ADDITIONS TO THE INSULAR LAND-SHELL FAUNAS OF THE PACIFIC COAST, ESPECIALLY OF THE GALAPAGOS AND COCOS ISLANDS.

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Several expeditions, during the last five years, have made collections on islands lying off the Pacific coast of America, south of the United States. Material from most of them came into my hands for examination, or as the property of the National Museum.

In 1896, Mr. A. W. Anthony, of San Diego, Cal., undertook a collecting tour along the west coast of Lower California, touching at Rosalia Bay and Guadelupe, Cerros, San Martin, San Benito and Natividad Islands. The collection of land shells included several novelties and was acquired by the National Museum. A subsequent visit to Clarion Island was less lucky; the few land shells obtained were put into formalin solution, which destroyed them utterly before they could be identified.

Guadelupe has been visited by Mr. C. H. Townsend, of the U. S. Fish Commission, and the Coronado Islands and Tiburon by parties from San Diego, from whom small lots of material have been obtained.

In 1898–99 a party from Stanford University visited Guadelupe, Cocos and the Galapagos Islands, particularly exploring the less-known islets of the latter group.

The party consisted of Mr. R. E. Snodgrass and Mr. Edmund Heller, who, through the generosity of Mr. Timothy Hopkins, of Menlo Park, Cal., were able to take passage on a sealing schooner from San Francisco, commanded by Captain W. P. Noyes. The time from December, 1898, to July, 1899, was spent in the work. The attempt was made to spend as much time as possible on the less-known islands. A week was given to Chatham, ten days to Charles, but Tagus Cove, Elizabeth Bay and Iguana Cove, all on Albemarle Island, were given three months. Narborough had never been visited by collectors and Abingdon but rarely. On Bindloe, Mr. Snodgrass made careful search, but could find no traces of the species reported from it.

Through the kindness of President Jordan and Mr. R. E. Snod-

grass, I have been able to examine and report upon the land shells of this expedition. All this material being of a congruent nature, the results obtained from a study of it may properly be assembled in a single paper.

The present publication may be regarded as a supplement to that published in the *Proceedings of the Academy of Natural Sciences* for 1896, pages 395–479, which was largely based on the collections made at the Galapagos by the late Prof. G. Baur.

Species from the Galapagos Islands.

The Stanford expedition collected land shells at Chatham, Hood, Charles, Barrington, Duncan, Albemarle, Narborough, James and Abingdon, islands of the group. From Narborough and Abingdon no collections had previously been made, but curiously enough no new species turned up on either. Narborough is probably the youngest island of the group, being actively volcanic in historic times; so perhaps its land shells are comparatively new immigrants from Albemarle, its nearest neighbor. But Abingdon, so small, distant and isolated, would have been expected to furnish some new material.

It was something of a surprise to find two new species from Albemarle out of ten collected, and three from Hood, all that were collected.

The additions to previously published lists of known species are three each to Albemarle and Narborough, six to Abingdon and one to Barrington.

The references are to my paper above cited of 1896, where the synonymy is given in full, and the species are here given in the same order, with the intercalation of those supposed to be new.

Bulimulus nux Broderip.

Bulimulus nux Dall, 1896, p. 429, Pl. XVI, fig. 6, Pl. XVII, fig. 10.

Charles and Chatham Islands, Snodgrass and Heller.

The collection of *B. nux* was not very large, but contained the banded variety (*B. unifasciatus* Reibisch non Sowerby) and the pale form, approaching *rugulosus*, which Reibisch named *invalidus*.

Bulimulus duncanus Dall.

Bulimulus duncanus Dall, 1896, p. 438, Pl. XVI, fig. 7.

Duncan Island, Snodgrass and Heller.

As in previous cases, all the specimens were dead, and those

collected were not quite mature as the parietal denticle had appeared in none of them. The species is probably extinct.

Bulimulus eschariferus Sowerby.

Bulimulus eschariferus Dall, 1896, p. 434.

Chatham and Barrington Islands, Snodgrass and Heller.

This species had not been found at Barrington previously.

Bulimulus Snodgrassi n. sp. Plate VIII, fig. 2.

Bulimulus having the general form of *B. perspectivus* Pfr., with a distinct suture and eight polished moderately convex whorls; apex attenuated, nucleus livid, with an apical dimple and fine regular ribbing which becomes obsolete on later whorls; there is also on the first four whorls more or less spiral sculpture of microscopically fine lines, which also disappear on later whorls; subsequent whorls smooth or with fine incremental lines; upper whorls dark purplish brown, later ones a little paler, with a narrow paler band just behind the suture, which on the last whorl becomes strongly marked, with a dark reddish narrower band on each side of it, and traces of another at the suture; in some specimens the dark coloration covers the whole surface on each side of the peripheral pale band, but inside the aperture the bands can always be distinguished; base rounded about a well-marked umbilicus; aperture small, ovate, marginally thickened and slightly expanded, but not reflected; a narrow band of callus over the body connects the posterior ends of the lips; pillar broad, slightly swollen, external coloration visible in the throat. Alt. of shell 17, of aperture 5.2, diam. of shell 6, of aperture 4 mm.

He means larger; B. perspectivus is 15.5 mm as described

Hood Island, Snodgrass and Heller; numerous.

This species is smaller than *B. perspectivus* and differently colored, but belongs to the same group.

Bulimulus approximatus n. sp. Plate VIII, fig. 4.

Shell belonging to the type of *B. nux* and *B. rugulosus* with seven pretty evenly tapered whorls, with a distinct suture; nucleus as in the last species, livid, but the early whorls bear no traces of revolving lines; whorls moderately convex, base evenly rounded; sculpture, on the later whorls, only of faint incremental lines; umbilicus small and narrow, aperture rather elongate. Alt. of shell 17.5, diam. 8 mm.

Hood Island, Snodgrass and Heller.

