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CONTRIBUTION TO THE BIOGEOGRAPHY OF COCOS ISLAND, INCLUDING A BIBLIOGRAPHY

by

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INTRODUCTION

The author's interest in Cocos Island was stimulated by an opportunity to collect mollusks on the island in 1932, during the return of an expedition to the Galápagos Islands on G. Allan Hancock's motor cruiser *Velero III*. The results of a study of these mollusks are contained in two papers, one on marine species (Hertlein, 1932) and one dealing with non-marine and brackish-water species (Hanna and Hertlein, 1938).

The present paper presents information concerning the species of mollusks which I collected, including those reported on in various publications, and summarizes what is known about the relationships and the zoogeographical significance of this assemblage.

In addition to this, during the course of this study, information was accumulated concerning the occurrence and distribution of representatives of other phyla of organisms reported from Cocos Island. This information is included under each major category along with the names of authors and dates of pertinent references, which are included in the bibliography. However, no attempt has been made to include all the phyla or all the species reported from Cocos and scattered throughout the literature. I believe, however, that the biota here mentioned is representative of the island.

ACKNOWLEDGMENTS

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Miss Veronica Sexton, Librarian, California Academy of Sciences, aided in making available needed literature, some of which was lent by the University of California, or consulted in the Bancroft Library, University of Washington, University of Missouri, University of Chicago, San Francisco Public Library and Seattle Public Library.

Mr. William Old, Jr., American Museum of Natural History, New York City, kindly checked certain references in the libraries available to him. Mr. Robert I. Nesmith, Curator, Foul Anchor Archives, Rye, New York, furnished information concerning manuscripts and published literature concerning Cocos Island. Mr. William A. Coolidge, Cambridge, Massachusetts, generously lent me a copy of a rare paper dealing with an expedition to Cocos Island by his brother, Amory Coolidge. Dr. Bruce Halstead, World Life Research Institute, Colton, California, and Mr. B. Joseph O'Neil, Boston Public Library, also furnished useful information.

Photographs of the Island were made available by Dr. John S. Garth, Allan Hancock Foundation, and Mr. Don Ollis, Santa Barbara, California.

GENERAL REMARKS

Cocos Island lies at 5° 32′ 57″ North Latitude and 86° 59′ 17″ West Longitude, about 500 kilometers (300 miles) west of Costa Rica and about 630 kilometers (350 miles) northeast of the Galápagos Islands. This island was known to mariners and cartographers at least as early as the first half

of the sixteenth century for it was first shown as "Y^{e} de Coques" on a map by Nicholas Desliens, in 1541 (Anonymous, 1920, p. 15).

The name of this island appeared on many maps and in various publications during the following centuries. The abundance of fresh water, wood, pigs, sea fowl, fish, and coconuts, and the ease with which they could be obtained, made this small island a favorite stopping place of pirates, privateers, and whaling vessels (Colnett, 1798, p. 73, mentioned placing 2000 coconuts on board the *Rattler* when he stopped there in 1793). The names of various ships (see Hancock and Weston, 1960, pp. 300–302) carved in the rocks at Chatham Bay are reminders of these early visitors. Two bays offer anchorage for ships. Wafer Bay is the more attractive for visitors but

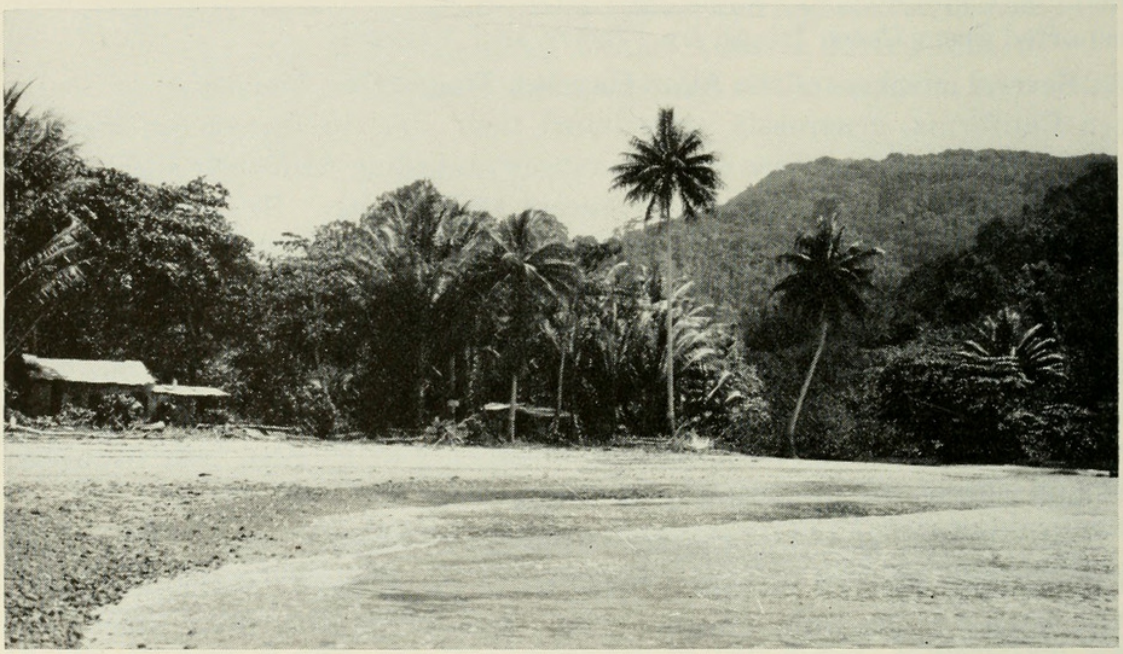

FIG. 1. Wafer Bay, Cocos Island, at the mouth of Arroyo del Genio. View showing sandy beach, dense vegetation, and a small house used by treasure hunters. (Photograph by John Garth, 1931.)

Chatham Bay, on the northeast side of the island, is more sheltered from the prevailing winds and offers more secure anchorage. In 1936, the government of Costa Rica issued stamps of several denominations on which an outline map of the island appears.

Politically, Cocos Island belongs to Costa Rica which country exercised sovereignty over it when, in 1888,[1] August Gissler was nominated Governor of the island (see Anonymous, 1920, p. 23) with a concession to search for treasure. The circumference of Cocos is about 23.3 kilometers (13 nautical miles or 14.6 statute miles), and the land area comprises approximately 46.6 square kilometers. The highest point, located in the western portion of the

1. Molina, 1851 (p. 27), mentioned that Cocos Island belonged to Costa Rica.

island, is reported to be 849.8 meters (2,788 feet) above sea level (see Anonymous, 1935, U.S. Hydrographic Office chart 823, South Pacific sheet 1; Anonymous, 1945, U.S. Hydrographic Office chart 1685, ed. 9).[2] Much of the coast is abrupt, and in places towering cliffs reach a height of 182.88 meters (600 feet). Chubb (1933, p. 27) remarked on these high cliffs and stated: "It is clear that when the cliffs were being formed the island stood some two or three hundred feet higher above sea level than it does now, but that since then either it has subsided or the sea level has risen, with the result that the lower part of the cliffs is submerged and the lower reaches of the mature river valleys are flooded." He also remarked that at some places a shore-shelf a few feet above sea level is evidence of post-Pleistocene fall in the sea level.

The island is composed of volcanic agglomerates, tuffs, and chiefly of lava flows of labradorite-andesite and hornblende labradorite-andesite (Chubb, 1933, p. 29). It is situated upon the southwestwardly trending Cocos Ridge (Shumway, 1954) which in general lies about 1829 meters (1000 fathoms) below sea level. Chubb (1933, p. 30), concluded from a study of the rocks that "The Cocos Island analyses [of andesite] compare fairly closely with those of the Galapagos basalts, but their alumina and potash content is higher, and their lime content is lower. Except for their abnormally high alumina content they compare better with labradorite-andesites from Rapa and Tahiti." Macdonald (1949, p. 1588), however, believed that knowledge of the composition of the rocks on Cocos Island is not sufficient to justify placing it in the mid-Pacific petrographic province.

Sedimentary rocks have been mentioned [Pittier, 1899, p. 144; Chavarría Mora (in Pittier), p. 158; Thomas, 1960, p. 34] as occurring on the island but if present there, the details are vague.

Cocos Island, in general, lies within the path of the eastward flowing equatorial counter current. Occasionally, however, southward shifting of currents brings the island under the influence of currents sweeping westward from the mainland (see figures 3 and 4). The temperature of the air ranges between 20°C. (68°F.) and 33.3°C. (92°F.) (Stewart, 1912, p. 378), and the months of greatest rainfall are reported to be May, June, and July, although there is heavy rainfall throughout the year. The surface temperature of the sea water is reported to be about 26.7°C. (80°F.) but there is a mean annual variation of about 5°C. (10°F.).

This beautiful and picturesque island is densely covered with vegetation in which palms and cecropia trees are conspicuous. Abundant rainfall gives rise to numerous waterfalls which plunge over steep cliffs. Flocks of sea birds (terns, noddies, Frigate-birds, and boobies), flying about the bays, and others perched in the trees, add to the attractiveness of the scene.

2. According to Murphy (1936, p. 317), "The central hills rise to an altitude of 518 meters, which is much less than is commonly credited to them."

FIG. 2. East side of Cocos Island, just south of Chatham Bay. View showing cliff, waterfall, and dense vegetation. (Photograph by Don Ollis, December 26, 1952.)

Any attempt to penetrate inland, however, is accomplished with difficulty because of the rough and irregular land surface which is covered by dense rain forest. Attempts to follow the bed of the stream emptying into Chatham Bay or the one in Arroyo del Genio (also cited as Canyon del Infierno on some maps) at Wafer Bay, is fraught with difficulty. The rocks in the stream and along the banks are very slick, and the stream bed is frequently interrupted by cliffs forcing the traveler to make a torturous detour. The presence of a particular fly, *Leucomelina pica*, and a species of ant, *Wasmannia auropunctata*, also add to the discomfort of such an adventure. One shipwrecked adventurer (Palliser, Brawner and Stachwick, 1932, p. 134) described his attempt to cross the high ridge between Wafer Bay and Chatham Bay, a distance over water, by boat, of about 1.6 kilometers (1 mile). He lost his way in the dense jungle growth of trees, vines, tall sharp-edged grass, was drenched by frequent torrential rains, and after other harrowing experiences, found his way back to Wafer Bay only after

several days had elapsed. Travel over the plateau-like top of the island is reported to be less difficult.

Cocos Island is best known from traditional accounts of treasure reputed to be buried there about 1819–1820, the value variously estimated at 60 to 100 million dollars. A large portion of this is supposed to have been placed there by a pirate, Benito Bonito (alias Bennett Graham) of the *Relampago,* who looted cities and ships along the coast of South America. Tradition has it that additional treasure was buried on the island by Captain William Thompson.

According to this latter story, a revolution in Peru, in 1820, led authorities in Lima to entrust for safe-keeping to Captain Thompson of the *Mary Dear* the "treasure of Lima," gold and jewels said to be valued at many millions of dollars. The vessel made its way to Cocos Island where the treasure was reputedly buried at Wafer Bay. The subsequent search with expenditure of much time, energy, and money has led to over 400 expeditions (Riesenberg, 1951, p. 5) of which at least 25 were well-equipped major expeditions. Captain August Gissler spent nearly 18 years searching for the treasure.

