the flow of water from the springs where these forms occur is comparatively excessive, and there follows a limited local extension of distribution or occupancy in the immediate region, equal to the area covered by the overflow. With the decline of the waters and the evaporation or drying up that follows, the larger areas are inhabitable for awhile, as the mollusks of this general group possess remarkable vitality, and can live for a long time away from, or without water, in damp mud, by burying themselves below the surface.

The soil or mud in the immediate region of alkaline or saline springs, through repeated overflow and evaporation, becomes supersaturated with the bitter chemicals, and it would seem that in course of time these conditions might play some part in inducing variation in the progeny of those individuals that possessed sufficient vitality to survive or to adapt themselves to these conditions. In many places, it is not unreasonable to suppose that such or similar conditions are an ever-present and operative influence within the environment.

I have heretofore† called attention to the remarkable variation exhibited by the pond snails, *Physa*, of the Colorado Desert, so abundant in and around Indio. In these the sculptural feature has no part, but the forms present not only the normal aspect of several well-known species, but the varietal phases, furnish connecting links between them, as well as extraordinary extremes to the extent of distortion.

Now these alternations of conditions are exactly what have occurred within the vast area, in various places of which, these forms occur.

No doubt there are many other springs still living (flowing) within the general region that await examination. The territory inhabited by Gould's species includes not only the localities from whence Merriam,

\* In this connection see Call's interesting and able paper "On the Quaternary and Recent Mollusca of the Great Basin," etc., Bull. 11, U. S. Geol. Survey, 1881.  
† Am. Naturalist, October, 1883, pp. 1014-1020.

arises from the study of the forms above and conditions to which they are related, and to the permanency of the same, as dependent on environmental conditions. If we are warranted in assuming that with volume of water ample of proportions as related to volume minimum of water; and that the smooth form that so largely prevails in the various species of the *Bythinellus* and *Planorbis* in the conventional sense of the word, normal, then we may suppose that upon the reversal of these conditions which are apparently fundamental, with volume of water deficient, the same variation may be attributed, because the same incident with the latter or alternative character, though temperature conditions probably have

the same flow of water from the springs where these conditions are so very excessive, and there follows a limited duration of occupancy in the immediate region of the overflow. With the decline of the water level or drying up that follows, the larger area of the surface, as the mollusks of this general group possess the power to live for a long time away from, or with the power to bury themselves below the surface, the immediate region of alkaline or saline springs, where evaporation, becomes supersaturated, and it would seem that in course of time these conditions play some part in inducing variation in the forms of the mollusks that possessed sufficient vitality to survive to these conditions. In many places, it is probable that such or similar conditions are an ever-present influence within the environment.

Attention to the remarkable variation exhibited by the *Bythinella* of the Colorado Desert, so abundant in these localities, where the sculptural feature has no part, but the smooth aspect of several well-known species, and the various transitional forms connecting links between them, as well as to the extent of distortion.

The conditions are exactly what have occurred in various places of which, these forms occur. In many other springs still living (flowing) within the territory, and upon examination. The territory inhabited by these mollusks is not only the localities from whence Merriam,

has written an interesting and able paper "On the Quaternary and Tertiary Mollusks of the Colorado Desert," etc., Bull. U. S. Geol. Survey, 1884, vol. 3, pp. 1014-1020.

Selous, Bailey, and Orest collected living examples, but places still further north, in the Great Basin so-called; for certain forms collected by Dr. Yarrow\* in 1872 on the shores of Sevier Lake, middle Utah, though unfortunately few in number and somewhat weathered, were recorded by the late Mr. Tryon, to whom the specimens were submitted, as "a representative of the genus *Tryonia*," and are referable to no other form. (Mus. No. 73960.)

In course of time living specimens from new localities may come to our knowledge, as they have within the past five years, since Orest collected the way with his Indian Springs collection, and it may be found, not in springs where the water is comparatively permanent in volume and sweet, the smooth form prevails, and *vice versa*, so far as quantity and quality of water and the matter of shell characters. Information on these points is now what is wanted.

*Tryonia clathrata* Stimpson.

Death Valley, Nevada (Mus. No. 123,621), Dr. C. Hart Merriam, May 25, 1891.

This is the veritable form described by the late Dr. William Stimpson in February, 1865, from the dead bleached specimens collected by Prof. William P. Blake on the surface of the Colorado Desert, while connected with one of the Pacific Railroad surveys, nearly forty years ago. Prof. Blake found it together with other small fresh-water gastropod shells, including Gould's *Ammicula protea*. Subsequently Gen. Carlton collected several examples of *T. clathrata* while on his way east with his command in 1861-'62, but in neither case is the exact locality of Blake's or Carlton's specimens stated. In neither of the lots collected by them were there any living examples; all were of a porcelaneous whiteness, the same as the innumerable bleached specimens of the more common *protea-exigua* form, that are spread over the surface of the desert. Of the thousands of these latter that I have received and collected along the line of the Southern Pacific Railroad, not a single example of *clathrata* has rewarded me for the time expended in the effort to find a specimen by the subsequent examination of the material from this part of the desert. Dr. Merriam's find indicates a more easterly and less southerly distribution for *clathrata*, and quite likely it may prove to be less abundant than its ally. Dr. Merriam's examples were found in a hot spring; the temperature of the water as noted being 97° F.

*Planorbis fusca* Hald.