A single specimen of this shell was obtained which differs from all the others of the *nux* group in the absence of spiral sculpture and the smooth and polished surface. The peristome is not quite matured, so it cannot be determined whether it is reflected or not, but the probabilities are in favor of its being simple and unreflected.

Bulimulus hoodensis n. sp. Plate VIII, fig. 1.

Shell allied to *B. unifasciatus* Sby., but smaller, with about six convex, rapidly tapering whorls; nucleus sculptured as usual in the group, livid purple; later whorls smooth, polished, with no sculpture but faint incremental lines; color light yellowish brown, with two broad reddish purple spiral bands nearly peripheral, and a narrower one in front of the suture; base evenly rounded, with a narrow but deep umbilicus; aperture ovate-oblong, the peristome white, thickened and distinctly reflected; pillar broad, white, not swollen, a thin wash of callus over the body, the external coloration distinct within the aperture. Alt. of shell 18, of aperture 8.5, diam. of shell 8.5, of aperture 6 mm.

Hood Island, Snodgrass and Heller.

This well-marked form more nearly resembles some of the continental species than the typical Næsioti. The distinctly reflected lip and rapid enlargement of the whorls distinguish it from any other Galapagos species.

Bulimulus jacobi Sowerby.

Bulimulus jacobi Dall, 1896, p. 436.

This seems to be the commonest and, among the islands, the most generally distributed species of the Galapagos. It was obtained by Messrs. Snodgrass and Heller at James and Albemarle, where it was previously known, and also from Narborough and Abingdon, where it had not previously been reported. There is not a great deal of variation in the specimens, which were found at elevations of from 1,700 to 2,000 feet. The form named *cinereus* by Reibisch was obtained at Iguana Cove, Albemarle Island, and the variety *acutus* Reibisch, at a height of 3,000 feet, near Tagus Cove, Albemarle Island. The species is usually found under flat pieces of rock, and a large proportion of the specimens are dead.

Bulimulus curtus Reibisch.

Bulimulus (*amastroides* var.?) *curtus* Dall, 1896, p. 442, Pl. XV, fig. 13, Pl. XVII, fig. 8.

Chatham Island, Snodgrass and Heller; also Baur, Wolf and the U. S. Fish Commission.

Bulimulus rugiferus Sowerby.

Bulimulus rugiferus Dall, 1896, p. 443.

James Island, Cuming.

A single specimen of a very young shell probably belonging to this species was obtained by Messrs. Snodgrass and Heller.

Bulimulus Tanneri Dall.

Bulimulus tanneri Dall, 1896, p. 438, Pl. XVI, fig. 3.

Tagus Cove, Albemarle Island, Snodgrass and Heller.

This species was previously known only from Indefatigable Island, where it was collected by the U. S. Fish Commission. The present specimens are not fully grown and do not show the broadly reflected lip.

Bulimulus indefatigabilis Dall, nom. nov.

Bulimulus n. sp. Dall, 1896, p. 444, Pl. XV, fig. 15.

One specimen found on James and two on Indefatigable Island, according to Reibisch.

In 1896, to complete my monograph of the Galapagos shells, I figured and described this shell but left it unnamed, thinking Herr Reibisch himself intended to name it. But the years have passed by and I have been unable to renew communication with that gentleman, who is, I am informed, absorbed in other pursuits, so I take this opportunity of applying a name to this shell.

Guppya Bauri Dall.

? Trochomorpha Bauri Dall, 1896, p. 447, Pl. XV, figs. 8, 9.

Abingdon Island, at an elevation of 1,700 feet, Snodgrass and Heller; Albemarle Island, Baur.

The specimens of this species obtained by Mr. Snodgrass were dead and discolored, but the identification is complete. This is a new locality for the species.

Conulus galapaganus Dall.

Conulus galapaganus Dall, 1896, p. 448, Pl. XV, fig. 11.

Chatham Island, at 1,600 feet, Baur; Abingdon Island, at 1,700 feet, Snodgrass and Heller; numerous.

Quite a number of these were obtained but mostly in poor condition. It was previously known only from Chatham Island.

Vitrea chathamensis Dall.

Vitrea chathamensis Dall, 1896, p. 448, Pl. XV, figs. 3, 10.

Chatham Island, 1,600 feet, Baur; Abingdon Island, 1,700 feet, Snodgrass and Heller.

Good specimens of this species were obtained by Mr. Snodgrass.

It was previously known only from Chatham Island, by a single specimen.

Vitrea actinophora n. sp. Pl. VIII, figs. 11, 16, 17.

Shell small with four brilliantly polished, subtranslucent, olivaceous whorls; spire depressed but slightly rounded, with a distinct suture; nuclear whorl and a half smooth, succeeding whorls near the suture with well-defined close-set incised lines in harmony with the lines of growth but short, rarely extending to the periphery; last whorl evenly rounded, base smooth, convex, with a narrow deep umbilicus; aperture oblique, hardly expanded, the peristome sharp, thin, the pillar and outer lips not approximated. Major diam. 4, minor diam. 3.2, alt. 2 mm.

Top of mountain near Tagus Cove, Albemarle Island, Snodgrass and Heller.

This belongs to the group of *V. radiatula* Alder, but is sufficiently distinguished by its sculpture and umbilicus; the last whorl is also proportionally smaller.

Endodonta Helleri n. sp. Pl. VIII, figs. 7, 8, 9.

Shell small, solid, pale olivaceous gray, with about five sharply sculptured, acutely keeled whorls; nucleus smooth, the succeeding whorls with close, oblique, evenly-spaced, elevated lamellæ in harmony with the lines of growth, and covering both the upper and lower surface of the shell; spire elevated, domelike, the surface of the whorls somewhat flattened with the periphery narrowly compressed forming a sharp marginated keel; base rounded with a rather wide and deep umbilicus; aperture oblique, the peristome widely reflected and thickened except at the upper angle which is appressed against the keel of the prior whorl; interior of the aperture with a narrow low rounded parietal lamella running far into the throat; on the basal side, a fourth of a whorl behind the aperture, two narrow white patches are seen through the shell, indi-

cating the presence of two short basal lamellæ. Major diam. 3, minor diam. 2.6, alt. 1.75 mm.

