A Monograph of Marcus Island.

By William Alanson Bryan, B.Sc.

PREFATORY NOTE.

The Trustees having been pleased to accept the offer of transportation tendered by Mr. W. C. Peacock in behalf of the Marcus Island Guano Company, authorized the writer, in the absence of the field collector, to undertake an expedition to Marcus Island in the interest of the Bishop Museum, to make a thorough investigation of the geology, zoology and botany of that remote island. The following paper contains the scientific results of the investigations made in the vicinity of and during a week's sojourn on the island. Owing to the presence of a party of Japanese, and the international complications resulting from both Japan and the United States claiming possession of the island, our stay was much more limited than had at first been planned. As a result, work on the marine zoology was curtailed to a considerable extent, and the collections made in all departments must be regarded as representative only. It has been thought advisable to restrict the present paper to the information gathered concerning Marcus Island, though much additional material was collected which will appear in the form of an account of our visit to Midway Island.

Grateful acknowledgments are due to the gentlemen interested in the commercial enterprise which made this expedition possible. Their never failing courtesy and generous assistance have done much to facilitate the work undertaken by this institution. In the proper connection I shall hope to acknowledge the kindly assistance of such distinguished specialists as Doctors Stejneger, Dall, Gilbert, Smith, Miss Rathbun and others to whom, as final authorities, I have referred various questions in nomenclature. Thanks are due Director Brigham for much assistance and kindly suggestions with the proof sheets; and to Mr. Sedgwick, who, as chemist of the Company, was my companion on the voyage, and who has added much to the accuracy and detail of the fol-

lowing account. I venture the hope that the present paper may be the first of a series of monographs which the Trustees may see fit to publish on some of the more interesting and as yet little known islands of this vast ocean.

INTRODUCTION.

Marcus Island, the subject of the present monograph, was so little known at a date as recent as 1900 that it could not be distinguished with certainty, either in location or characteristics, from a number of reported islands which are said to lie in that portion of the ocean, and since it was impossible to obtain definite information, however brief, concerning it, it seems but fitting to bring together here a history of the island so far as it can be gathered.

On a Mercator's projection map this mere speck of land rising above the ocean's surface is distant from Honolulu 2400 miles, and 4500 miles west by south from San Francisco, some 1200 miles southeast of Yokohama, and not less than 1000 miles from Guam, the nearest American soil. A number of corrected readings taken by our vessel places the centre of the island in Lat. 24° 14′ N., and 154° E. Long. Los Jardines, the nearest islands which are not directly confused with Marcus Island, are placed on certain maps and charts 200 miles to the southwest with their position indicated as doubtful; however, as they are described as being two small islands which were discovered in 1788 by Captain Marshall, and have been reported at rare intervals since by whalers, they need not here be taken farther into account. As to who named Marcus Island and for whom it was named the records at hand give no clue; doubtless its discovery, early history and naming are lost in the maze of uncertain and oftimes unreliable log books kept by those hardy seamen who made long voyages in these waters while engaged in the whaling industry.

Turning to the Directory of the North Pacific Ocean, published in 1886, I find that "Marcus Island has been shown as a doubtful island in Lat. 24° 25′ N., and Long. 153° 45′ E; but several other announcements of islands are found hereabouts. *Island* from whalers report, in Lat. 24° N., 150° 40′ E. *Another island* in 24° 5′ N., 150° 10′ E. It was seen by Captain Kilton in the *David Hoadley* in May, 1868. He describes it as a low, level, sandy island covered with trees and bushes, about two or three miles long east

and west. No breakers were visible, extending any great distance, from either end; its width was not ascertained. The position of the west end, by set of sights, was 24° 24′ N., 153° 58′ E., or twenty miles northward of the reported position of Weeks Island."

The U. S. Survey Ship Tuscarora, which made cable soundings across the Pacific in 1874, to which I will subseqently allude, came close enough to the island to observe large black rocks on the reef which fringed the shore. Commander Belknap states that the island is about sixty feet high and appears when first seen like a forest of trees rising out of the water. He placed it in Lat. 24° 14′ N., Long. 154° 0′ E., which agrees exactly with observations taken by our party.

