

LAND SHELLS OF MAKATEA

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The island of Makatea (Aurora, Metia, Matea) has probably not been visited by malacologists since the time of the United States Exploring Expedition (1839). The only references to the land shells of this island which I find in the available literature are those given by Gould or on specimens that probably came from him. Garrett, who lived for many years in the Society Islands and visited many other Polynesian islands, evidently did not visit Makatea. In his papers I find no allusion to Gould's species and in his collection no shells from this island.

Bernice P. Bishop Museum has been fortunate in receiving two large representative collections from the little-known island of Makatea. The first was a package of about a peck of soil, moss, and fragments of rotten wood from under a rotten log. This material was collected on "the northwest rim of the plateau, under heavy forest at about 300 feet elevation" by Mr. K. P. Emory in March 1930. After drying and sifting this material nearly 600 shells were picked out, and 16 species belonging to 10 genera were identified. This was more than three times the number of species recorded by Gould. All the shells were dead.

In October 1932, Mrs. G. P. Wilder, who accompanied her husband to Makatea on a botanical expedition, collected 8 packages of "sweepings" from under dead logs and stones, 7 packages of moss and lichens from stones and dead logs, and 5 vials of shells preserved in alcohol from the backs of the leaves of ti (*Taetsia fruticosa*) and fronds of the birdsnest fern (*Asplenium nidus*). These lots were collected from near sea level to 300 feet elevation.

Slightly more than 80 percent of the 2100 shells collected by Mrs. Wilder were found in sweepings from one locality at an elevation of 250 feet "gathered around coconut trees in pockets of coral rocks." All the shells were dead when collected. From this lot 15 species belonging to 11 genera were identified. Altogether 19 species belonging to 15 genera were identified from Mrs. Wilder's material, which contains all but 3 of the species now known to inhabit Makatea.

Besides the shells collected by Mrs. Wilder and by Mr. Emory, a

single specimen of *Nesopupa pleurophora* was found on a lichen in the Museum herbarium. This was collected by W. B. Jones in 1922.

All but 4 of the 22 species now known to inhabit Makatea have been reported from other Polynesian islands. One of these, *Cyclomorpha obligata*, has been identified with *Cyclomorpha flava* Broderip from the island of Anaa about 170 miles southeast of Makatea. Typical examples of both species are easily separated and, in the absence of any intergrading specimens, I have considered the two as distinct species. The only other species which might be considered endemic are *Microcystis pertenuis* (Gould), *Thaumatodon daedalea* (Gould), and *Aphanoconia trochlea* (Gould). None of these have been reported from any other island. The remaining 18 species belong to widely dispersed species most of which are common on several, if not most, of the Polynesian islands.

A few of the widely distributed Polynesian species of land shells are not found in the Makatean fauna in the material which I have examined. These are frequently found associated with the more common Makatean species. They are *Liardetia samoensis* (Mousson), *Trochonanina calculosa* (Gould), *Tornatellides simplex* (Pease), and *Assimineia nitida* (Pease).

From existing knowledge of the distribution of the species of land shells enumerated below, it is evident that the island of Makatea has a very low percentage of endemism. I have little hesitation in predicting that the four species now known only from this island may be found in the Society Islands or the neighboring islands of the Tuamotu Archipelago. It is probable that the remaining 18 species were accidentally introduced by man with the introduction of plants. Most of these were probably carried by Polynesians, but about six (*Gastrocopta lyonsiana*, *Pupisoma orcula*, *Subulina octona*, *Prosopeas javanicum*, *Opeas gracile*, and *Opeas clavulinum*) have arrived since the advent of the white race into the Pacific.

***Microcystis pertenuis* (Gould).**

Helix pertenuis Gould: Boston, Soc. Nat. Hist. Proc., vol. 2, p. 172, 1846; U. S. Expl. Exped., Mollusca, p. 45, pl. 5, figs. 60, a-c, 1852.

No shells belonging to this species were found by Mr. Emory or Mrs. Wilder. The depressed spire and the absence of the perforation

prevent this species from being confused with *M. discordiæ* Garrett, which was found by both Mr. Emory and Mrs. Wilder.

Microcystis discordiæ Garrett.

Microcystis discordiæ Garret: Acad. Nat. Sci., Phila. Jour., vol. 8, p. 383, 1881; vol. 9, p. 20, pl. 2, figs. 35, *a-b*, 1884.

This small zonitoid was abundant in the material collected by Mr. Emory, but only six were taken by Mrs. Wilder, from three localities. Two were alive. These were at first identified as *Microcystis pertenuis* (Gould), but on closer examination they proved to be *Microcystis discordiæ* Garrett. Although the periphery is obtusely angular, the spire is proportionately higher than the figure given by Gould, and all the specimens in Bernice P. Bishop Museum are perforate.