Near Iguana Cove, Albemarle Island, at an elevation of 2,000 feet, Snodgrass and Heller.

This very characteristic and elegant little shell adds a representative of a genus and family new to the Galapagos fauna.

Pupa Wolfii Miller.

Pupa (Leucochila?) wolfii Dall, 1896, p. 446, Pl. XVII, fig. 14.

Guayaquil, Ecuador, Wolf; Albemarle Island, near the sea level, Wolf and Baur; near Tagus Cove, Albemarle, on leaves of *Croton;* near Iguana Cove, Albemarle, at 2,000 feet elevation; Narborough Island, Snodgrass and Heller; abundant.

This species was usually found, when alive, on leaves of plants. It seems to be common and many of the specimens approximate in the characters of the armature of the mouth to *P. clausa.* Their distinctness cannot yet be said to be demonstrated.

Pupa clausa Reibisch.

Pupa clausa Dall, 1896, p. 447.

On bushes near the sea, Indefatigable Island, Wolf; Abingdon and Narborough Islands, near the sea level, Snodgrass and Heller.

These localities are additional to that of Wolf, which was the only one previously known for this rather doubtful species.

Succinea Bettii Smith.

Succinea bettii Dall, 1896, p. 448, Pl. XV, fig. 6.

Previously known from Charles, James and Chatham Islands; Iguana Cove, Albemarle and James Island, Snodgrass and Heller; variety *Wolfii* Reibisch, at 1,700 feet elevation, Abingdon Island, 2,000 feet elevation near Iguana Cove, Albemarle Island, Snodgrass and Heller.

This species appears to be common and is doubtless widely diffused among the islands.

Succinea brevior (Smith).

Succinea brevior Dall, 1896, p. 449, Pl. XV, fig. 4, Pl. XVI, fig. 8, Pl. XVII, fig. 9.

At 1,000 feet elevation, on shrubbery, near Black Beach, Charles Island, Baur; Charles Island, Snodgrass and Heller.

Succinea producta (Reibisch).

Succinea producta Dall, 1896, p. 449, Pl. XV, fig. 7, Pl. XVI, fig. 10, Pl. XVII, fig. 5.

Chatham Island, on lichen-covered rocks at 900 to 2,000 feet elevation, Wolf and Baur; Chatham and Narborough Islands, Snodgrass and Heller.

The last locality is a new one for the species.

Succinea corbis Dall.

Succinea corbis Dall, 1896, p. 450, Pl. XV, fig. 5.

South Albemarle Island, on dry bones of turtles, Dr. Baur; Iguana Cove, Albemarle Island, and also on James Island, Snodgrass and Heller.

The specimens obtained by Messrs. Snodgrass and Heller were less strongly reticulate than the original type, but on examination in a good light and strong magnification the characteristic sculpture was detected.

Tornatellina chathamensis Dall.

Leptinaria chathamensis Dall, 1896, p. 451, Pl. XVI, fig. 9, Pl. XVII, fig. 16.

Chatham Island, on ferns at 1,600–2,000 feet above the sea, also South Albemarle Island, Baur; Iguana Cove, Albemarle Island, Snodgrass and Heller.

In his revision of certain *Stenogyridæ*, Dr. Pilsbry has shown that the small forms, often called *Leptinaria*, which are allied to and perhaps were the original root stock of the *Achatinellidæ*, must take the name *Tornatellina*, while the very similar shells with a Stenogyroid radula will be called *Leptinaria*. Hence the shell described by me as *Leptinaria chathamensis* will now take its place as a *Tornatellina*.

The close resemblance between many of the non-arboreal minuter Achatinellas and *Tornatellina* is sufficiently obvious. The anatomy confirms the relationship intimated by the shell characters. Add to this that the only fossil (possibly Pliocene) Achatinellas yet observed belong to this dwarfish dull-colored group, and the hypothesis that *Achatinella* originally sprang from a Tertiary *Tornatellina*-like immigrant, borne, perhaps, on the wings of the wind, from other islands of the Pacific, does not seem to be very far-fetched.

Helicina nesiotica Dall.

Helicina (*Idesa*) *nesiotica* Dall, 1896, p. 451, Pl. XV, figs. 1, 2, Pl. XVII, fig. 12.

Chatham Island, on leaves at 1,600 feet, Baur; top of mountain, near Tagus Cove, Albemarle, also near Iguana Cove, Albemarle, Snodgrass and Heller.

It is quite likely that this inconspicuous species may exist on all the islands, and the new material obtained during this the latest expedition may serve to confirm the opinion that the islands are still not sufficiently explored to warrant final conclusions on interisland distribution.

Cocos Island Species.

Cocos Island is a remote volcanic islet, about half-way between the Galapagos Islands and the Panamic Isthmus in a north-north-easterly direction. The only reference to its land shells I have found is a short paper by von Martens[1] on a small collection of small land shells obtained by Herr Pittier in June, 1898. These comprised four species of which one was an undetermined species of *Conulus*.

Messrs. Snodgrass and Heller obtained also four species, one of which appears to be identical with one of von Martens', the other three to be undescribed.

I have had the valuable advice of Dr. H. A. Pilsbry in the determination of these shells, and it appears that the revision of the group containing *Subulina*, etc., leaves in the genus *Leptinaria* the Achatinoid forms which have, like these from Cocos Island, the dentition of *Stenogyra*, while to *Tornatellina* will fall those having a radula recalling *Achatinella*, such as the species described by me under the name of *Leptinaria chathamensis*.

The list of Cocos Island species, so far known, will be as follows:

Conulus sp.

Guppya Hopkinsii Dall. On leaves.

Leptinaria (*Neosubulina*) *Pittieri* (von Martens).

Leptinaria (*Neosubulina*) *Martensi* Dall. Under stones.