Weeks Island, not unlike many others hereabouts, was originally a whaler's report, and by some is believed to be identical with Marcus Island. However, it was later seen by Captain Gelett of the Hawaiian Mission Ship Morning Star, and was located by him in 24° 4′ N., and 154° 2′ E. He states that it was about five miles long, densely covered with trees and shrubbery, with a white sandy beach, and a knoll near the centre rising about 200 feet above the sea. He saw no signs of inhabitants, and noted that a reef extended to the north of it.[1]

In an attempt to harmonize these varied and scattering reported islands and reefs, all of which have been more or less confounded with Marcus Island, one should not lose sight of the fact that they were made mainly in the days of long sailing voyages, when slight errors in the variation of the chronometer would tend to throw out the longitude, to which strong and variable currents add another element of uncertainty. In addition to which, since Marcus Island is not far from a centre of volcanic activity, disturbances of this character may have removed some reefs or islets below the surface of the sea; yet my observations of the flight of certain birds while in the vicinity of the island leads me to strongly believe in the existence of an island some fifty to seventy-five miles to the north and east of the island of Marcus.

[1] Still farther to the north are given: *Wake's Island* in Lat. 31° 14′ N., Long. 155° 0′ E. (A whaler's notice). *A Reef* in 31° 18′ N., 153° 20′ E. *An Island* in 31° 0′ N., 147° 16′ E. *A Reef* in 32° 0′ N., 147° 20′ E. *A Reef*, announced by the China Mail Steamer, in 31° 30′ N., 154° 0′ E. *Ganges Reef* in 30° 47 N., 154° 20′ E., and other reports which are doubtless repetitions or copies of one or the other of the above, making them too numerous to recount; however, suffice it to note that the Commanders of the Pacific Mail Steamers do not believe in their existence. *Congress Island* is given in 25° 30′ N., 148° 0′ E. *An Island* in 26° 6′ N., 154° 36′ E. Both located by whalers.

On the evening of the day previous to our sighting land, while we were something over a hundred miles to the north and east of it, all of the land birds observed took a uniform course off our starboard bow as they flew heavily laden on their return home from the day's fishing at sea. We held a course practically due west, and on the following noon sighted Marcus two points off our port bow. By knowing something of the radius to which certain of the birds observed go to sea, it did not seem improbable that the island (loc. cit., p. 1126) reported by the whaler as being in 26° 6′ N., 154° 36′ E. might yet be found to be a reality.

When the island was sighted from the masthead at about 7:30 on the morning of July 30, 1902, it resembled a low level cloud just discernible above the horizon. By 9 o'clock a rough outline was easily traced; an hour later a sandy beach and a few straggling coconuts rising above the forest line were seen; but nowhere, either at this time or subsequently, were we able to locate any elevation that could be mistaken for the sandy mound reported on Weeks Island. As we came closer to land breakers could be seen on the reef along the northwest side. A boat was lowered and manned. The Captain's party, including Mr. Sedgwick and the writer, took places in the stern, and then began one of the most exciting experiences of my life, for it was evident that we would have to make a landing over the reef, and the presence of numerous sharks about our boat made a setting for the undertaking which gave every promise of a real adventure. As we were rowed landward we could see the swells breaking into great sheets of spray on the jagged submerged walls of coral and shooting high into the air; but by following along the line of breakers we finally came to a place about a third of the distance from the southwest point where, by waiting a favorable opportunity, it was possible to get our boat through a narrow shallow opening in the reef, and to make our landing without mishap.