Most of the Makatean specimens are dead and somewhat smaller than those collected by Garrett in the Society Islands and have nearly one-half whorl less. One of them measures: diameter, 3.4 mm.; altitude, 2.3 mm.

Thaumatodon dædalea (Gould).

Helix dædalea Gould: Boston, Soc. Nat. Hist., Proc., vol. 2, p. 173, 1846; U. S. Expl. Exped., Mollusca, p. 54, pl. 4, figs. 51, *a-d*, 1852.

Although Gould gives Tahiti as one of the habitats of this species, it is not mentioned by Garrett in his "Terrestrial Mollusca of the Society Islands." Gould reports this species as abundant under stones. It was not found by Mr. Emory. Mrs. Wilder took a fine series of dead shells at an elevation of 250 feet in soil in pockets of coral rocks and a few at 300 feet under a dead coconut log. Two other small lots were taken at elevations of 250 and 300 feet in moss growing on coral rocks.

This species cannot be referred to any species from the Society Islands in the Garrett collection.

Libera species ?

A single dead and partly broken shell of this genus was taken in moss growing on coral stones by Mrs. Wilder at an elevation of 250 feet. It does not belong to any of the species from the Society Islands as represented in the Garrett collection. The periphery is extremely sharp, more so than in that of any other species, and the sutures are not impressed as in species from the Society Islands. The periphery

of each of the three median whorls extends over the whorl below as a slightly sharp, raised ridge. From these characters it is clearly more closely related to *Libera fratercula* from Cook Islands than to any species from the Society Islands. The surface texture, though badly worn, is finer than that of *L. fratercula*. The basal portion of the aperture is broken, so the complete armature of the aperture is lacking. Because the shell is incomplete, I hesitate to describe it as a new species.

Subulina octona (Brugière).

(For synonymy and distribution see Pilsbry, Man. Conch., vol. 18, pp. 73, 223, 1906.)

This widespread tropical species was taken by Mr. Emory and also by Mrs. Wilder, who found it at eight localities at elevations of 100 to 300 feet. As this species is present in Hawaii and other islands of the Pacific, I would assume that it will be found in all parts of Makatea from a few feet above high-water mark.

Prosopias javanicum (Reeve).

Achatina javanicum Reeve, Conch. Icon., vol. 5, pl. 17, fig. 79, 1849. (For synonymy and distribution see Pilsbry, Man. Conch., vol. 18, p. 138, 1906.)

Many shells of this species were taken by Mrs. Wilder at 250 feet. It is probably abundant all over Makatea associated with *Subulina octona* and *Opeas opananum*.

Opeas opananum (Pfeiffer).

Bulimus opananum Pfeiffer: Zool. Soc. London, Proc., p. 34, 1846. (For synonymy and distribution see Pilsbry, Man. Conch., vol. 18, p. 183, 1906.)

This species was collected by Mr. Emory and also by Mrs. Wilder, who found it at seven localities. The Makatean shells agree closely with those of this species collected by Mrs. J. F. G. Stokes on the island of Rapa in 1921.

Opeas gracile (Hutton).

Bulimus gracile Hutton: Asiatic Soc., Bengal, Jour., vol. 3, p. 84, 1834. (For synonymy and distribution see Pilsbry, Man. Conch., vol. 18, p. 125, 1906.)

I have referred to this species specimens collected by both Mr. Emory and Mrs. Wilder. These shells are more slender, with less

convex whorls, and smaller embryonic whorls than those referred to *O. opanum*. Many of these shells have whorls nearly as flat as specimens identified as *O. goodalli* from Oahu by Pilsbry, but they probably do not belong to this species, as the adult shells are somewhat larger than any from Oahu in the Bishop Museum collections. Those collected by Mrs. Wilder came from near or under logs, altitude 250 to 300 feet.

Opeas clavulinum (P. and M.).

Bulinus clavulinus Poties and Michaud: Gal. Moll. Mus. Donai, vol. 1, p. 136, pl. 14, figs. 9-10, 1838.

Opeas clavulinum Pilsbry: Man. Conch., vol. 18, p. 135, pl. 23, figs. 17, 21, 22, 1906.

Shells collected on Makatea are nearer to this species than to any other reported from the Pacific region. The outlines of the upper whorls are closer to Pilsbry's figure of *O. clavulinum* (pl. 23, fig. 21) than to *O. mauritianum* Pfeiffer or *O. opella* Pilsbry and Vanatta identified by Pilsbry in the Bishop Museum collection from Hawaii.

Mrs. Wilder's material consists of five lots from under or near dead logs and in pockets in stones, altitudes 250 to 300 feet.

Gastrocopta pediculus (Shuttleworth).

Pupa pediculus Shuttleworth: Naturf. Gesells. Bern, Mittheil., p. 296, 1852.