Opeas juncea (Gould).

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[1] *Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin*, pp. 156-160, 1898.

Vertigo cocosensis Dall. On leaves.

Succinea globispira von Martens. On leaves.

Siphonaria gigas Sowerby and *Melampus panamensis* C. B. Adams were obtained by the U. S. Fish Commission from the beaches of Cocos Island in 1888.

Guppya Hopkinsii n. sp. Pl. VIII, figs. 5, 6.

Shell small, with $5\frac{1}{2}$ whorls, of a reddish horn-color when fresh, polished below; above, the surface is dulled by fine close even striation in harmony with the lines of growth crossed by a microscopic, partly obsolete spiral striation; spire moderately elevated, nepionic whorls polished, the sutures very distinct, the whorls rounded between them; base evenly rounded, the periphery of the last whorl situated in the path of the suture as it advances and not in the middle of the whorl; umbilical region impressed, imperforate; aperture lunate, wider than high, the margins acute, the parietal surface without callus and polished. Alt. 4.2, lat. 6 mm.

Cocos Island, on leaves, Heller and Snodgrass, 1899.

This is a very neat little shell in which the reddish color of the living form seems to fade to a pale yellowish after the animal has been some time removed. It seems to have been not uncommon. It is named in honor of Mr. Timothy Hopkins, patron of the expedition. An examination of the animal by Dr. Pilsbry has settled the genus.

Leptinaria (Neosubulina) Martensi n. sp. Pl. VIII, fig. 10.

Shell small, of a yellowish-green color, polished, with $5\frac{1}{2}$ whorls, a rather blunt apex and distinct suture; under magnification the upper whorls are seen to be minutely axially wrinkled, most distinctly so in front of the suture, but, in the later whorls, this sculpture becomes obsolete. There is also a fine obscure spiral striation and in certain spots, under magnification, the two series of lines form a faint reticulation. The shell has much the general form of *Cochlicopa lubrica*, the aperture is small, semilunate, the pillar obliquely truncated, somewhat thickened at the twisted edge; on the body is a very prominent projecting lamina which extends inside the shell for about one whorl, projects at the mouth half-way to the outer lip and is united to the pillar and outer lip by a thin callus; the outer lip is not reflected, but is not sharp-edged in the adult; directly opposite the parietal lamella is a sin-

gle thickened spiral ridge, but little elevated, and extending inward about one-third of the last whorl. Alt. of shell 10, of aperture 4.25 ; lat. of shell 4, of aperture 2 mm.

Cocos Island, under stones, Heller and Snodgrass.

An immature dextral specimen among the seven sinistral *L. Pittieri* v. Marts. may have belonged to this species. It differs from that species by being dextral, by having the mouth larger in proportion to the spire, and in having one less whorl in a somewhat greater length. The specimens were strongly contracted in alcohol but presented the general appearance of *Stenogyra*, with which the short and broad, very small, radula fully agrees. The partitions of the upper whorls are not absorbed. The foot is entire and quite small. I could detect no jaw nor eyes, but the tentacles were inverted. It seems, according to Dr. Pilsbry, that *Leptinaria* is the proper name for these stenogyroid forms with dentition of *Achatina*, while *Tornatellina* includes those with achatinelloid teeth. Consequently *Neosubulina*, which was founded chiefly on these distinctions, is, at most, hardly of more than sectional value. The resemblance to *Stolidoma* Desh. is quite marked, but they may be discriminated by the apical characters of the shell.

Vertigo cocosensis n. sp. Pl. VIII, fig. 13.

Shell small, reddish brown, rather pointed, with nearly five rounded whorls; apex paler, polished, rather blunt; last whorl much the largest; base rounded with a well-marked umbilical pit; aperture wider behind, the posterior part of the outer lip and the pillar lip broadly reflected, the anterior outer and basal margin narrow; the pillar and outer lip united by a thin callus; lamellæ according to Sterki's formula .ABDE, comprising one columellar and two parietal folds, and, on the outer wall well within the peristome, two narrow little-elevated ridges, of which the anterior is shorter. Axial length of shell 2.2, of aperture .8, width of last whorl 1.5, of aperture .8 mm.

Cocos Island, on leaves, Heller and Snodgrass.

The chief peculiarity of this species is that the surface, which looks silky under an ordinary hand lens, when more magnified is seen to be punctate all over, recalling *V. variolosa* Gould, of Florida, which, however, differs in form, size and dental armature.

Succinea globispira von Martens.

S. globispira v. Mts., Sitzb. Ges. Naturf. Freunde zu Berlin, p. 158, 1898.

Cocos Isand, on leaves, Heller and Snodgrass.

This is a rather rude, short-spired form of a yellowish-white color, and which covers itself in life with pellets of its own excreta. It does not seem to be abundant.

Species from the Californian Islands.

Epiphragmophora Veatchii (Newcomb).

Arionta Veatchii Newcomb (MS.) Tryon, Am. Journ. Conch., II, p. 316, Pl. 22 (5), fig. 19; Pl. 23 (6), fig. 6, Oct., 1866; III, p. 162, 1867.

Cerros Island, off Lower California, in about N. Lat. 28°, Veatch (1859), Anthony (1896).

This splendid shell is well suited to its arid environment, since Stearns had a specimen collected by Veatch which only issued from behind its epiphragm in 1865, having been kept six years in a dry box without food or moisture.

Epiphragmophora leucanthea n. sp. Pl. VIII, figs. 18, 20.

Shell with five and a half rather convex whorls; pale lavender, nearly white below, with an obsolete white peripheral band, above which the whorl is more or less tinged with pale bluish gray; a translucent band above the peripheral one through which the dark brown with which the interior of the whorls is lined may show through more or less distinctly; nuclear whorls with wavy radial striæ, visible under a lens, for a whorl and a half, translucent; succeeding whorls opaque, except as stated, polished, with rather distinct incremental lines and obsolete vermiculations or malleations; base rounded, perforate, with the umbilicus nearly closed by the columellar reflection; aperture rounded, the outer lip slightly reflected, white, with the throat brown internally; body without callus, pillar short, arcuate, with no thickening or denticle upon it. Major diam. 28, minor 23.5, alt. of shell 20, of aperture 15 mm.