Finding certain officers of the Japanese Government in possession of what we had anticipated to be American territory, it might be well to explain that, remote as the island is from the two countries, both Governments had considered it of sufficient importance to lay claim to its sovereignty. The Japanese claim was based fundamentally on its accidental discovery by a shipwrecked captain, who had gone ashore on the island in a terrific storm. This event

brought the knowledge of it to the attention of the Japanese, and from time to time hunting and fishing vessels called there, and on all such visits found it entirely uninhabited. In 1896 these visits were made of a more or less permanent character, and since that

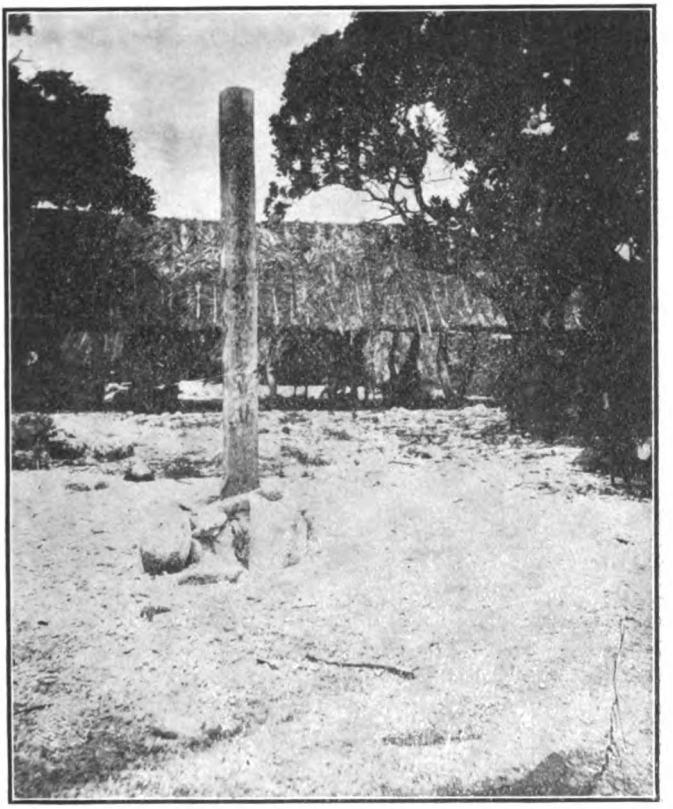


FIG. 1. Photographed from the beach in front of the settlement. Showing the wooden monument erected by the Government of Japan in 1898, which sets forth her claim to the island. The palm-thatched shed was used by the colony in preparing birds for fertilizer.

time Japanese have repaired to the island each year during the summer months and have established a thrifty colony. However, no official steps were taken by their Government to lay claim to the island until in July, 1898, when it was incorporated in the Bonin Group and officially named Minami Torishima (South Bird

Island). In that year a wooden monument (Fig. 1) which set forth Japan's claim was erected on the south beach.

On the other hand Captain Rosehill, a citizen of the United States, while engaged in trading in the Pacific, landed on the island in June, 1889, with a view of ascertaining its value as a coconut island, and believing himself to be the first person to set foot on its soil, or at least that it had never been taken or occupied by any Government or individual, he claimed it for the United States. Since that time he had been engaged in making a satisfactory proof of his claims and organizing the present expedition to investigate its guano deposits. Later, the Japanese Government (I understand) has relinquished all claims to the island and it may now be regarded as undisputed American territory.

Learning of Captain Rosehill's intended visit, the Japanese Government despatched a cruiser to the island and left a naval officer and a party of marines in control. It was owing to the military regulations imposed by them that the work of our party was so materially hampered, and that the period of our stay was made much too brief to accomplish as exhaustive an investigation as had been originally planned.

PHYSICAL FEATURES.

The geographical position of Marcus Island has been touched upon under a previous head; it therefore remains to consider its structure and physical features before attempting to draw conclusions concerning its geological history.