Although it has been rumored from time to time that these treasure-troves have been found, so far as is definitely substantiated, no one has found them, other than an occasional coin the source of which is unknown. A vast amount of literature has grown up based upon these fascinating legends of treasures and the search for them. Many references to this subject are contained in the bibliography.

For additional general information concerning Cocos Island see the following: Anonymous (1920; 1939b; 1945; 1951); Beebe (1926); Belcher (1843); Campbell (1932; 1934); Collenette (1926); Dampier (1729); Fraser (1943); Gueydon (1948); Hancock and Weston (1960); Lièvre (1893); Nesmith (1958); Pittier (1899); Rogers (1931); Rose (1926); Schmitt (1939a); Slevin (1931); Snodgrass and Heller (1902); Vancouver, 1798; Wafer [1699 (1903)].

BIOGEOGRAPHY

An excellent summary of the zoogeography of the vertebrate fauna of Cocos Island was published by Schmidt (1930). The general consensus of most authors who have given careful consideration to this subject is that the island received its fauna and flora by transport over open water and that the endemic species have arisen because of geographic isolation.

The vertebrate fauna of Cocos Island consists of two lizards and seven land birds. Townsend reported a snake (not identified as to genus or species) from this island, but this record has not been substantiated by any subsequent collection from there. The lizards and three endemic land birds

differ from any other species, but their closest relatives live in Central America. There are no native mammals. A rat, *Rattus norvegicus,* is reported to have reached the island, undoubtedly from some of the many ships which have anchored there or from an occasional shipwreck. Pigs have been introduced, and evidence of their destructive influence is noticeable at many places. There are also reports of other domestic animals including cats, goats, deer, chickens, and even monkeys (Thomas, 1960, p. 34), introduced on the island intentionally or otherwise, and many of these appear to have become established as permanent members of the animal community.

The composition of the known invertebrate land and marine fauna is predominantly eastern Pacific in affinities. The evidence as to the origin of the sparse land snail fauna may be considered equivocal. Some authors consider their affinity to be with Indo-Pacific forms, others consider the relationship to be with American species. It is probable that some elements of the land snail fauna were derived from Central America, and some from Polynesia.

The most comprehensive study of the land plants of Cocos Island is by Stewart (1912). He reported that eight species, 8.69 per cent of 77 vascular plants, are endemic. Twenty-seven species also occur on the Galápagos Islands where the endemicity was reported to be 40.9 per cent. Stewart (1912, pp. 381–383) believed that the flora is that of an oceanic island, of more recent origin than that of the Galápagos Islands, and that its flora was derived chiefly from the mainland by chance agencies such as winds, ocean currents, and migratory birds. He, furthermore, concluded that there is no evidence to indicate that the island ever was connected by land with the mainland or with the Galápagos Islands.

Svenson (1935, p. 259) following Johnston (1931, p. 35), mentioned that the flora of Cocos Island consists of about 100 species of which about 10 are endemic, consisting overwhelmingly of ferns, melanostomes, and orchids. He stated that with the exception of the ferns, virtually none of these species occur in the Galápagos Islands.

More recently Vinton (1951), in discussing a possible explanation for the derivation of the Galápagos fauna and flora, suggested a peninsula extending southwest from Costa Rica to within a hundred miles of the Galápagos Islands. He postulated that such a land area existed during Miocene time, and included the locality now occupied by Cocos Island (see his fig. 1). It was also his belief that such a land area would have deflected the currents at that time when an open seaway existed across Panama. He remarked on the recent origin of Cocos Island and suggested a probable Pleistocene age for it. He agreed in general with Stewart's opinion concerning derivation of the fauna and flora.

Schott (1931) published an excellent discussion concerning the shifting of oceanic currents, north and south, in the Panamic and northwestern

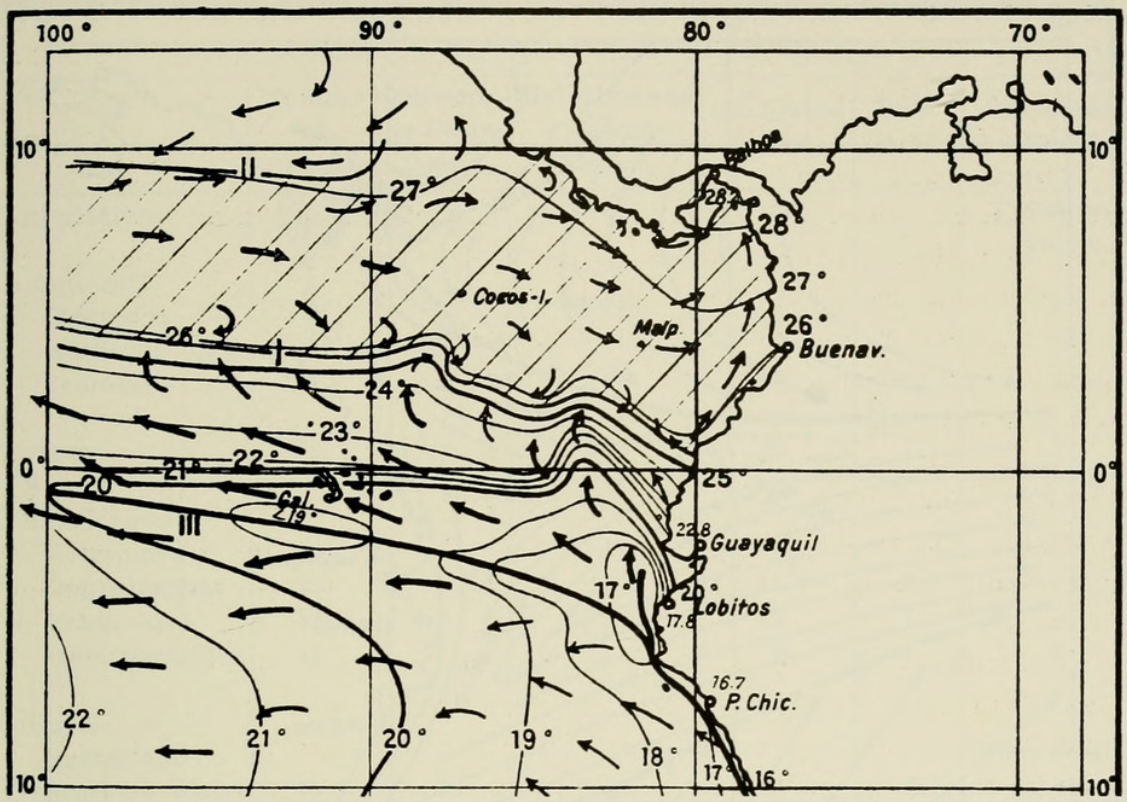

FIG. 3. Copy of illustration by Schott (1931, plate 20, figure 1) showing position of Cocos Island and the course of the equatorial countercurrent during August–September of a normal year.

South American region. He reported that this shift takes place about every seven years, and a decided displacement about every thirty-four years. The effect which this phenomenon produced upon the climatic and biological features in this region was described by Murphy (1936, pp. 102–108). Later Garth (1946) discussed the effect of this shifting of oceanic currents upon the composition of the brachyuran (crab) fauna of the Galápagos Islands. This same shifting of currents whereby Cocos Island is at times in the path of the Equatorial Countercurrent, and at other times under the influence of westwardly directed currents from off the mainland, can be invoked to explain the means of transportation by which the island received most of its invertebrate marine fauna.

The percentage of Indo-Pacific species in the invertebrate fauna of Cocos Island is small, except in the assemblage of corals and in those groups in which the species have an exceptionally wide distribution, such as the Holothurioidea. These species from the western Pacific may have reached the island by the agency of transpacific currents, directly, or conceivably by progressing eastward from one atoll to another or to truncated submarine islets (guyots) (see Ladd, 1960, pp. 143–145) which are known to exist in some places in the eastern Pacific.

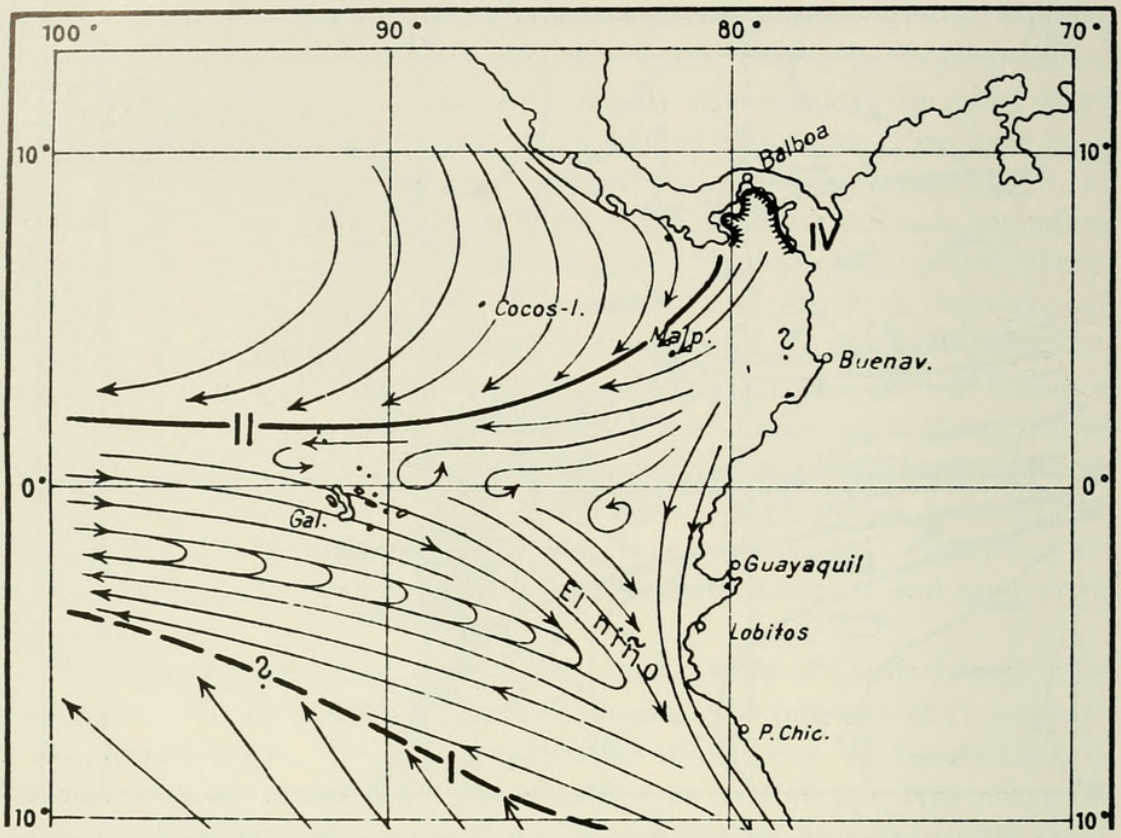

FIG. 4. Copy of illustration by Schott (1931, plate 21, figure 3) showing position of Cocos Island and the course of the current westward from along the American mainland of Central America during March, 1891, a year of extreme displacement southward of the currents.