Eastern side of Cerros Island, Anthony, 1896.

This is evidently a derivative from *E. Veatchii*, from which it differs in the absence of the numerous interrupted brown bands, in the usually blunter and lower spire and more distinct and deeper sutures.

Epiphragmophora areolata (Sowerby).

Helix areolata Sowerby (MSS.), Pfeiffer, Zeitschr. für Mal., II, p. 154, 1845.
Polymita areolata Tryon, Am. Journ. Conch., II, p. 319, Pl. 23 (6), fig. 5, 1866.

Margarita Bay, L. Cal., Newcomb; Natividad Island, ten miles south of Cerros Island, Anthony, 1896.

This species was mistakenly referred to Oregon by Tryon. Binney, in *Land and Fresh-water Shells of North America*, figures for it a specimen of *E. Veatchii* (p. 177, fig. 311, two middle figures) and one of *E. levis* Pfr. (*ibid.*, two outer figures). Though doubtless similar in origin and in coloration, *areolata* is smaller than *Veatchii* and has a more depressed spire, and on the whole is easily separable from the latter if a good series is compared.

Epiphragmophora levis (Pfeiffer).

Helix levis Pfr., Zeitschr. für Mal., II, p. 152, 1845; Binney, Land and Fresh-water Sh. N. Am., I, p. 180, fig. 316, 1869.

Rosalia Bay, mainland of Lower California, in N. Lat. 28° 30′, Anthony, 1896.

Erroneously referred to the Columbia river by Pfeiffer.

Epiphragmophora crassula n. sp. Pl. VIII, fig. 3.

Shell small, solid and heavy, smooth, with five whorls; spire rather pointed, suture distinct, not deep, last whorl evenly rounded at the periphery; color opaque white with more or less numerous very pale-brown subtranslucent spiral bands, all or part of which may be absent; usually there is a peripheral white band and between it and the suture one or two translucent bands of which the anterior is most constant; from two to four narrower translucent bands may exist in front of the periphery; the base is rounded, at first minutely perforate, later imperforate and sealed by a reflection of the pillar lip; aperture rounded, slightly oblique, with a solid white, slightly reflected peristome, but no callus on the body; pillar broad, short with a conspicuous callosity. Alt. of shell 15, of aperture 6, lat. of shell 15.5, of aperture 7.5 mm.

Natividad Island, ten miles south of Cerros Island, Anthony, 1896.

This species is an offshoot of *E. levis* Pfr., from which it differs by its smaller and much heavier shell, fewer whorls, conspicuous

peristome and narrower, fewer and less interrupted banding of a paler tint.

Epiphragmophora pandoræ (Forbes).

Helix pandoræ Fbs., P. Z. S., 1850, p. 55, Pl. IX, figs. 3a, 3b.
Helix damacenus Gould, Proc. Bost. Soc. N. Hist., VI, p. 11, 1856.

San Benito Island, east of Cerros, in N. Lat. 28° 16′, Anthony, 1896; Santa Barbara, on Margarita Bay, L. Cal., Forbes.

This is a well-marked species which varies from white to dark gray above, and, below, may be white or banded with ashy gray. The nucleus is, however, invariably of a livid purplish color and the surface is dull and conspicuously striate. A typical specimen, received by Dr. Lea from Forbes, is now in the National Museum.

It differs from the San Benito shells chiefly in having the spire less elevated and the whorls slightly flatter above.

Epiphragmophora Stearnsiana (Gabb).

Helix Stearnsiana Gabb., Am. Journ. Conch., III, p. 235, Pl. XVI, fig. 1, 1867.

Lower California, from San Diego, Cal., south to San Tomas river, Binney; San Martin Island, in N. Lat. 30° 30′, Anthony, 1896.

These specimens do not seem to differ from those taken on the mainland.

Epiphragmophora (Micrarionta) guadelupiana n. sp. Plate VIII, figs. 14, 15.

Shell small, thin, depressed, of a dark-brownish color with a narrow reddish band, bordered on each side by a pale streak, just above the periphery; spire little elevated, suture distinct; epidermis strong, in well-developed specimens slightly microscopically hirsute; sculpture of well-marked incremental lines, stronger on the spire, with occasional microscopic punctations; base more or less flattened, the last whorl with the periphery somewhat above the middle of the whorl, umbilicus narrow and deep; aperture subcircular, very oblique with a strong whitish reflection of the peristome, the ends of the lip on the body approximated, throat with the bands showing through. Alt. of shell 6, diam. 10.5, aperture diam. 4.5 mm.

Guadelupe Island, off Lower California, in N. Lat. about 29°, Anthony, 1896; Snodgrass and Heller, 1899.

This very well-marked little species is nearest to *E. catalinæ*, but is more depressed, with a larger umbilicus and differently shaped

aperture. It seems to be tolerably abundant, though most of the specimens received were defective.

Epiphragmophora sp. indet.

Among the shells collected by Anthony from Guadelupe Island, was a single specimen of a species of *Epiphragmophora* considerably larger than the preceding, but which I am unable to identify since it is not mature. There is a pale band and an almost obsolete reddish band at the periphery. It represents a species quite unlike *E. guadelupiana.*

Binneyia notabilis Cooper.

Binneya notabilis Cooper, Proc. Cal. Acad. Sci., III, p. 62, 1863, with figures.

Santa Barbara Island, Cooper, 1863; Guadelupe Island, Anthony, 1896.

This species appears to be abundant on Gaudelupe Island, but owing to want of care in collecting few of the delicate shells were intact when received.

Succinea (rusticana Gld. var.?) **guadelupensis** Dall. Pl. VIII, fig. 12.