On approaching the island from the sea in a small boat, one is attracted by the intense blue of the ocean washing the growing reef on every side. The reef itself is of the common form fringing almost all coral islands of this class in the Pacific. Its outer face, though jagged and broken, seldom gives way to form a channel of sufficient width and depth to admit of a small boat passing through at low tide; in fact only two such places were found by our crew: one, the first point from which we effected a landing, about a third of the distance from the southwest point on the northwest side of the island; the other, about a quarter of the distance from the same point on the southern side. This latter, by no means a safe passage for a whale boat, is the principal opening and the one made use of by the Japanese in landing their supplies and shipping the fertilizer and bird skins secured by them. The time at my

disposal did not permit of making systematic soundings; nevertheless a number of attempts were made at various times to find anchorage for our schooner close in to land, with the result that

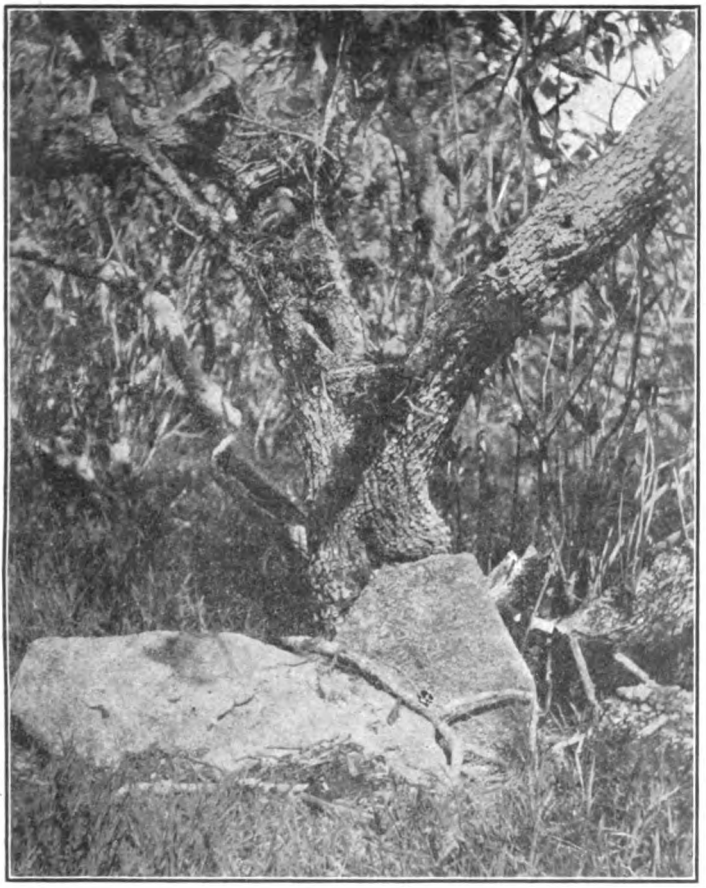


FIG. 2. Showing large flag rock of shingle conglomerate that has been broken loose from the water line and carried inland by the action of the sea. In the tree are three nests of the Noddy Tern, *Anous stolidus* (Linn.).

bottom was found at a depth of eight to fourteen fathoms on all sides of the island, within a few hundred yards of land. The bottom was of solid rock—probably coral—with occasional patches of sand and shingle. I believe that no vessel has found a satisfactory

anchorage, though the best is considered to be half a mile off land on the southern side in fourteen fathoms of water.

The set of the current in these waters is in a northwesterly direction, though the island forms a local current which is exceedingly variable and not to be relied upon when close in to the breakers. On the table reef, particularly along the northwest and eastern sides, are to be seen huge blocks of solid coral rocks rising ofttimes eight or ten feet above the water at low tide; many of these rocks weigh tons and the force required to disengage them from the growing reef and carry them landward cannot be estimated, though it should by no means be lost sight of in considering the forces used by nature in this interesting work of island building.

Scattered at irregular intervals all along the beach, and not infrequently inland quite a distance, were to be found concrete flag stone rocks (Fig. 2) that had been broken loose from where they were formed below the tide line and lifted high and dry on the beach in time of storms. Stones of shingle and sand, all of the most compact character, measuring three by five feet on the surface, and some six inches thick, were observed forty and fifty feet above the sea level and several hundred feet inland. When exposed to the wash of the ocean these conglomerate stones are invariably smoothly polished, and, being very compact and overgrown with nullipores, give very little indication of their composite character; however, when carried up on the beach and exposed to atmospheric agencies they tend to disintegrate and were always leached out and roughened, resembling an ordinary pudding stone in structure.