Very few species of invertebrates in the marine fauna of Cocos Island are identical with Caribbean or Atlantic forms but many closely related species occur in that region.

The following tabular summary indicating the distribution of the species of a few biologic categories (mostly those represented by a number of species), although based on lists which undoubtedly do not include all the species which may exist on the island, reveals the general interregional relationship of these groups. Additional collecting, especially in this and other tropical eastern Pacific islands where corals occur abundantly, may result in changes in the percentages of marine species shown in the various regions. I believe, however, that the general affinities of the fauna are revealed in this table. Additional remarks on the distribution and affinities of the phyla accompany the lists of species included under their respective categories in the following pages.

From the evidence of known distribution of the genera and species, I am inclined to agree with Stewart, Schmidt, and Vinton that the biota of Cocos Island was derived chiefly from the mainland, by the chance agencies of wind, ocean currents, birds, or pelagic mammals.

TABLE 1. *Number and general distribution of species of particular groups of animals reported from Cocos Island.*

	Number of Species	Endemic on Cocos Island	Mainland and Panamic Region	Galápagos Islands	Indo-Pacific	Caribbean-Atlantic
Foraminifera	17		14	13		1 Mediterranean
Coelenterata						
Hydrozoa	5		5	3		1
Anthozoa (corals)	18	1	12	10	10	1
Bryozoa	20		18	20	1	2
Echinodermata						
Asteroidea	6		4	5		
Ophiurioidea	15		15	12	1	
Echinoidea	13	1	12	10	1	
Holothurioidea	11		11	6	8	2
Mollusca						
Marine and Brackish-Water	88	5	74	38	5	Many related species
Land snails	9	7			1 or 2	
Annelida	9		4	4	1	1
Arthropoda (Crustacea)						
Brachyura	33		30	23	3	2
Anomura	17	2	11	10 (or 11)	4	1
Myriopoda	7	3	4			
Pisces	59	5	38	20	16	
Reptilia (lizards)	2	2	Related species			
Aves (land birds)	7	3	4			

ZOOLOGY

Phylum PROTOZOA

Class SARCODINA

Order **Foraminifera**

Ammodiscus pacificus Cushman and Valentine. Southern California to Panama; Galápagos Islands.

Dentalina filiformis d'Orbigny. Mainland; Galápagos Islands.
Dentalina cf. *D. jugosa* Williamson. Galápagos Islands. Monaco.
Eggerella advena Cushman. Cordova, Alaska, to Peru.
Haplophragmoides hancocki Cushman and McCulloch. Ketchikan, Alaska, to Peru; Galápagos Islands.
Lagena striatopunctata var. *excentricitas* Cushman and McCulloch. Galápagos Islands.
Nouria polymorphinoides Heron-Allen and Earland. West Mexico to South America; Galápagos Islands.
Reophax agglutinatus Cushman. Mainland; Galápagos Islands.
Reophax excentricus Cushman. Mainland; Galápagos Islands.
Textularia articulata d'Orbigny. Southern California to Sechura Bay, Peru.
Textularia conica d'Orbigny. Gulf of California to Colombia; Galápagos Islands.
Textularia corrugata Heron-Allen and Earland. Gulf of California to Ecuador; Galápagos Islands.
Textularia panamensis Cushman. Gulf of California to Peru.
Textularia schencki Cushman and Valentine. Southern California to Central America; Galápagos Islands.
Trochammina charlottensis Cushman. San Francisco, California, to Colombia; Galápagos Islands.
Trochammina nitida H. B. Brady. Cordova, Alaska, to Sechura, Peru.
Vaginulina exilis Cushman and McCulloch. Galápagos Islands.

These 17 species of foraminifera were reported from Cocos Island by Cushman and McCulloch (1939; 1950) and Lalicker and McCulloch (1940). Fourteen of these also occur on the mainland and 13 are reported from the Galápagos Islands.

Phylum COELENTERATA

Class HYDROZOA

The following species were reported from Cocos Island by Fraser (1938; 1948).

Clytia cylindrica A. Agassiz. Colombia to Peru; Galápagos Islands.
Gonothyraea gracilis Sars. Costa Rica to Peru; Galápagos Islands.
Halecium washingtoni Nutting. California to Peru.
Obelia commissuralis McCrady. Mexico to Panama; Atlantic.
Thuriaria orisioides Lamouroux. Mexico to Colombia; Galápagos Islands.

These 5 species all live on the mainland coast, and 3 have been reported from the Galápagos Islands. This class probably is represented on Cocos Island by more species than shown in the present list assembled from only a cursory search in papers published by Fraser.

Class ANTHOZOA

Order **Pennatulacea**

Family **Pennatulidae**

Leioptilus undulatus Verrill [Boone (1933, pp. 16, 57, pl. 19) reported *Ptilosarcus gurneyi Gray* (not *P. gurneyi* Gray, 1860), from Cocos Island. Deichmann (1941a, p. 13) later referred this record to *Leioptilus undulatus*]. Magdalena Bay, Baja California, to the north end of the Gulf of California and south to Panama.

Order **Scleractinia**

(Corals)

The following species have been reported from Cocos Island by Durham and Barnard (1952) and Durham (1962). These, with their geographic ranges follow:

Astrangia dentata Verrill (Durham, 1962, pp. 45, 46, 52). La Paz, Baja California, to Panama.

Astrangia hondaensis Durham and Barnard (1952, p. 73; Durham, 1962, pp. 44, 46). Questionably from Cocos Island and the Galápagos Islands.

Balanophyllia scheeri Durham (1962, pp. 45, 46, 53). Known only from Cocos Island.

Cladocera debilis Milne Edwards and Haime (Durham and Barnard, 1952, p. 58; Durham, 1962, pp. 44, 46). Galápagos Islands; Atlantic.

Cycloseris mexicana Durham and Barnard (1952, p. 53; Durham, 1962, pp. 44, 46). Gulf of California to La Libertad, Ecuador; Galápagos Islands.

Endopachys vaughani Durham and Barnard (1952, p. 103; Durham, 1962, pp. 44, 46). Gulf of California; Galápagos Islands.

Leptoseris digitata Vaughan (Durham and Barnard, 1952, p. 36; Durham, 1962, pp. 44, 46). Questionably from Cocos Island; Gorgona Island, Colombia, to La Plata Island, Ecuador; Hawaiian Islands; Andaman Islands.

Pavona (Pavona) cf. *P. (P.) explanulata* Lamarck (Durham and Barnard, 1952, p. 42; Durham, 1962, pp. 44, 46). Clipperton Island; Indo-Pacific.

Pavona (Pavona) varians Verrill (Durham, 1962, pp. 45, 46, 50). Colombia; Hawaiian Islands; Great Barrier Reef; Red Sea.

Pavona (Polyastra) ponderosa Gardiner (Durham, 1962, pp. 45, 46, 50). Bonin Islands; Maldive Islands.

Pocillopora damicornis Linnaeus (Durham, 1962, pp. 45, 46, 48). Panama; Galápagos Islands; to Indian Ocean.

Pocillopora elegans Dana (Durham, 1962, p. 45, 46, 48). Gulf of California to the Galápagos Islands; Indo-Pacific.

Pocillopora meandrina Dana (Durham, 1962, pp. 45, 46, 48). Gulf of California; Indo-Pacific.

Pocillopora verrucosa Ellis and Solander (Durham, 1962, pp. 45, 46, 48). Gulf of California; Galápagos Islands; Clipperton Island; to Indian Ocean.

Porites excavata Verrill (Durham, 1962, pp. 45, 46, 51). Panama.

Psammocora profundacella Gardiner (Durham, 1962, pp. 45, 46, 49). Galápagos Islands; Fanning Island; Funafuti Island.

Psammocora (Stephanaria) stellata Verrill (Durham and Barnard, 1952, p. 30; Durham, 1962, pp. 44, 45, 46, 49). Gulf of California to La Libertad, Ecuador; Galápagos Islands; Hawaiian Islands; Fiji.

Tubastrea tenuilamellosa Milne Edwards and Haime (Durham, 1962, pp. 45, 46, 54). Gulf of California to Panama; Galápagos Islands.

Eighteen[3] species of corals (three identifications doubtful) have been reported from Cocos Island and of these fourteen are reef-building (hermatypic) forms. One species is known only from Cocos Island. Twelve species (one identification doubtful) live along the eastern Pacific mainland or in the Panamic province and 10 species (one identification doubtful) live in the Galápagos Islands. Ten species (two identifications doubtful) also live in Indo-Pacific waters. Only one of the 18 species occurs in Atlantic waters.

Phylum BRYOZOA

The following list of species of Bryozoa from Cocos Island, and their occurrence elsewhere, was generously furnished by Dr. John D. Soule.

These species are all from Allan Hancock Foundation sample number 328, Chatham Bay, Cocos Island, in 25.6 meters (14 fathoms), February 13, 1938. Three of these species, as indicated in the list, also were represented in Allan Hancock Foundation sample 330, Chatham Bay, Cocos Island, in 85.95 meters (47 fathoms), February 14, 1938.

A few species of Bryozoa from Cocos Island were mentioned by Osburn (1950; 1952).

Aplousina filum (Jullien), 1903. Previously reported from the Gulf of California; Cocos Island; Octavia Rocks, Colombia; Galápagos Islands.

Cellaria veleronis Osburn, 1950. Originally reported from the Galápagos Islands. This is the first record of its occurrence from Cocos Island.

Chaperiella condylata (Canu and Bassler), 1930. Common in the Galápagos Islands. It ranges from southern California to the Galápagos Islands. No prior record from Cocos Island.

Cleidochasma contracta (Waters), 1899. Previously reported from the

3. According to Dr. J. W. Durham (verbal communication, October 3, 1962), his record (1962, p. 51) of the occurrence of *Porites californica* Verrill from Cocos Island, is incorrect.

Galápagos Islands and the Gulf of California. No prior record from Cocos Island.

Colletosia radiata (Moll), 1803. Widely distributed from the cool temperate waters off Oregon to the Galápagos Islands. No prior record from Cocos Island.

Copidozoum tenuirostre (Hincks), 1880. Known from northern California to the Galápagos Islands. No prior record from Cocos Island. (Also present in sample 330.)

Crepidacantha poissoni (Audouin), 1826. Ranges from the Channel Islands, California, to the Galápagos Islands. No prior record from Cocos Island.

Crepidacantha setigera (Smitt), 1873. Previously reported from Cocos Island, Galápagos Islands and Florida.

Discoporella umbellata (Defrance), 1823. Common from Point Conception, California, to Point Santa Elena, Ecuador, including the Gulf of California, the coast of Costa Rica, and the Galápagos Islands.

Enantiosula manica Canu and Bassler, 1930. Reported from the Gulf of California, Cocos Island, and the Galápagos Islands. (Also present in sample 330.)

Holoporella brunnea (Hincks), 1884. Abundantly represented from off British Columbia to the Galápagos Islands. No prior record from Cocos Island. (Also present in sample 330.)

Micopora coriacea inarmata Soule, 1959. Common in the Gulf of California. Reported from the Galápagos Islands. No prior record from Cocos Island.

Microporella ciliata (Pallas), 1766. Common from the coast of Oregon to the Galápagos Islands. No prior record from Cocos Island.