Shell small, acutely pointed, strongly marked with incremental lines; whorls very convex, with deep sutures; last whorl the largest; aperture small for the genus, oblique, with a well-marked callus over the body. Lon. of shell 8.5, of aperture 5, of last whorl 7, diam. of shell 5, of aperture 3.2 mm.

Guadelupe Island, Anthony, 1896.

This variety differs from *S. rusticana* in its much smaller size with the same number of whorls, also by the incurving outer lip where it joins the body. The surface is rather coarsely striated with incremental lines. The specimen obtained was dead, and the color when fresh was doubtful, but the appearances indicate that was pale yellow. It resembles a good deal *Succinea corbis* Dall from the Galapagos, but is a broader shell and does not possess the fine reticulate surface sculpture. It may very likely prove eventually to be of specific rank, but in the present state of our knowledge of the American species I prefer to introduce this as a variety.

Epiphragmophora catalinæ Dall.

"*Helix tenuistriata*" W. G. Binney (as mutation of *H. Gabbi*), Land and Fresh-water Sh. N. Am., part I, p. 175, fig. 305, 1869 ; not of A. Binney, 1842.
Arionta Gabbi W. G. Binney, Bull. U. S. Nat. Mus., No. 28, p. 148, fig. 130, 1885.

This form was collected on Catalina Island by H. Hemphill, and, while obviously a member of the *Gabbi-facta* group, seems perfectly distinguishable from the other members of that group. There is a very large series of *Gabbi* and *facta* in the collection of the National Museum, and notwithstanding their variability I do not find any specimens which are not readily referred to one or the other, and none intermediate between these and *catalinæ*. The name *tenuistriata* had previously been used specifically by A. Binney, and was repudiated for this shell by his son. As the original *tenuistriata* A. Binney has never been identified, and in the case of the present species the name would have to rest anonymous, it seems better to apply a local name to it which is free from any uncertainty. It has a small deep umbilicus partly shaded by the reflected pillar lip and a broadly reflected peristome, the ends of which upon the body are not approximated. It measures as follows: Alt. of shell 7, diam. 12, diam. aperture 4.5 mm. There are five and a half rounded whorls and the entire shell is finely spirally striate. It is also found fossil on Santa Barbara Island, but the fossil specimens are often considerably larger than the largest living specimens now known; one measures 15 mm. in major diameter and nearly 10 mm. in height.

Epiphragmophora Kellettii Forbes.

Helix Kellettii Forbes, P. Z. S., 1850, p. 55, Pl. IX, fig 2, a, b.
Epiphragmophora (*Micrarionta*) *Kellettii* Pilsbry, Cat. Land Shells of Am. North of Mex., p. 6, 1897.

The measurements of the type are major diam. 22, minor diam. 19, alt. 19 mm. No locality is mentioned. A shell occurs on San Clemente Island of the Santa Barbara group, which has been referred to *Kellettii* as a dwarf variety. I suspect it to be distinct, but, at all events, it is sufficiently different to deserve a name:

Epiphragmophora (var. ?) **clementina** Dall.

Shell small, thin, pale translucent brownish in color with obscure, revolving series of very minute yellow or whitish flecks; whorls four, the nucleus wrinkled transversely, reddish, slightly flattened, the succeeding whorls rather convex with a distinct suture; a very

narrow dark reddish-brown band, with a hardly visible pale border in front of it, revolves above the periphery; sculpture of rather well-marked incremental rugæ, cut on the upper part of the last whorl by microscopic spiral striation, to which is added a partly obsolete oblique striation which is visible, under magnification, chiefly in patches; the effect of the whole is to give the surface a very fine shagrination; the last whorl near the aperture descends strongly and the plane of the aperture forms an angle of about 45° with the axis of the shell; base full and rounded, the umbilicus completely covered by a reflection of the pillar lip; aperture rounded, the peristome narrow, whitish, slightly thickened and reflected. Major diam. 15, minor diam. 12, alt. 11 mm.; other specimens are slightly larger.

Habitat: San Clemente Island, Cal., U. S. Fish Com.

The typical *E. Kellettii* is that found in the vicinity of San Diego. It has six whorls and they are well rounded. It differs from the Catalina Island form in its less flattened and more inflated whorls, more dome-like spire, smaller size and browner aspect, the contrast between the upper and lower sides of the last whorl being much less marked. Specimens from the Coronado Islands are like those from San Diego. The National Museum has this species only from the above-mentioned three localities authentically. "Santa Barbara," frequently mentioned as a locality, should read "Santa Barbara Islands," as it is improbable that the shell occurs at the town of Santa Barbara on the mainland. A lot in the National Museum are labelled "Oregon City, Shumard," which is, of course, an error. *E. clementina* differs in size, in number of whorls and in the more emphasised surface sculpture. It is more like the San Diego shells than like those from Catalina.

Epiphragmophora Orcutti n. sp. Pl. VIII, fig. 19.

Shell globose, moderately elevated, polished, with nearly six moderately convex whorls forming a dome-like spire; color purplish brown, lighter toward the umbilicus; a narrow pale band on the last whorl bordered behind by a darker brown, poorly defined, similar band, both being above the periphery and the suture in the earlier whorls being laid on the anterior edge of the darker line; nucleus finely flexuously radiately wrinkled, pale colored; subsequent whorls with fine incremental wrinkles the ridges of which are cut by revolving, partly obsolete incised lines; as a rule

these lines are not deep or continuous, cutting merely the tops of the wrinkles and not the furrows between them; suture distinct, last whorl rounded, plump, toward the aperture descending below the pale band; base plumply rounded, the umbilicus covered by a reflection of the pillar-lip with a minute chink behind it; aperture very oblique, thickened, whitish, reflected, especially near the pillar; throat livid brownish with the bands well indicated. Major diam. of large and small specimens, respectively, 24 and 22.5, minor diam. 20 and 18.5, alt. 19 and 16 mm.