Gastrocopta pediculus Pilsbry: Man. Conch., vol. 24, p. 145, 1917.

Typical shells of this widespread Polynesian species were taken by Mr. Emory and by Mrs. Wilder. All were dead. Mrs. Wilder's material came from five localities under dead coconut logs, in soil from rock pockets, and from moss growing on coral rocks, altitudes 250 to 300 feet.

Gastrocopta lyonsiana (Ancey).

Pupa lyonsiana Ancey: Soc. Zool. France, Mem., vol. 5, p. 713, 1892.

Gastrocopta lyonsiana Pilsbry: Man. Conch., vol. 24, p. 141, 1917.

Shells agreeing with Ancey's type in Bernice P. Bishop Museum were found by both Mr. Emory and Mrs. Wilder but are much rarer than *G. pediculus*. Mrs. Wilder's material consists of only two specimens taken at altitude 250 feet, one in earth in rock pockets and one in moss growing on coral rocks.

Nesopupa pleurophora (Shuttleworth).

Pupa pleurophora Shuttleworth: Naturf. Gesells. Bern, Mittheil., p. 296, 1852.

Nesopupa pleurophora Pilsbry: Man. Conch., vol. 25, p. 326, 1920.

A fine series of this species was taken by Mr. Emory. Mrs. Wilder found a few in rock pockets, under rotten logs, and in moss, altitude 250 and 300 feet. Mr. W. B. Jones also collected one under lichens growing on a dead *Pandanus* log, altitude 300 feet.

At first I was inclined to place some of these specimens under *N. tantilla* (Gould). The more numerous teeth (8-9) of nearly all the shells would place them nearer to *N. pleurophora* than to *N. tantilla*.

Nesopupa armata (Pease).

Vertigo armata Pease: Zool. Soc. London, Proc., p. 461, 1871.

Nesopupa armata Pilsbry: Man. Conch., vol. 25, p. 327, 1920.

A few typical shells were taken by Mr. Emory. They are easily separated from those of *N. pleurophora* by being slightly longer and by the strong oblique upper palatal fold.

Pupisoma orcula (Benson).

Helix orcula Benson: Ann. Mag. Nat. Hist., vol. 6, p. 251, 1850.

Pupisoma orcula Pilsbry: Man. Conch., vol. 26, p. 31, pl. 2, figs. 1-5, 1920; vol. 27, p. 228, 1926 (Hawaiian reference).

Eight shells of what is probably this species were found in the Emory material. Mrs. Wilder collected a single live specimen on a ti leaf. They are much closer to shells figured by Pilsbry (especially his figure 2) than to Hawaiian shells identified by Pilsbry under this name. Compared to those from Hawaii, the Makatean shells are narrower, with a proportionately higher spire. The spiral lines on the base are easily made out with a high-powered lens.

Elasmias ovatum apertum (Pease).

Tornatellina aperta Pease: Zool. Soc. London, Proc., p. 673, 1864.

Elasmias ovatum apertum Pilsbry and Cooke, Man. Conch., vol. 23, p. 120, 1915.

Three typical examples of this subspecies were taken by Mrs. Wilder on leaves of shrubs, altitude 175 feet.

Lamellidea pusilla (Gould)

Partula pusilla Gould: Boston Soc., Proc., vol. 2, p. 197, 1847;

U. S. Expl. Exped., Mollusca, p. 83, pl. 7, figs. 90, 90a, 1852.

Tornatellina (Tornatellinops) pusilla Pilsbry and Cooke: Man. Conch., vol. 23, p. 176, 1915.

In the fine series of this species taken by Mr. Emory all stages of growth are represented. It was also taken by Mrs. Wilder from five localities, altitude 150 to 300 feet. All of these were dead when taken except one shell found by Mrs. Wilder on a ti leaf. Additional material was taken by Mrs. Wilder under dead coconut logs and in pockets in coral rocks.

An examination of Pease's type lots of *L. nitida* and *L. serrata* in the British Museum proves that the types of *L. serrata* represent paraneanic or metaneanic stages of *L. nitida*, which should be considered as a pure synonym of *L. pusilla*. *L. oblonga* (Pease) and *L. pusilla* (Gould) are two of the most widespread species of the genus. Their habit of living commonly on the ground on dead leaves and stones makes them easy subjects for transportation. Up to the present only *L. oblonga* has been found in Hawaii. Both species are found associated together in nearly all the groups of islands of the central Pacific.

Lamellidea oblonga (Pease).

Tornatellina oblonga Pease, Zool. Soc., Proc., p. 673, 1864.

Tornatellina (Lamellina) oblonga Pilsbry and Cooke, Man. Conch., vol. 23, pp. 160, 162, 1915.

A fine series of this abundant and widespread species was taken by Mr. Emory. The palatal rib was present in most of the juvenile shells.

Lamellidea (Tornatellinops) variabilis Odhner.