Microporella marsupiata (Busk), 1860. Known from the Gulf of California and the Galápagos Islands. No prior record from Cocos Island.

Parellisina curvirostris (Hincks), 1862. World wide in tropical and temperate waters. No prior record from Cocos Island.

Reptadeonella violacea (Johnston), 1847. Previously reported from the Gulf of California, coast of Mexico, Cocos Island, and Galápagos Islands.

Reteporellina denticulata gracilis Osburn, 1952. Recorded previously from the Gulf of California, Cocos Island, and the Galápagos Islands.

Retevirgula areolata (Canu and Bassler), 1923. Ranges from southern California to the Galápagos Islands. Common at the Galápagos Islands. No prior record from Cocos Island.

Trypostega venusta (Norman), 1864. Previously reported from the Gulf of California, the coast of Mexico, Cocos Island, and the Galápagos Islands.

Tubulipora flexuosa (Pourtales), 1867. Previously reported from the Gulf of California and the Galápagos Islands. No prior record from Cocos Island.

Eighteen of the 20 species in this list live along the mainland in tropical eastern Pacific waters. All are known to live in the Galápagos Islands, 9 in California waters, 2 in the Caribbean area one of which occurs world-wide in tropical and temperate waters.

Phylum BRACHIOPODA

Family **Rhynchonellidae**

Hispanirhynchia? craneana Dall [as *Hemithyris craneana* Dall, 1895, p. 717; 1920, p. 288; Hertlein and Grant, 1944, p. 60 as "*Hispanirhynchia* [?]" *craneana*].

This species was originally dredged off Cocos Island in 2149 meters (1,175 fathoms). It has not been reported elsewhere.

Phylum ECHINODERMATA

Class Asteroidea

The following is a list of the species of Asteroidea from Cocos Island and their occurrence elsewhere. The records of species not previously reported from this island were furnished by Mr. Fred Ziesenhenne.

Coronaster marchenus Ziesenhenne (1942, p. 212). Galápagos Islands.

Linckia columbiae Gray (Ziesenhenne, 1962, written communication). California to Peru; Galápagos Islands.

Narcissia gracilis A. H. Clark (Ziesenhenne, 1962, written communication). Gulf of California; Galápagos Islands.

Oreaster occidentalis Verrill (H. L. Clark, 1940, p. 333). Mexico to Peru; Socorro and Clarion Islands, Revillagigedo Islands; Galápagos Islands.

Pauliella aenigma Ludwig (Ziesenhenne, 1937, p. 215). Gulf of California to Panama; Clarion Island, Revillagigedo Islands.

Tamaria obstipa Ziesenhenne (1942, p. 209). Galápagos Islands.

Four of the 6 species of this class reported from Cocos Island also live along the mainland, 5 in the Galápagos Islands, and 2 in the Revillagigedo Islands.

Class Ophiurioidea

The following brittle stars, with their known ranges, have been reported from Cocos Island. Records of those not previously reported from this island were generously furnished by Fred Ziesenhenne.

Amphiodia violacea Lütken (A. H. Clark, 1939, p. 2). Los Coronados Islands, off west coast of Baja California, Mexico, to Colombia (Ziesenhenne, 1963, written communication).

Diopederma danianum Verrill (H. L. Clark, 1940, p. 343). Baja California to Panama.

Ophiacantha phragma Ziesenhenne (1940, p. 12). Southern California to Ecuador; Galápagos Islands.

Ophiactis savignyi Müller and Troschel (Ziesenhenne, 1962, written communication). Mainland; Galápagos Islands; Clipperton Island; worldwide in tropical waters.

Ophiactis simplex LeConte (Ziesenhenne, 1962, written communication). California to Peru; Galápagos Islands.

Ophiocoma aethiops Lütken (H. L. Clark, 1940, p. 341). Baja California to Panama; Galápagos Islands.

Ophiocoma alexandri Lyman (H. L. Clark, 1940, p. 341). Baja California to Panama; Galápagos Islands.

Ophioderma panamense Lütken (H. L. Clark, 1940, p. 342; Ziesenhenne, 1955, p. 193). San Pedro, California, to Paita, Peru; Guadalupe Island; Revillagigedo Islands; Galápagos Islands.

Ophioderma variegatum Lütken (H. L. Clark, 1940, p. 343; Ziesenhenne, 1955, p. 198). San Diego, California, to Panama; Revillagigedo Islands; Galápagos Islands.

Ophiomyxa panamensis Lütken and Mortensen (H. L. Clark, 1940, p. 336). Gulf of California to Panama; Galápagos Islands; Socorro Island, Revillagigedo Islands.

Ophionereis dictyota Ziesenhenne (1940, p. 30). Gulf of California, to Panama.

Ophionereis nuda Lütken and Mortensen (H. L. Clark, 1940, p. 340). Isabel Island, Mexico, to Panama; Galápagos Islands.

Ophiophragmus marginatus Lütken (Ziesenhenne, 1962, written communication). Mexico to Ecuador; Galápagos Islands.

Ophiophragmus paucispinus Nielsen (Ziesenhenne, 1962, written communication). Mexico to Costa Rica; Galápagos Islands.

Sigsbeia lineata Lütken and Mortensen (H. L. Clark, 1940, p. 336). Panama; Galápagos Islands.

Of the 15 brittle stars reported by H. L. Clark and by Ziesenhenne from Cocos Island, all also live in mainland waters, 12 in the Galápagos Islands, 3 in the Revillagigedo Islands, Mexico, and 1 in Indo-Pacific waters.

Class Echinoidea

H. L. Clark (1940; 1948) recorded the occurrence of 13 species of echinoids from Cocos Island. These, with their recorded geographic ranges follow.

Centrechinus (= Diadema) mexicana A. Agassiz (H. L. Clark, 1948, p. 235). Consag Rock, Gulf of California, to La Plata Island, Ecuador; Revillagigedo Islands; Galápagos Islands.

Centrocidaris doederleini A. Agassiz (H. L. Clark, 1948, p. 226). Galápagos Islands.

Clypeaster ochrus H. L. Clark (1947, p. 297). La Paz, Baja California, to Ecuador; Galápagos Islands.

Clypeaster rotundus A. Agassiz (H. L. Clark, 1948, p. 296). Georges Island, Gulf of California, to Santa Elena Bay, Ecuador; Revillagigedo Islands; Galápagos Islands.

Clypeaster speciosus Verrill (H. L. Clark, 1940, p. 350). Magdalena Bay, Baja California, and the Gulf of California; Revillagigedo Islands; Galápagos Islands.

Echinometra van-brunti A. Agassiz (H. L. Clark, 1940, p. 349; 1948, p. 294). Angel de la Guardia Island, Gulf of California, to San Francisco Bay, Ecuador; Revillagigedo Islands; Galápagos Islands.

Encope cocosi H. L. Clark [1948, p. 330; Mortensen (Monogr. Echin., IV.2. Clypeastroida, p. 448, 1948, as *Encope micropora cocosi)*]. Known only from Cocos Island.

Eucidaris thouarsii Valenciennes (H. L. Clark, 1940, p. 347; 1948, p. 229). Santa Catalina Island, California; Guadalupe Island, Baja California, and the Gulf of California to La Plata Island, Ecuador; Revillagigedo Islands; Galápagos Islands.

Hesperocidaris panamensis A. Agassiz (H. L. Clark, 1948, pp. 226, 131). Off Galera Point, Ecuador; Galápagos Islands.

Lovenia cordiformis A. Agassiz (H. L. Clark, 1940, p. 352; 1948, p. 348). Santa Barbara, California, and the Gulf of California to Guayaquil, Ecuador; Revillagigedo Islands; Galápagos Islands. Hawaiian Islands (Ziesenhenne, 1937, p. 236).

Lytechinus pictus Verrill (H. L. Clark, 1940, p. 349). Monterey, California, to the Gulf of California.

Meoma grandis Gray (H. L. Clark, 1948, p. 344). Angeles Channel, Gulf of California, to Port Utria, Colombia; Revillagigedo Islands; Galápagos Islands.

Plagiobrissus pacificus H. L. Clark (1948, p. 342). Gulf of California to Panama Bay and questionably from La Plata Island, Ecuador.

Of these 13 species, 1 is known only from Cocos Island. All the others are known to occur also in the waters of the mainland of the Panamic province. Six of these also occur in the Revillagigedo Islands and 10 occur at the Galápagos Islands. One has been reported from the Hawaiian Islands.

Class HOLOTHURIOIDEA

Brandtothuria arenicola Semper. Gulf of California to Ecuador; Galápagos Islands; Revillagigedo Islands; West Indies. Almost circumtropical.

Brandtothuria impatiens Forskål. Cedros Island, Baja California, and Gulf

of California to Colombia; Galápagos Islands; Revillagigedo Islands; West Indies. Almost circumtropical.

Jaegerothuria inhabilis Selenka. Gulf of California to Ecuador; Galápagos Islands; Revillagigedo Islands; Hawaii to Australia.

Lessonothuria pardalis Selenka. Gulf of California to Colombia; Hawaii. Almost circumtropical but lacking in Atlantic and West Indies.

Ludwigothuria atra Jaeger. Galápagos Islands; Clipperton Island; Hawaii to Mozambique.

Ludwigothuria kefersteini Selenka. Mexico to Peru; Galápagos Islands; Revillagigedo Islands.

Microthele difficilis Semper. Gulf of California to Galápagos Islands; Clipperton Island; Australia; east coast of Africa to east coast of Pacific.

Psolus diomedeae Ludwig. Gulf of California to Ecuador; Galápagos Islands.

Selenkothuria theeli Deichmann. Gulf of California to Zorritos, Peru; Galápagos Islands; Revillagigedo Islands.

Semperothuria imitans Ludwig. Gulf of California to Panama; Galápagos Islands; Revillagigedo Islands; Samoa.

Theelothuria paraprinceps Deichmann. Gulf of California to Panama; Clarion Island, Revillagigedo Islands.

These holothurians were reported from Cocos Island by Deichmann (1941b; 1958). All occur in the Panamic region and all except three also live in western Pacific waters. The percentage of these species reported from both the eastern Pacific and western Pacific waters is much greater than that of most classes of invertebrates recorded from Cocos Island. However, many species in this group of animals, especially the Aspidochirota, are widely distributed (see Deichmann, 1958, pp. 253, 277).

Phylum MOLLUSCA

Marine and Brackish-Water Mollusks

Class PELECYPODA

Arca (Anadara) reinharti Lowe [Rost, 1955, p. 227, as *Anadara (Scapharca) reinharti.*]

Cetoconcha scapha Dall (1902, p. 561). Off Cocos Island in 183 meters (100 fathoms).

Crenella divaricata d'Orbigny (Soot-Ryen, 1955, p. 130).

Isognomon (Melina) chemnitzianum d'Orbigny [Pilsbry and Vanatta, 1902, p. 559 (as *Perna chemnitzianum* d'Orb. (?); Dall, 1908, p. 437 (as *Melina chemnitziana);* Hertlein, 1932, p. 45 (as *Pedalion chemnitzianum)*].

Isognomon quadrangularis Reeve [von Martens, 1902b, p. 138 (as *Perna quadrangularis);* Pilsbry and Vanatta, 1902, p. 137 (as *Perna quadrangularis);* Biolley, 1907, p. 25 (as *Perna quadrangularis)*].