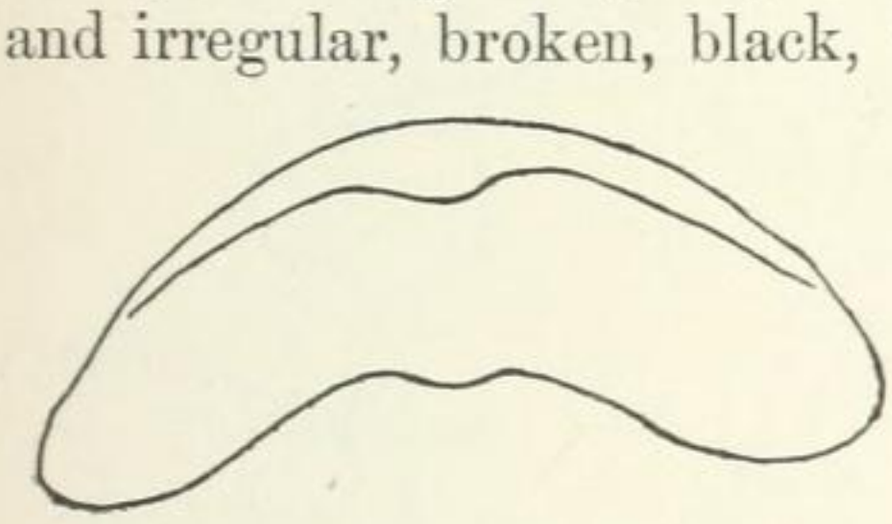
Habitat: Rosario mesas, in northern Lower California, in May, 1886, by C. R. Orcutt.

This form much resembles in shape the typical *E. Kellettii*, from which it differs in the absence of the yellow flecking and the different surface sculpture. *E. Kellettii* is also a more globose shell. The same stock, doubtless, was the origin of both species, as well as several others.

Addendum—Note on the Anatomy of Guppya Hopkinsi Dall.

By Henry A. Pilsbry.

The sole is distinctly tripartite; tail with a subtriangular mucous pore surmounted by a blunt short fleshy process. The mantle lining the lung cavity is pearl-gray with some opaque white spots and irregular, broken, black, transverse lines. Genital system of the simple "haplogon" type, the vas deferens and retractor terminal on the penis. Kidney long-triangular, nearly double the length of the pericardium. Jaw arcuate with a slight median projection below, entirely smooth. Radula with the centrals tricuspid, the ectocones diverging; laterals bicuspid; marginal teeth at first with the long cusp bifid (entocone + mesocone), then trifid (entocone + mesocone + ectocone), the outermost marginals shortened and simplified as usual. The whole anatomy agrees with *Guppya*, so far as that genus is known.



Jaw and teeth of *G. hopkinsi.*

EXPLANATION OF PLATE VIII.