Kellon, Utah Territory (Mus. No. 123623), Vernon Bailey, November 7, 1891.

Five semifossilized examples were detected in the dry wash of a clay bank at an elevation of about 100 feet above the lake.

*Planorbis merriami* Pilsbry and Beecher. †

"Shell small, globose-turinate, narrowly but distinctly and deeply umbilicated. Spire low-conic, acute; whorls four, slightly shouldered

\*U. S. Geol. Survey, W. of the 100th Meridian, vol. v, p. 948.

†The Nautilus, vol. v, April 1892, p. 143.

lower portion rather flattened, periphery and base convex. Surface smooth, horn-colored. Aperture oblique, ovate, angled above, broadly rounded below; upper portion of the inner lip adherent to the body-whorl, lower portion arcuate, without a callosity thickening.

"Alt. 3, diam.  $2\frac{1}{2}$ mm.

"Collected from a warm spring (temperature  $97^{\circ}$  F.) in Pahrangat Valley, Nevada, by Dr. C. Hart Merriam, and submitted to the writer by Dr. R. E. C. Stearns.

"This species differs from *F. fusca* Hald., in the much more distinct umbilicus, thin texture, and the *non-thickened* inner lip.

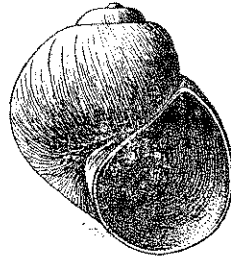


Fig. 2. *Fluminicola merriami*.

"Specimens may be seen in the National Museum (No. 123626) collected at Warm Springs, Pahrangat Valley, Nevada, by Dr. C. Hart Merriam, May 25, 1891."

This form, not previously described, is regarded by Mr. Pilsbry, who is an authority on the shells of this and allied groups, as a new species. It was found associated with *Tryonia clathrata*, elsewhere noted, the temperature of the water being  $97^{\circ}$  F.

*Fluminicola fusca* Hald. var. *minor*.

Ash Meadows, Nye County, Nevada (Mus. No. 123624), F. Stephens, March 4, 1891.

Numerous (200) living specimens of nearly uniform size in spring.

*Fluminicola nuttalliana*\* Lea.

Shoshone Falls, Idaho (Mus. No. 58596).

A large number of specimens, probably as many as two hundred and fifty, were collected at this locality by Dr. Merriam (October 10, 1890), who found them clinging to the rocks in the stream. They vary considerably in elevation of the spire, etc., but the form of the mouth is quite persistent.

A dwarfed but characteristic aspect of this species occurs among the surface shells in the Colorado Desert.

#### Suborder SCUTIBRANCHIATA.

##### Section RHIPODOGLOSSA.

*Helicina chrysocheila* Binney.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123627); also Texas near the mouth of the Rio Grande (Mus. No. 123167), William Lloyd.

Four characteristic illustrations of this well marked and handsome species described in Binney's Terr. Air-breathing Moll., U. S., Vol. II, p. 354, 1851. In addition to the above number, two were obtained at the Texan locality.

\* Inadvertently omitted in my previous list, but included in list published in N. Am. Fauna, No. 5, 1891, p. 27.

er-lateral portion rather flattened, periphery  
is smooth, horn-colored. Aperture oblique,  
ly rounded below; upper portion of the inner  
horn, lower portion arcuate, without a callus.

spring (temperature 97° F.) in Pahrana  
Hart Merriam, and submitted to the writer

in *F. fusca* Hald., in the much more distinct  
and the *non-thickened* inner lip.

specimens may be seen in the National Museum  
123626) collected at Warm Springs, Pahrana  
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58596).

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the rocks in the stream. They vary consider-  
ably in size, but the form of the mouth is quite

distinctive aspect of this species occurs among the  
of the Kalston Desert.

#### Order SCUTIBRANCHIATA.

Suborder RHIPODOGLOSSA.

specimens (Mus. No. 123627); also Texas near the mouth of the  
Rio Grande (Mus. No. 123627), William Lloyd.

specimens of this well marked and handsome  
species were obtained at the above number, two were obtained at

specimens previously listed, but included in list published in N

*Melicina tropica* Jan.

Brownsville, Tex. (Mus. No. 123628), William Lloyd.

A single example.

#### Class PELECYPODA.

Order TETRABRANCHIATA.

Suborder SUBMYTILACEA.

*Anodonta nuttalliana* Lea.

Walker, Calif. (Mus. No. 123629), T. S. Palmer.

One semifossil example.

*Unio anodontoides* Lea.

Brownsville, Tex. (Mus. No. 123630); Mier, Tamaulipas, Mexico, May 4, 1891 (Mus.  
No. 123632), William Lloyd.

The Brownsville examples are less elongated than usual in this species.  
The Mexican specimens are full grown and of the usual proportions.

These localities are believed to be much farther south than heretofore  
reported.

*Unio berlandieri* Lea.

Mier, Tamaulipas, Mexico (Mus. No. 123631), William Lloyd, May 4, 1891.

The examples of this species are nearly full grown adults and of the  
characteristic aspect.

#### Suborder CONCHACEA.

*Faldium occidentale* Newc.

Death Valley, Nevada (Mus. No. 123633), Dr. C. Hart Merriam, June 2, 1891.

Several examples. The above place is on the western edge of the  
Kalston Desert, in Nye County, Nevada.