Lithophaga attenuata Deshayes (Bartsch and Rehder, 1939, p. 18).

Lithophaga (Myoforceps) aristata Dillwyn (Soot-Ryen, 1955, p. 141; Turner and Boss, 1962, p. 108).

Ostrea palmula Carpenter [von Martens, 1902b, p. 137 (as *Ostrea ochracea* Sowerby) ; Biolley, 1907 (as *Ostrea ochracea);* Hertlein, 1932, p. 45 (also cited as *Ostrea callichroa* Hanley)].

Pecten (Pecten) sericeus Hinds (Grau, 1959, p. 142).

Pecten (Cyclopecten) cocosensis Dall (1908, p. 405); Hertlein (1935, p. 319. Original locality only and pl. 18, figs. 7 and 8); Keen (1958, p. 72); Grau (1959, p. 30) (Dall's record).

Pecten (Cyclopecten) exquisitus Grau (1959, p. 36).

Pecten (Oppenheimopecten) hancocki Grau (1959, p. 155).

Class Gastropoda

(Marine and Brackish-Water Forms)

Acanthina brevidentata Wood [von Martens, 1902b, p. 137 (as *Monoceros brevidentata);* Biolley, 1907, p. 21 (as *Monoceros brevidentatum);* Hertlein, 1932, p. 45].

Acmaea (Nomaeopelta) mesoleuca Menke [von Martens, 1902b, p. 137 (as *Acmaea striata* Quoy and Gaimard) ; Pilsbry and Vanatta, 1902, p. 559 (as "*Scarria*" *mesoleuca);* Biolley, 1907, p. 26 (Record of Pilsbry and Vanatta (1902), also p. 24 (as *Acmaea striata);* Tomlin, 1928, p. 188 (as *Collisella mesoleuca);* Hertlein, 1932, p. 45 (as *Acmaea (Collisella) aeruginosa* Middendorff); Hertlein, 1937, p. 306 (von Marten's record (1902b) of *Acmaea striata* cited)].

Acmaea strigatella Carpenter (Pilsbry and Vanatta, 1902, p. 559).

Bursa caelata Broderip [von Martens, 1902b, p. 137 (as *Ranella caelata);* Biolley, 1907, p. 21 (as *Ranella caelata)*].

Caducifer cinis Reeve [von Martens, 1902b, p. 137 (as *Pollia cinis);* Pilsbry and Vanatta, 1902, p. 559 (as *Tritonidea cinis);* Biolley, 1907, p. 21 (as *Pollia cinis);* Keen (1958, p. 398, as *Caducifer thalia* Pilsbry and Lowe).]

Cantharus (Gemmophos) gemmatus Reeve [Hertlein, 1932, p. 45 (as *Cantharus gemmatus)*].

Cantharus sanguinolentus Duclos [von Martens, 1902b, p. 137 (as "*Pollia sanguinolenta* Duclos 1832 = *haemastoma* Gray, 1839"); Pilsbry and Vanatta, 1902, p. 559 (as *Tritonidea sanguinolenta);* Biolley, 1907, p. 21 (as *Pollia sanguinolenta)*].

Cerithium adustum Kiener (von Martens, 1902b, p. 137; Biolley, 1907, p. 22; Hertlein, 1932, p. 45.)

Cerithium maculosum Kiener (Pilsbry and Vanatta, 1902, p. 559; Dall, 1908, p. 437).

Conus brunneus Wood (von Martens, 1902b, p. 137; Biolley, 1907, p. 20; Tomlin, 1927, p. 155; Hanna and Strong, 1949, p. 269).

Conus dalli Stearns (Hertlein, 1932, p. 45; Hertlein, 1937, p. 306; Hanna and Strong, 1949, p. 305).

Conus gladiator Broderip (Calif. Acad. Sci. Coll., W. H. Ochsner collector, 1905).

Conus recurvus Broderip [Dall, 1910, p. 225 (as *Conus scariphus* Dall); Hanna and Strong, 1949, p. 280 *(Conus scariphus* in synon.)].

Conus tiaratus Broderip (Hertlein, 1932, p. 45; Hanna and Strong, 1949, p. 272).

Cymatium vestitum Hinds (Hertlein, 1932, p. 45).

Cypraea isabella mexicana Stearns [von Martens, 1902b, p. 137 (as *Cypraea* "wahrscheinlich" *isabella* Linnaeus); Biolley, 1907, p. 21 ("?"); Schilder and Schilder, 1938, pp. 176, 197 (as *Cypraea controversa mexicana);* Demond, 1957, p. 304 (as *Cypraea (Luria) isabella)*].

Cypraea moneta Linnaeus [Hertlein, 1932, p. 45; Hertlein, 1937, p. 307; Ingram, 1947a, pp. 58 (16), 74 (32); Ingram, 1947b, p. 147 (11); Ingram, 1948, p. 140; Ingram, 1951, p. 152 (28); Demond, 1957, p. 304 (as *Cypraea (monetaria) moneta)*].

Cypraea rashleighana Melvill [Ingram, 1945, p. 106; 1947a, p. 76 (34); 1947b, p. 148 (12); 1951, p. 155 (31)].

Ellobium stagnalis d'Orbigny [Biolley, 1907, p. 19 (as *Auricula* (?) *stagnalis);* Hanna and Hertlein, 1938, p. 32 (as *Auricula stagnalis)*].

Fissurella virescens Sowerby (von Martens, 1902b, p. 137; Pilsbry and Vanatta, 1902, p. 559; Biolley, 1907, p. 23; Tomlin, 1928, p. 188; Hertlein, 1932, p. 45).

Harpa crenata Swainson (Hertlein, 1932, p. 45).

Hipponix grayanus Menke [Pilsbry and Vanatta, 1902, p. 559 (as *Amalthea grayana);* Biolley, 1907, p. 23; Hertlein, 1932, p. 45 "cf."].

Hipponix pilosus Deshayes [von Martens, 1902b, p. 137 (as *Hipponix* perhaps *barbatus* Quoy and Gaimard)].

Latirus tuberculatus Broderip (Dall, 1908, p. 436; Hertlein, 1932, p. 45).

Littorina aspersa Philippi [von Martens, 1902b, p. 137 (as *Littorina aspera);* Biolley, 1907, p. 23 (as *Littorina aspersa);* Hertlein, 1932, p. 45].

Littorina conspersa Philippi [von Martens, 1902b, p. 137; Biolley, 1907, p. 21; Dall, 1908, p. 437 (also, Malpelo Id.); Hertlein, 1932, p. 45].

Littorina modesta Philippi (Tomlin, 1927, p. 168). [Keen (1958, p. 282) pointed out that this species "has been cited from the Panamic province,

but it seems an indeterminate form with a type locality in Alaska."]

Marginella minor C. B. Adams (Bartsch and Rehder, 1939, p. 18).

Melampus tabogensis C. B. Adams [Dall, 1896, p. 452 (as *Tralia panamensis* C. B. Adams); Dall, 1900, p. 97 (as *Melampus panamensis);* von Martens, 1900, p. 561 (Dall's record (1900) cited; von Martens, 1902b, p. 137 (as *Melampus tabogensis);* Dall, 1908, p. 436 (as *Melampus panamensis);* Morrison, 1946, p. 36)].

Melampus trilineatus C. B. Adams (Hanna and Hertlein, 1938, p. 134).

Mitra fultoni E. A. Smith [(Calif. Acad. Sci. Coll., W. H. Ochsner collector, 1905; Sphon, 1961, pp. 34, 35)].

Mitra lens Wood [Dall, 1908, p. 436].

Mitra tristis Swainson (Stanford Univ. Coll.).

Mitrella ocellata Gmelin [Pilsbry and Vanatta, 1902, p. 559 (as *Columbella cribraria* Lamarck) ; Biolley, 1907, p. 26 (record of Pilsbry and Vanatta, (1902)].

Murex humilis Broderip (Dall, 1908, p. 436).

Nerita funiculata Menke [von Martens, 1902b, p. 137 (as *Nerita bernhardi* Recluz); Pilsbry and Vanatta, 1902, p. 559 (as *Nerita fulgurans bernhardi* Recluz) ; Biolley, 1907, p. 23 (as *Nerita bernhardi);* Hertlein, 1932, p. 45 (as *Nerita bernhardi)*].

Nerita ornata Sowerby [von Martens, 1902b, p. 137; Biolley, 1907, p. 23; Dall, 1908, p. 437 (as *Nerita scabricosta* Lamarck); Hertlein, 1932, p. 45 (as *Nerita scabricosta* var. *ornata)*].

Neritina pilsbryi Tryon [Biolley, 1907, p. 18 (as *Neritina latissima* Broderip var. *globosa* Broderip); Hertlein, 1902, p. 45].

Nitidella sertularium Orb.? (Tomlin, 1927, p. 162). [Record probably incorrect. A Patagonian species].

Olivella (Olivella) cocosensis Olsson (1956, p. 180; Keen, 1958, p. 424).

Phos cocosensis Dall (Dall, 1917, p. 578; Strong and Lowe, 1936, p. 310; Keen, 1958, p. 406.)

Planaxis planaxis Wood (Dall, 1908, p. 436).

Planaxis planicostatum Sowerby [von Martens, 1902b, p. 137 (as *Planaxis planicostatus);* Pilsbry and Vanatta, 1902, p. 559 (as *Planaxis planicostatus);* Biolley, 1907, p. 21 (as *Planaxis planicostatus);* Tomlin, 1927, p. 168; Hertlein, 1932, p. 45].

Polinices helicoides Gray [Tomlin, 1927, p. 170 (as *Polinices glabella* Reeve)].

Purpura patula pansa Gould [von Martens, 1902b, p. 137 (as *Purpura patula* Linnaeus); p. 140 (as "*Purpura patula* L. *(pansa* Conr.)"; Pilsbry and Vanatta, 1902, p. 559 (as *Purpura patula);* Biolley, 1907, p. 21 (as *Purpura patula);* Dall, 1908, p. 436 (as *Thais patula);* Tomlin,

1928, p. 163 (as *Thais patula);* Hertlein, 1932, p. 45 (as *Thais patula)*].

Pyrene labiosa Sowerby [Pilsbry and Vanatta, 1902, p. 559 (as *Columbella labrosa);* Biolley, 1907, p. 26 (as *Columbella labrosa,* record of Pilsbry and Vanatta)].

Siphonaria gigas Sowerby (Dall, 1896, p. 453; Dall, 1900, p. 97; von Martens, 1902b, p. 137; Pilsbry and Vanatta, 1902, p. 559; Biolley, 1907, p. 25; Dall, 1908, p. 436; Dall, 1909, p. 205; Hertlein, 1932, p. 45).

Siphonaria gigas var. *characteristica* Reeve [Tomlin, 1927, p. 154 (as *Siphonaria characteristica);* Hertlein, 1932, p. 45.]

Tegula cooksoni E. A. Smith (Tomlin, 1928, p. 187; also Calif. Acad. Sci. Coll., W. H. Ochsner collector, 1905).