Fig. 1. *Bulimulus hoodensis* Dall; alt. 18 mm., p. 91.
Fig. 2. *Bulimulus Snodgrassi* Dall; alt. 16.5 mm., p. 90.
Fig. 3. *Epiphragmophora crassula* Dall; alt. 15 mm., p. 100.
Fig. 4. *Bulimulus approximatus* Dall; alt. 17 mm., p. 90.
Fig. 5. *Guppya Hopkinsi* Dall; viewed from above, major diam. 6 mm., p. 97.
Fig. 6. The same, in profile.
Fig. 7. *Endodonta Helleri* Dall; profile; diam. 3 mm., p. 93.
Fig. 8. The same, viewed from above.
Fig. 9. The same, basal view, the basal lamellæ indicated by the lighter spots.
Fig. 10. *Leptinaria Martensi* Dall; alt. 10 mm., p. 97.
Fig. 11. *Vitrea actinophora* Dall; viewed from above, major diam. 4 mm., p. 93.
Fig. 12. *Succinea guadelupensis* Dall; alt. 8.5 mm., p. 102.
Fig. 13. *Vertigo cocosensis* Dall; alt. 2.2 mm., p. 98.
Fig. 14. *Epiphragmophora guadelupiana* Dall; major diam. 11 mm., p. 101.
Fig. 15. The same, in profile.
Fig. 16. *Vitrea actinophora* Dall; in profile, p. 93.
Fig. 17. The same, from below.
Fig. 18. *Epiphragmophora leucanthea* Dall; alt. 20 mm., p. 99.
Fig. 19. *Epiphragmophora Orcutti* Dall; alt. 16 mm., p. 104.
Fig. 20. *Epiphragmophora leucanthea* Dall; from below, major diam. 28 mm., p. 99.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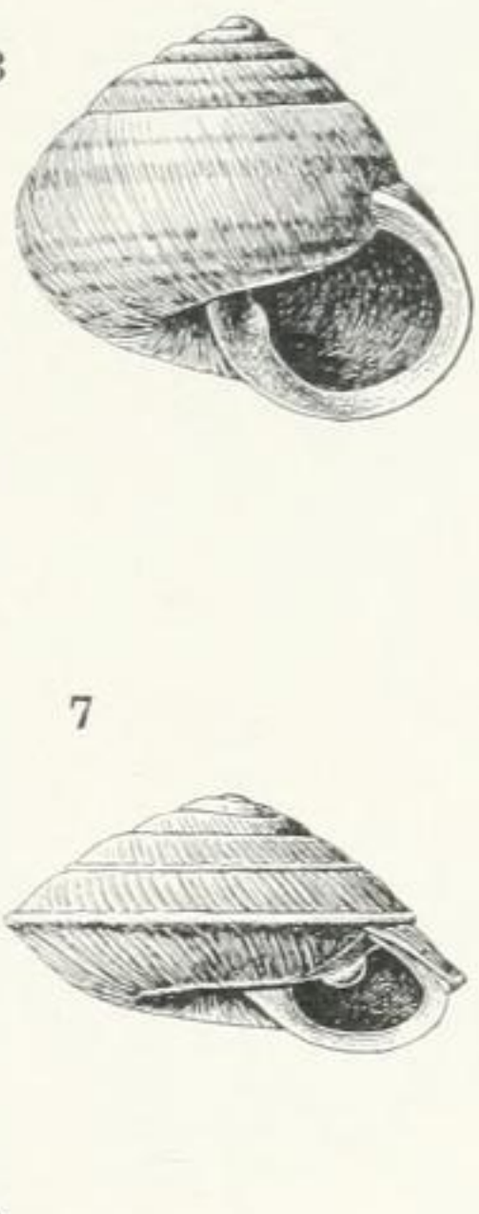
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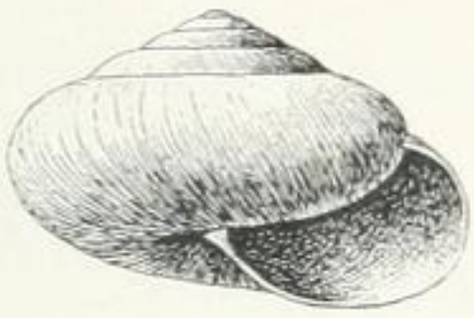
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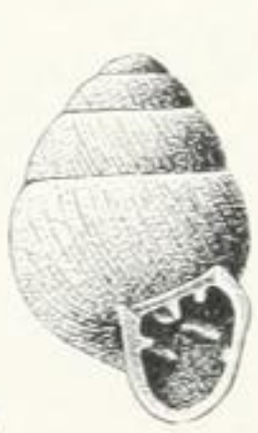
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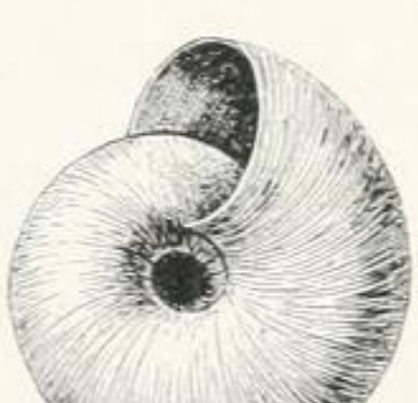
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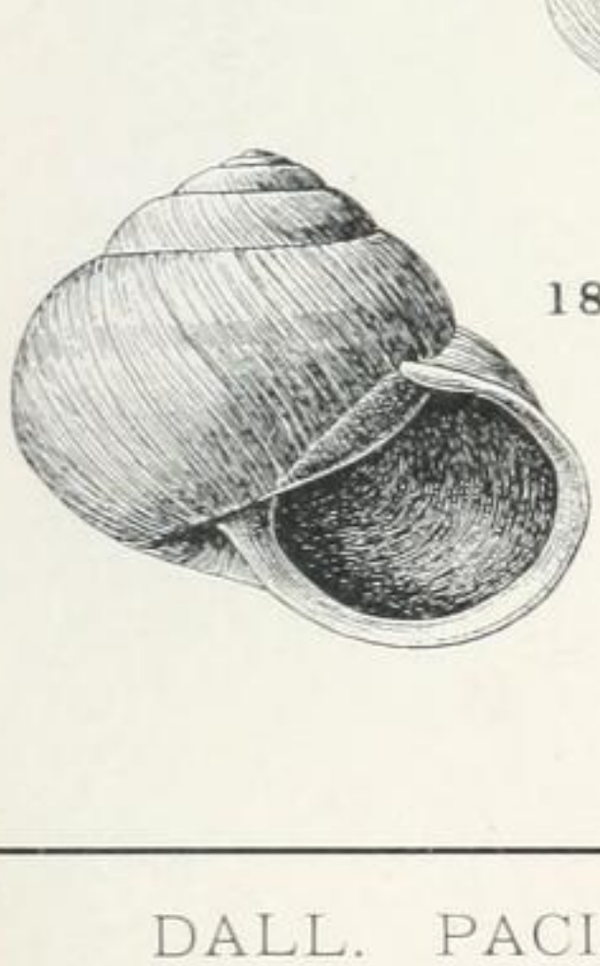
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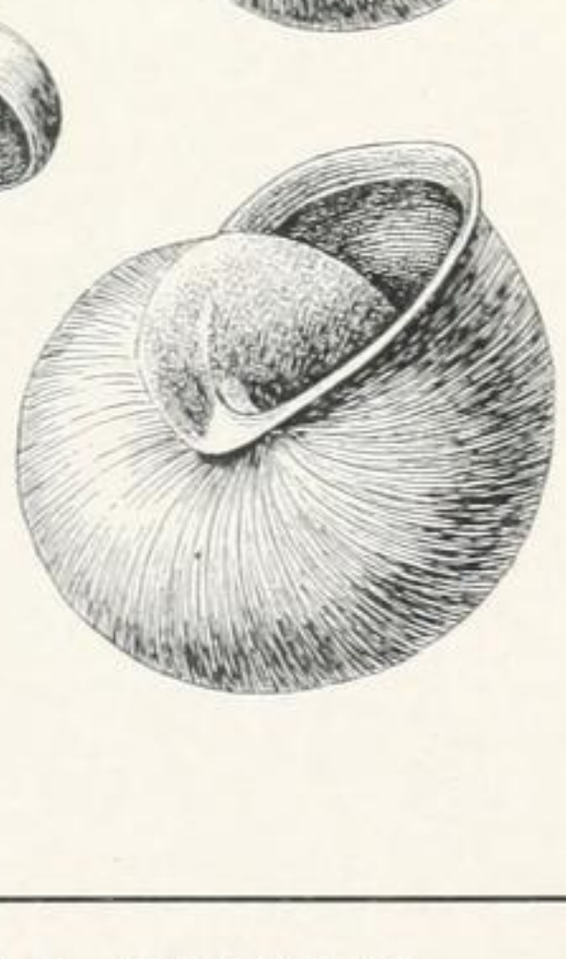
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