Pacificella variabilis Odhner, Nat. Hist. Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 249, pl. 8, figs. 15-17, 1922.

Lamellidea variabilis Pilsbry and Cooke, The Nautilus, vol. 47, p. 60, 1933.

This widespread form of Odhner's species was taken by Mrs. Wilder in six localities. Dead shells were taken under dead coconut logs, altitude 250 and 300 feet, live ones on the leaves of ti at 150 feet and on the backs of birdsnest fern at 10 feet. A single live specimen was taken in moss, altitude 250 feet. All these are typical when compared with material from Palmyra Island. A series of the same or a closely related species was found in the material collected by Mr. Emory.

Truncatella (Taheitia) scalariformis Reeve.

Truncatella scalariformis Reeve, Zool. Soc. London, Proc., p. 197, 1842; Pfeiffer, Mon. Auric., p. 191, 1856.

I have identified Makatean specimens of this species from shells in the Garrett collection labeled "Paumotu Is.," which were collected by Garrett and probably came from the island of Anaa. They may have been part of the original stock upon which Mousson based his *T. arctecostata*. The Makatean shells differ slightly in that the sutures are not impressed and the whorls are nearly flat, the whole shell being nearly cylindrical. They have the characteristic costae of Garrett's shells. Makatean shells are about 6.5 mm. long, with from 29 to 38 costae on the last whorl. This species was collected by Mr. Emory and also by Mrs. Wilder, who found specimens at eight localities under dead logs, stones, and in moss growing on stones, altitude 100 to 300 feet.

From one locality at 250 feet, Mrs. Wilder collected a few shells which are somewhat larger than most of the others. One of them measures 7.5 by 2.7 mm. with slightly more than 4 whorls; in this there are 33 costae on the last whorl. In the juvenile shells the embryonic whorls are smooth and slightly wider than the first post-embryonic whorl. One of these with $9\frac{1}{2}$ whorls is 7 mm. long.

Cyclomorpha obligata (Gould).

Cyclostoma obligatum Gould, Boston Soc. Nat. Hist., Proc., vol. 2, p. 205, 1847; U. S. Expl. Exped., Mollusca, p. 104, pl. 8, figs. 119, 119a, 1852.

A single lot of this species was taken by Mrs. Wilder, altitude 100 feet, at the top of the high bluff above the beach. These are typical specimens agreeing with Gould's description and figure. Most authors have united this species with Broderip's *C. flava* from the island of Anaa. The two forms are easily separated, *C. obligata* being consistently larger and ash-colored, the last whorl sculptured with 10 to 12 strong, sharp, widely spaced spiral ridges, which are as strong below the periphery as above. In *C. flava* the shells are smaller, yellow-orange, with about 20 low, rounded, closely spaced spiral ridges which are less conspicuous below than above the periphery. A typical specimen of *C. obligata* measures 10.7 by 9.0 mm., $5\frac{2}{3}$ whorls; and of *C. flava*, 7.8 by 6.8 mm., $5\frac{1}{2}$ whorls.

Aphanoconia trochlea (Gould).

Helicina trochlea Gould, Boston Soc. Nat. Hist., Proc., vol. 2, p. 202, 1847; U. S. Expl. Exped., Mollusca, p. 99, pl. 7, figs. 109, a-c, 1852.

This species was taken by Mr. Emory and by Mrs. Wilder from six localities, altitude 100 to 300 feet, under stones and dead logs at the roots of ferns. The shells agree well with Gould's description and figure. There is considerable individual variation in the number and degree of development of the supra-peripheral spiral ridges. Including the peripheral ridge, there may be as few as 5 in some shells; in others as many as 8 or 9. Where there are only a few ridges they are of nearly equal strength; but where many they are of unequal development. Below the periphery the base is marked with fine, almost cuticular, closely spaced spiral lines.

This interesting little species has no close relatives either from other Tuamotuan islands or from the Society Islands. It is not included in Wagner's Helicinidae.

Georissa striata (Pease).

Chondrella striata Pease, Zool. Soc. London, Proc., p. 477, 1871; Garrett, Acad. Nat. Sci. Phila., Jour., p. 106, pl. 3, fig. 40, 1884.

Many shells of this minute species were taken by Mr. Emory and by Mrs. Wilder. Those collected by Mrs. Wilder are from six localities, altitudes 200 to 300 feet, in moss on stones and around fern roots, and also under stones and dead logs.

Two forms appear in the material from Makatea. Both agree in all characters except that in the typical form all the whorls except the embryonic are covered with close spiral striae. In the second form, which is far more abundant and sometimes occurs in pure colonies, the last whorl is nearly smooth and without spiral sculpture. The penultimate and other post-embryonic whorls are sculptured as in the typical form. The typical form was found associated with the much commoner smooth form in only three colonies.

\$2