Tegula maculostriata C. B. Adams [Pilsbry and Vanatta, 1902, p. 559 (as *Chlorostoma maculostriatum* C. B. Adams); Biolley, 1907, p. 26 (record of Pilsbry and Vanatta cited)]. [The type locality of *T. maculostriata* is Jamaica. The specimens so identified by Pilsbry and Vanatta from Cocos Island resemble the illustration of the type specimen published by Clench and Turner (Occasional Papers on Mollusks, Department of Mollusks, Museum of Comparative Zoölogy at Harvard College, Vol. 1, No. 15, p. 305, pl. 39, fig. 13). The spire is higher and the scupture coarser than that of *T. cooksoni* E. A. Smith].

Tegula gallina multifilosa Stearns [Pilsbry and Vanatta, 1902, p. 559 (as *Chlorostoma gallinum multifilosum);* Biolley, 1907, p. 26 (as *Chlorostoma gallinum multifilosum,* record of Pilsbry and Vanatta cited)]. [Record from Cocos Island doubtful. Not known with certainty south of Baja California].

Thais columellaris Lamarck [von Martens, 1902b, p. 137 (as *Purpura columellaris);* Pilsbry and Vanatta, 1902, p. 559 (as *Purpura columellaris);* Biolley, 1907, p. 21 (as *Purpura columellaris);* Dall, 1908, p. 437; Hertlein, 1932, p. 45)].

Thais haemastoma biserialis Blainville [Hertlein, 1932, p. 45 (as *Thais biserialis)*].

Thais (Vasula) melones Duclos [von Martens, 1902b, p. 137 (as *Purpura melo);* Pilsbry and Vanatta, 1902, p. 559 (as *Purpura melones);* Biolley, 1907, p. 21 (as *Purpura melones);* Dall, 1908, p. 436 (as *Thais melones);* Hertlein, 1932, p. 45 (as *Thais crassa* Blainville)].

Thais speciosa Valenciennes (Calif. Acad. Sci. Coll., W. H. Ochsner, collector, 1905).

Thais triangularis Blainville (Calif. Acad. Sci. Coll., W. H. Ochsner, collector, 1905).

Trivia pacifica Gray (Tomlin, 1927, p. 166.)

Vermetus sp. (von Martens, 1902b, p. 137; Biolley, 1907, p. 25).

(Land Forms)

Habroconus (Cocosconus) hopkinsi Dall (Baker, 1941, p. 225).
Habroconus (Pseudoguppya) pacificus Pfeiffer (Baker, 1941, p. 226).
Habroconus (Cocoslens) pallidus H. B. Baker (1941, p. 224).
Leptinaria biolleyi von Martens (Hanna and Hertlein, 1938, p. 128).
Nesopupa (Cocopupa) cocosensis Dall (Hanna and Hertlein, 1938, p. 129).
Ochrodermella biolleyi von Martens (Hanna and Hertlein, 1938, p. 127).
Ochrodermella cumingiana Pfeiffer (Hanna and Hertlein, 1938, p. 125).
Opeas gracile Hutton (Hanna and Hertlein, 1938, p. 130).
Succinea globispira von Martens (Hanna and Hertlein, 1938, p. 129).

The land snails from Cocos Island have been discussed in a paper by Hanna and Hertlein (1938) who have summarized the literature pertaining to them. Baker (1941, pp. 223–226) later made changes in the nomenclature of some of the species.

Of the 9 species reported from Cocos Island, *Opeas gracile* Hutton is widely distributed over the Indo-Pacific region and evidently is an introduced species. It also is possible that the species of *Leptinaria* may have arrived on the island adventitiously. The other 7 species, known only from Cocos Island, belong to the genera *Habroconus, Nesopupa, Ochrodermella,* and *Succinea.* Kobelt (1899) and Hanna and Hertlein (1938) suggested Indo-Pacific affinities of the endemic species of these genera on Cocos Island. Germain (1934, p. 153), remarked on the small number of species, the absence of *Bulimulus,* and the fact that *Ochrodermella* also occurs in the Caroline Islands. Baker (1941, p. 352) believes that the affinities of the land snails from Cocos Island are with species on the American mainland. It appears probable that some elements of the land snail fauna were derived from the eastern Pacific and others from Polynesia.

For additional information concerning these land snails see Ancey (1903); Baker (1945); Biolley (1907; 1908–1909); Dall (1896; 1900); Gude (1903); von Martens (1890–1901; 1898; 1902a); Pilsbry and Cooke (1920).

Order **Pteropoda**

Limacina inflata d'Orbigny (Howard, 1952, p. 13).
Creseus virgula Rang (Howard, 1952, p. 13).
Diacria quadridentata parva Howard (1952, p. 13).
Cavolina longirostris constricta Howard (1952, p. 13).

Class AMPHINEURA

Acanthochitona hirudiniformis Sowerby.

Chiton stokesi); Biolley, 1907, p. 24 (as *Chiton (Radsia) stokesi);* Dall, *Chiton (Chiton) stokesii* Broderip [Pilsbry and Vanatta, 1902, p. 559 (as

1908, p. 436 (as *Chiton stokesii);* Tomlin, 1927, p. 154 (as *Chiton stokesii);* Leloup, 1956, p. 246.]

Chiton (Radsia) goodallii Broderip [von Martens, 1902b, p. 137 (as *Chiton (Radsia) goodalli);* Boone, 1933, p. 24 (as *Chiton (Chiton) goodallii),* p. 201 (as *Chiton goodallii)*].

Placiphorella blainvillei Broderip (Dall, 1908, p. 357; Dall, 1909, p. 246).

Class CEPHALOPODA

Abraliopsis hoylei Pfeffer (Robson, 1948, p. 118).

Argonauta expansa Dall (Robson, 1932, p. 197, in synonymy of *Argonauta cornuta* Conrad, 1854, p. 332. Not *Argonauta cornutus* Bosc, Hist. Nat. des Coquilles, vol. 3, p. 262, AN X[1802]).

Helicocranchia beebei Robson (1948, p. 130).

Liocranchia reinhardti Steenstrup (Robson, 1948, p. 128).

Melanoteuthis beebei Robson (1932, p. 103).

Octopus (Octopus) pusillus Gould [Dall, 1909, p. 194 (as *Polypus pusillus);* Robson, 1929, p. 150].

Octopodoteuthis nielseni Robson (1948, p. 120).

Onykia (Teleoteuthis, Auctt.) sp. (Robson, 1948, p. 121).

Polypus januarii Hoyle (Dall, 1909, p. 194). [Locality records from the Pacific doubtful according to Robson, 1932, pp. 235, 240. Type locality northeast Brazil].

Pyroteuthis giardi Fischer (Robson, 1948, p. 118).

(?) *Sthenoteuthis* sp. *(Rhynchoteuthis* stage) (Robson, 1948, p. 125).

Symplectoteuthis oulaniensis Lesson (Dall, 1909, p. 195; Berry, 1912, p. 304; Robson, 1948, p. 127).

Taonidium pacificum Robson (1948, p. 130).

One of the earliest references in which the occurrence of marine mollusks at Cocos Island is mentioned is that by Colnett (1798, p. 71) who stated "Shell-fish, were scarce, though we collected some very large limpets, of a new kind, and a few dead conches. The latter were seen in great numbers on the beach, and mostly inhabited by the Diogenes crab." It seems possible that the large limpets mentioned by Colnett might be referable to *Siphonaria gigas* Sowerby or *S. gigas characteristica* Reeve which occur abundantly at some places on this Island.

The identification of some of the species in the present paper, based upon records taken from the literature, may be doubtful, but the general composition of the assemblage is in harmony with other island molluscan faunas (except that of Clipperton Island) in the eastern Pacific. Further collecting on Cocos Island would undoubtedly yield additional species. I believe, however, that the general composition represented by the present list is representative of the marine molluscan fauna of this Island.

The present list contains 88 species and subspecies (3 species identified only as to genus, not included in this number) arranged as follows: Pelecypoda 12, Gastropoda 57, Pteropoda 4, Amphineura 4, Cephalopoda 11. Of the total only 4 species, 3 pelecypods and 2 cephalopods, described from or near Cocos Island, have not been reported elsewhere. All but 14 species have been reported occurring on or near the mainland. At least 38 species listed here also have been reported from the Galápagos Islands and at least 33 species occur in the Gulf of California. Two gastropods, belonging to the genus *Cypraea,* and 3 cephalopods, also have been reported from Indo-Pacific waters.

The 4 species of pteropods reported from Cocos Island by Howard (1952, p. 13) also occur at other localities in the eastern Pacific.

The marine molluscan fauna of Cocos Island contrasts decidedly with that of Clipperton Island where nearly 50 per cent of the species are Indo-Pacific forms or have affinities with species in the central or western Pacific (see Hertlein and Emerson, 1953; 1957).

Phylum ANNELIDA

Chloeia entypa Chamberlin (Hartman, 1939a, p. 3). Southern California to Panama.

Chloeia viridis Schmarda (Hartman, 1940, pp. 190, 205. Also cited from Cocos Island as *C. euglochis* Ehlers by Treadwell, 1928, p. 450). Gulf of California to Panama and the Galápagos Islands; West Indies.

Eusigalion spinosum Hartman (1939b, pp. 10, 17, 59). Farallon Islands, California, to Cocos Island, and the Galápagos Islands.

Lepidonotus furcillatus Ehlers (Hartman, 1939b, p. 16). Cited from Cocos Island on page 16 but on page 2 cited from Wreck Bay, Chatham Island, Galápagos Islands.

Nerine cirratulus hirsutus Treadwell (1928, p. 479, as *Spio hirsuta);* Hartman (1959, p. 390). Known only from Cocos Island.

Notopygos crinita Grube (Treadwell, 1928, p. 450). St. Helena Island.

Perinereis helleri Grube (Cited from Cocos Island as *Neanthes obscura* Treadwell, 1928, p. 472). Philippine Islands.

Psammolyce spinosa Hartman (1939b, pp. 10, 17, 74). Clarion Island, Revillagigedo Islands, Mexico.

Sthenelais fusca Johnson (Hartman, 1939b, pp. 10, 17, 61). Washington to Panama and the Galápagos Islands.

A few species of this group have been reported from Cocos Island by Treadwell (1928) and Hartman (1939a, 1939b, 1940). All except two of these have also been reported from mainland waters. The nomenclature followed here is that of Hartman (1959).

Phylum ARTHROPODA

Class CRUSTACEA

Subclass COPEPODA

Gloiopotes ornatus Wilson.

Pennella instructa Wilson.

These two species, parasites on a sailfish, were reported from off Chatham Bay, Cocos Island by Schmitt (1939b, p. 27).

Subclass CIRRIPEDIA

Conchoderma, "very probably *C. virgatum* (Spengler)" (Schmitt, 1939b, p. 27). Attached to a copepod, *Pennella instructa* Wilson (with sucker fish, *Echeneis remora* Linnaeus), taken from a sailfish from off Chatham Bay, Cocos Island.

Tetraclita squamosa Bruguière [von Martens, 1902b, p. 138, (as *Tetraelita* (type. error) *porosa* Gmelin)]. World-wide in tropical and subtropical seas (see Pilsbry, 1916, U. S. Nat. Mus., Bull. 93, p. 249).

Tetraclita squamosa milleporosa Pilsbry (Hertlein, 1932, p. 45). Originally described from Albemarle Island, Galápagos Islands (Pilsbry, 1916, U. S. Nat. Mus., Bull. 93, p. 257).

Subclass MALACOSTRACA

Order **Amphipoda**

Podoceropsis dubia Shoemaker (1942, p. 32, fig. 12). Originally described from Chatham Bay, Cocos Island.

Talorchestia fritzi Stebbing (1903, p. 928). Originally described from Cocos Island.

Order **Decapoda**

Brachyura

Dr. John Garth furnished the following list of species of spider crabs from Cocos Island:

Family **Majidae**

Euprognatha bifida Rathbun. Mainland.

Euprognatha granulata Faxon. Mainland; Galápagos Islands.

Herbstia tumida (Stimpson). Mainland.

Inachoides laevis Stimpson. Mainland.

Lissa aurivilliusi Rathbun. Mainland; Galápagos Islands.

Lissa tuberosa Rathbun. Mainland.

Microphrys branchialis Rathbun. Mainland.
Microphrys triangulatus Lockington. Mainland; Galápagos Islands.
Mithrax (Mithrax) spinipes (Bell). Mainland; Galápagos Islands.
Podochela hemphilli (Lockington). Mainland.
Sphenocarcinus agassizi Rathbun. Mainland; Galápagos Islands.
Stenocionops ovata (Bell). Mainland; Galápagos Islands.
Stenorhynchus debilis Smith. Mainland; Galápagos Islands.
Teleophrys cristulipes (Stimpson). Mainland; Galápagos Islands.

Family **Parthenopidae**

Thyrolambrus glasselli Garth (formerly known as *T. erosus* Rathbun). Mainland.

According to Dr. Garth, all these species also occur on the mainland and none is found in the Indo-Pacific. He stated: "The only semi-endemics among the brachyurans that I recall are *Euprognatha granulata* Faxon, shared with the Galápagos Islands, and *Portunus (Achelous) brevimanus* (Faxon) (family Portunidae), shared with the Revillagigedo Islands."

The following records of Brachyuran crabs from Cocos Island, with their general distribution, are taken from Boone, Rathbun, and others.

Family **Majidae**

Mithrax (Mithraculus) denticulatus Bell. Mainland; Galápagos Islands.
Paradasygius depressus Bell (Garth, 1958, p. 81). Mainland.

Family **Parthenopidae**

Parthenope (Platylambrus) exilipes Rathbun. Mainland; Galápagos Islands.

Family **Portunidae**

Portunus (Achelous) brevimanus Faxon. Cocos Island, type locality; Revillagigedo Islands.

Family **Xanthidae**

Carpilodes cinctimanus White. Galápagos Islands. [According to Rathbun (U. S. Nat. Mus., Bull. 152, p. 242, 1930), *Liomera cocosana* Boone, type locality, Cocos Island, is a synonym of *C. cinctimanus*].

Eriphia squamata Stimpson. Mainland; Galápagos Islands. [According to Garth (Allan Hancock Pacific Expeditions, Vol. 5, No. 10, p. 486, 1946) Boone's record (1927) of *Eriphia granulosa* A. Milne Edwards from Cocos Island is referable to *E. squamata*].

Leptodius cooksoni Miers. Galápagos Islands; Clarion Island, Revillagigedo Islands. [According to Glassell (Trans. San Diego Soc. Nat. Hist., vol. 7, no. 38, p. 453, 1934), Boone's record (1927) of *Xanthodius lobatus* A. Milne Edwards, a female from Cocos Island, is based on a young specimen of *Leptodius cooksoni*].

Micropanope polita Rathbun [1902, p. 281 (as *Xanthias politus)*]. Gulf of California; mainland; Galápagos Islands.

Ozius tenuidactylus Lockington [Boone (1927, p. 225) as *Ozius agassizii* A. Milne Edwards, a species now believed to be a synonym of *Ozius tenuidactylus* Lockington (see Glassell, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 14, p. 104, 1935, as *Ozius tenuidactylos)*]. Mainland; Galápagos Islands.

Ozius verreauxii de Saussure. Mainland; Galápagos Islands.

Trapezia cymodoce ferruginea Latreille. Mainland; Galápagos Islands; Indo-Pacific.

Family **Grapsidae**

Grapsus grapsus Linnaeus. Mainland (east and west coasts); Galápagos Islands. [According to Dr. Garth (written communication), Boone's record (1927) of *Pachygrapsus crassipes* Randall from Cocos Island, was based upon a young specimen of *Grapsus grapsus*].

Pachygrapsus transversus Gibbes. Mainland (east and west coasts); Galápagos Islands.

Plagusia immaculata Lamarck. Mainland; Galápagos Islands; Indo-Pacific [Also recorded from Cocos Island by Garth (Allan Hancock Pacific Expeditions, vol. 5, no. 10, p. 512, 1946)].

Planes cyanea Dana. 60 miles south of Cocos Island; mainland; Galápagos Islands; Indo-Pacific. [According to Chace (Proc. U. S. Nat. Mus., vol. 101, no. 3272, p. 70 et seq., 1950), records of *Planes minutus* Linnaeus (such as that of Boone, 1927) from the eastern Pacific are referable to *P. cyanea*].

Family **Gecarcinidae**

Cardiosoma crassum Smith (Schmitt, 1939b, p. 27). A land crab. San José, Baja California, Mexico, to the mouth of the Tumbes River, Peru.

Family **Ocypodidae**

Uca panamensis Stimpson. Mainland; Galápagos Islands. [According to Crane (Zoologica, New York Zool. Soc., vol. 26, pp. 205, and 178, 1941, respectively), Boone's record of *Uca galapagensis* Rathbun, based upon a female from Cocos Island, is now referable to *U. panamensis*, and her

record of *U. galapagensis*, a male, from the Galápagos Islands, is referable to *U. macrodactyla* Milne Edwards and Lucas].

Family **Calappidae**

Calappa convexa de Saussure. Mainland; Galápagos Islands.

Anomura

Miss Janet Haig furnished the following list (supplemented by three species by Boone, 1932) of Anomuran crabs from Cocos Island with their occurrences elsewhere.

Family **Coenobitidae**

Coenobita compressus H. Milne Edwards. Mainland; Galápagos; Indo-Pacific.

Family **Paguridae**

Pagurus californiensis Benedict (Boone, 1932, p. 9). Mainland; Galápagos Islands.

Calcinus explorator Boone (1932, p. 22; Chace, 1962, p. 624). Galápagos Islands.

Pylopagurus hirtimanus Faxon. Galápagos Islands.

Pylopagurus longimanus Faxon. Known only from Cocos Island.

Family **Porcellanidae**

Petrolisthes cocoensis Haig (1960, p. 117). Cocos Island, probably endemic.

Petrolisthes edwardsii de Saussure. Mainland.

Petrolisthes marginatus Stimpson. Mainland.

Petrolisthes ortmanni Nobili. Mainland.

Petrolisthes tonsorius Haig. Mainland.

Family **Hippidae**

Hippa denticulatifrons Miers (Boone, 1932, p. 58). Galápagos Islands; Indo-Pacific.

To these may be added the following Macruran forms:

Family **Palaemonidae**

Brachycarpus biunguiculatus Lucas (Holthuis, 1952, pp. 6, 7). Gulf of California to Colombia; East and West Americas; Galápagos Islands; Mediterranean; Indo-Pacific.

Macrobranchium americanum Bate (Holthuis, 1952, pp. 130, 131, 132. Also cited from Cocos Island as *M. jamaicense* Herbst by Beebe, 1926, p. 435,

and by Boone, 1930, pp. 20, 146). Baja California to Peru; Galápagos Islands.

Macrobranchium hancocki Holthuis (1952, pp. 112, 113. Also cited from Cocos Island as *M. olfersii* Wiegmann by Beebe, 1926, p. 435, and Boone, 1930, pp. 20, 143). Costa Rica to Colombia; Galápagos Islands.

Palaemon (Palaemon) ritteri Holmes, Holthuis (1952, pp. 175, 176, 177). San Diego, California, to Paita, Peru; Galápagos Islands.

Family **Palinuridae**

Panulirus gracilis Streets (Holthuis and Villalobos, 1961, p. 254). Gulf of California to Paita, Peru; ?Galápagos Islands.

Panulirus penicillatus Olivier (Chace, 1962, p. 617). Galápagos Islands; Socorro Island, Revillagigedo Islands; Hawaiian Islands; Tuamotu Islands; Red Sea to South Africa.

From an inspection of the ranges of the species in the foregoing lists, it is obvious that the affinities of the species are with those of the mainland and the Galápagos Islands.

Fifty species of brachyuran, anomuran and macruran (shrimp-like) crustaceans are here listed from Cocos Island but additional species are known to occur there. Of the 50 species, two are endemic, 41 occur on the mainland, 33 (or 34) at the Galápagos Islands, seven in Indo-Pacific waters and three (or four) in Atlantic waters.

Authors who have published papers which include crabs and shrimps occurring at Cocos Island include: Boone (1927; 1930a; 1930b; 1932); Chace (1962); Faxon (1893; 1895, list pp. 257–258); Garth (1946; 1958); Haig (1960); Holthuis (1952); Holthuis and Villalobos (1961); Rathbun (1902; 1930); Schmitt (1939b).

Class MYRIOPODA

Newportia rogersi Pocock. Mainland.

Otocryptops melanostoma Newport. Mainland.

Otostigmus scabricauda Humbert and Saussure. Mainland.

Epinannolene pittieri Brölemann. Cocos Island only.

Leptodesmus folium Brölemann. Cocos Island only.

Orthomorpha coarctata Saussure. Cocos Island only.

Rhinocricus (Eurhinocricus) biolleyi Brölemann. Mainland.

Seven species of Myriopoda have been reported from Cocos Island by Brölemann (1903; 1905). Of these, 3 chilopods and 1 diplopod also occur on the mainland, and 3 diplopods are reported only from Cocos Island.

Class INSECTA

A few members of this class from Cocos Island noticed in the literature are mentioned here.

Arrhinotermes oceanicus Wasmann (1902, p. 139). A termite.

Eutermes sp. (prope *ripperti* Rambur) (Wasmann, 1902, p. 139). A termite.

Kalotermes (Neotermes) larseni Light (1935, p. 239). A termite. Known only from Cocos Island. Said to be related to *Neotermes castaneus* Burmeister which occurs in the American tropics.

Leucotermes insularis Wasmann (1902, pp. 139, 140). A termite.

Historis odius Fabricius. Cited as *Histrio* probably *odius* by Williams, (1911, p. 296). *Histrio orion* Fabricius, now believed to be a synonym, also was reported from Cocos Island by Beebe (1926, p. 436). This butterfly ranges throughout the American tropics.

Herse cingulata Fabricius [Williams, 1911, p. 317 (as *Phlegathontius cingulata)*]. This hawk-moth is wide spread in the American tropics and also occurs in the Galápagos Islands.

Leucomelina pica Macquart (Coquillett, 1901, p. 375). This little fly is abundant on Cocos Island at least at certain times in the year. It was originally described from Brazil and the American tropics.

Cicada sp. (Heidemann, 1901, p. 370). One species of cicada has been reported from Cocos Island.

Odynerus (Pachodynerus) nasidens Latreille (Williams, 1926, p. 349). Williams reported this wasp from Cocos Island.

Popilius lenzi Kuwert (1897, p. 301; van Doesburg, 1953, p. 203). This beetle was described from Cocos Island. Its affinities are with species on the mainland.

Collenette (1926, p. 234) mentioned collecting a "longicorn beetle" and "lady-birds" on Cocos Island. He also mentioned (p. 231) seeing an insect there resembling *Agraulis vanillae* Linnaeus (a widely distributed species) from the Galápagos Islands.

Order **Hymenoptera**

Atta cephalotes Linnaeus* (Forel, 1908, p. 40; Emery, 1919, p. 40).

Azteca emmae Forel* (1908, p. 62; Emery, 1919, p. 40).

Brachymyrmex longicornis Forel* (1909, p. 64; Emery, 1919, p. 40).

Camponotus (Myrmothrix) abdominalis stercorarius Forel* (1908, p. 71; Emery, 1919, p. 40).

Camponotus (Myrmobrachys) biolleyi Forel [Forel, 1902, p. 177 (as *Camponotus biolleyi)*; Wheeler, 1919, pp. 301, 305; Emery, 1919, p. 40)].

Camponotus (Myrmobrachys) blandus F. Smith* [Forel, 1908, p. 72; Emery, 1919, p. 40, as *Camponotus (Myrmocamelus) blandus*].

Camponotus (Myrmaphaenus) cocosensis Wheeler (1919, pp. 301, 305; 1933, p. 61).

Cryptocerus cristatus Emery (1919, p. 40).

Cyphomyrmex rimosus slavini Forel* (Forel, 1908, p. 43; Emery, 1919, p. 40).

Eciton (Labidus) crassicornis F. Smith (Emery, 1919, p. 40).

Euponera (Trachymesopus) stigma Fabricius (Wheeler, 1919, pp. 301, 302; Emery, 1919, p. 40).

Odontomachus haematodes Linnaeus* (Forel, 1908, p. 35; Emery, 1919, p. 40).

Odontomachus haematodes insularis Guérin (Wheeler, 1919, pp. 301, 303).

Pheidole biconstricta bicolor Emery (1919, p. 40).

Pheidole punctatissima Mayr (Emery, 1919, p. 40).

Pheidole subarmata Mayr* (Forel, 1908, p. 52; Emery, 1919, p. 40).

Prenolepis (vividula) guatemalensis cocoënsis Forel [Forel, 1902, p. 178 (as *Prenolepis guatemalensis* var. *cocoensis);* Wheeler, 1919, pp. 301, 305; Emery, 1919, p. 40, as *Prenolepis (Nylanderia) guatemalensis* var. *cocoënsis*].

Pseudomyrma belti Emery, var. (1919, p. 40).

Solenopsis geminata Forel* (1908, p. 45; Emery, 1919, p. 40).

Solenopsis succinea Emery (1919, p. 40).

Tetramorium guineënse Fabricius (Wheeler, 1919, pp. 301, 303; Emery, 1919, p. 40).

Wasmannia auropunctata Roger (Wheeler, 1919, pp. 301, 304; Emery, 1919, p. 40).

Wasmannia auropunctata var. *rugosa* Forel* (1908, p. 45; Emery, 1919, p. 40).

The foregoing includes the combined lists of species and subspecies of ants reported from Cocos Island by Forel (1902; 1908), by Wheeler (1919; 1933) and by Emery (1919).

Forel (1908) suggested that 10 species (those in the list indicated by the symbol*) of the ant fauna of Cocos Island evidently arrived there with cultivated plants. Emery (1919) discussed the ant fauna and remarked on the preponderance of Central American forms. Apparently he favored the theory that some of these insects reached the island by way of a land bridge connected with the mainland during late Tertiary time.

Wheeler (1919, p. 301) remarked on seven species (which he listed) as follows: "With the exception of the tropicopolitan 'tramp', *Tetramorium guineënse,* of Old World origin, none of the forms is known to occur in the Galápagos Islands and all are neotropical or have strongly neotropical affinities." Further (p. 302), "It is evident that the Cocos ants are decidedly tropical whereas those of the Galápagos are mainly such as belong to sub-

tropical or temperate regions or at any rate to the cooler or subalpine regions in the New World tropics."

Class ARACHNIDA

Argyroepeira nigriventris Keyserling. Reported from Cocos Island by Banks (1902, p. 61) and by Heller (1902, p. 78). It has also been reported from the Galápagos Islands, Central America, Colombia, Brazil, and the West Indies.

Phylum CHORDATA

Class REPTILIA

Anolis townsendi Stejneger
Sphaerodactylus pacificus Stejneger

Only two species of lizards have been described from Cocos Island, both by Stejneger (1900, p. 163; 1903, p. 3). *Sphaerodactylus pacificus* has been compared by herpetologists with *S. lineolatus* Lichtenstein which ranges from Central America to Colombia (Stejneger, 1903, p. 4; Barbour, 1921, p. 236, pl. 1, fig. 3, pl. 13, figs. 1–4).

For additional information on this group see Heller (1903); Taylor (1956).

Class PISCES

Fowler (1938, pp. 248–261) published lists of the fishes known to occur at Cocos Island. He recorded 72 species from or in the general vicinity of this island. Briggs (1961, pp. 552–554) reported 16 of 53 (30 per cent) species of transpacific shore fishes at Cocos Island. This would be 22.2 per cent of the 72 species reported from the island by Fowler. More recently Briggs (written communication April 3, 1962) mentioned a total of 59 shore fishes "of which sixteen are trans-pacific, thirty-eight are American, and five are endemic."

A freshwater guppy, *Cotylopus cocoensis* Heller and Snodgrass (1903, p. 211, pl. 11), described from streams at Chatham Bay, Cocos Island, was said to be allied to *Sicydium salvini* Grant from Panama.

Other workers who have contributed information concerning fishes from Cocos Island include: Beebe (1926, pp. 228, 435); Beebe and Tee-Van [1941a; 1941b (sharks, rays, mantas, chimaeras)]; Fowler (1932); Halstead and Bunker (1953); Halstead and Schall (1956); Heller and Snodgrass (1903); Heere (1936); Klausewitz (1958); Myers (1941); Myers and Wade (1941); Nichols and Breeder (1928); Schmitt and Schultz (1940); Seale (1940); Snodgrass and Heller (1905).

Class AVES

(Land Birds)

Butorides virescens maculatus Boddaert. (Green heron). [Gifford, 1913, p. 65 (as *Butorides virescens);* Sludd, 1962, written communication (as *Butorides virescens maculatus*)]. Mainland and Galápagos Islands.

Dendroica petechia aureola Gould. (Yellow warbler). Reported from Cocos Island as *Dendroica aureola* Gould by Townsend (1895, p. 122) and as *Dendroeca petechia* by Gifford (1919, p. 216); Beebe, 1926, p. 435 (as *Dendroica petechia aureola*); Sludd, [1962, written communication (as *Dendroica petechia aureola*)]. Mainland.

Hirundo rustica erythrogaster Boddaert. (Barn swallow). (Gifford, 1919, p. 205). Mainland.

Nesococcyx ferrugineus Gould. (Cocos Island Cuckoo). [Gould, 1843, p. 105 (as *Coccyzus ferrugineus*); Gifford, 1919, p. 195 (as *Coccyzus ferrugineus*); Beebe, 1926, p. 435 (as *Coccyzus ferrugineus*); Sludd, 1962 [written communication (as *Nesococcyx ferrugineus*)]. Known only from Cocos Island.

Nesotriccus ridgwayi Townsend. (Ridgway's flycatcher). (Townsend, 1895, p. 124; Gifford, 1919, p. 200; Beebe, 1926, p. 435). Known only from Cocos Island.

Pandion haliaëtus Linnaeus. (Osprey). (Gifford, 1919, p. 193). Mainland.

Pinaroloxias inornata Gould. (Cocos Island finch). [Gould, 1843, p. 104 (as *Cactornis inornata*); Townsend, 1895, p. 123 (as *Cocornis agassizi);* Richmond, 1902, pp. 247–248 (discussion of the type locality and synonymy of *Pinaroloxias inornata);* Gifford, 1919, p. 242 (as *Pinaroloxias inornata);* Beebe, 1926, p. 435 (as *Cocornis agassizi);* Swarth, 1931, pp. 268–271; Lack, 1945, pp. 19, 126, 129, and 1953, pp. 67, 72; Bowman (1961, pp. 20, 92, 94, 100, 104, 109, 113, 115, 129, 159, 161, 168, 177, 204, 207–216, 218, 220, 225, 231, 234, 289, pls. 7, 12, 16, 20)]. Known only from Cocos Island.

This list of 7 species and subspecies of land birds from Cocos Island with their occurrence elsewhere, was compiled from the literature supplemented by information received from Dr. Paul Sludd. Of the 7, 3 are known only from this island. Wallace in 1876 (p. 60), remarked on the interesting occurrence of "*Coccyzus*" [*Nesococcyx*] on this island.

Gifford (1919) discussed the land birds of Cocos Island and additional remarks concerning members of this group may be found in papers by Beck (1907); Murphy (1936); Rothchild (1902); Townsend (1895); see also Carriker (1910) and Eisenmann (1955).

Sea birds from Cocos Island have been discussed by Snodgrass and Heller (1902; 1903); by Gifford (1913), whose account includes references to other authors; and by Murphy (1936, p. 319).

BOTANY

The flora of Cocos Island has attracted the attention of several botanists. A comprehensive report by Stewart (1912) recorded 77 species of vascular plants, 20 of which are ferns. Only 8 of them (8.69 per cent), are endemic. Twenty-seven of these species, 11 of them ferns, also occur in the Galápagos Islands where the endemicity is reported to be 40.9 per cent

Stewart concluded from his studies that the flora of Cocos Island was that of an oceanic island, younger than that of the Galápagos Islands, and that there was no evidence to support the theory that the island was ever connected by land with either the mainland or the Galápagos Islands. He believed that the flora reached the island chiefly from the mainland fortuitously through the agencies of winds, ocean currents, and migratory birds.

Svenson (1935, p. 259), referring to Johnston (1931, p. 35), stated that the vegetation of Cocos Island consists of about 100 species, of which about 10 are endemic, "overwhelmingly of ferns, melanostomes, and orchids." He mentioned that there is no change in the flora to a height of at least 457 meters (1500 feet). He also stated that except for ferns, virtually none of the species also occur on the Galápagos Islands.

Cook (1939) described a mountain palm, *Rooseveltia frankliniana,* from Cocos Island. It was said to be rather closely related to *Plectis oweniana* Cook from Guatemala. Cook believed that the coconut palms observed on Cocos Island as early as 1699 by Wafer, were introduced there.

Various components of the Cocos Island flora have been discussed by authors in several papers including: Bartram (1933. Mosses; see also list by Stewart, 1912, p. 395); Clark (1953, Hepaticae); Cook (1910; 1939; 1940, Palms); Cooke and Bonar (1961, Fungi); Howe (1934, Hepaticae); Pittier (1899); Rose (1892); Stewart (1911, pp. 230, 233–235. He remarked on the origin of the Galápagos flora and gave occasional reference to Cocos Island); Svenson (1935, includes various authors in his bibliography).

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