The reef varies considerably in width; it is a little more than a hundred yards in the narrowest place on the eastern side, while the average width is approximately two hundred yards. On the three main points the reef extends nearly seven hundred yards seaward. Being on the northern limits of the coral belt only the more hardy reef building *porites* and *pocillopora* are here to be commonly found. Perhaps a clear conception of the form of this bit of land, if indeed we can dignify a mere heap of sand and shells in the midst of the ocean by calling it land, can be had by holding in mind a roughly formed right-angle triangle, the chief angle of which would form the southwest point. By the ordinary action of

the sea the sides have become concave, while the angles have been rounded down to form obtuse points. Beginning with the south side we find the beach composed, for almost its entire length, of coarse coral shingle, from which the finer coral sand or detritus has been thoroughly sifted. The average size of the pebbles along

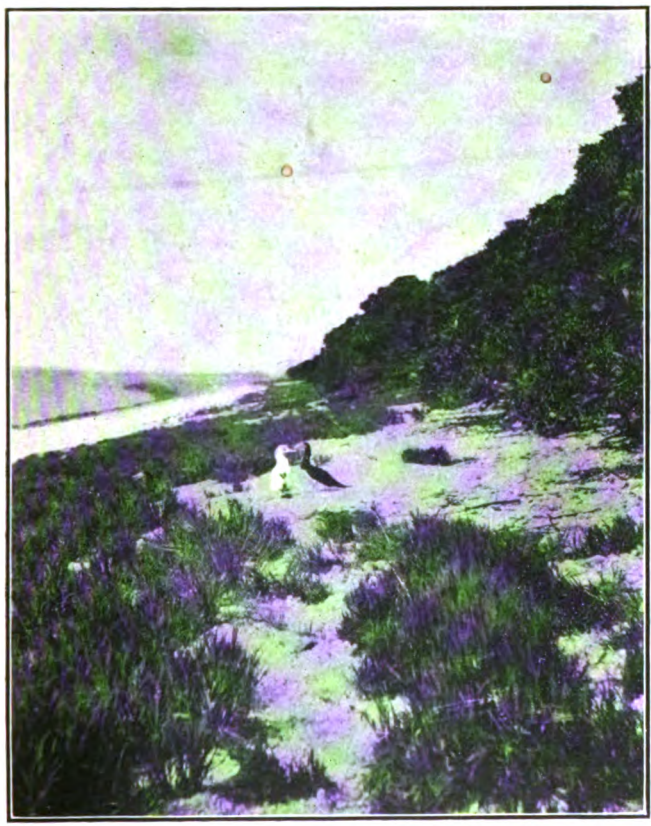


FIG. 3. The northwest side, looking toward the north point. The birds are the female and the downy young of the Booby, *Sula sula* (Linn.).

the water line was probably half an inch in diameter. Back some distance these bits of coral were considerably larger in size and were not so worn and rounded. Immediately in front of the settlement, between a salt water well and the sea, was exposed a table of shingle conglomerate, the surface of which was some fifteen feet or more above the sea.

The old exposed beach conglomerate was immediately back of the opening in the reef, and it was doubtless owing to the action of the waters that the loose superposed shingle, which was some four feet in depth over it, had been removed exposing this interesting bit of geological data. Everywhere along this beach was to be found evidence that the island was being added to at all times, and especially during storms. Stretching along the entire southern side was an apparently new beach. On inquiry I learned from the Japanese that in the month of October, 1901, there had been a heavy storm from the south that prevailed with much violence for ten days, during which the sea rose to a point they indicated to me that was fully twenty feet above the ordinary water line.[2] It was at the time of this storm that the new beach referred to was laid down; I estimated its width to be forty feet, with the greatest depth of twelve feet at about the middle of the southern shore. Back of this new deposit there were evidences of similar constructive storms in the not too distant past.

The northwest coast (Fig. 3) was made up largely of sand and small coral shingle, and the beach formed a less abrupt angle with the sea level than the one just considered, indicating that though it was not wholly free from storms they had been less frequent, and as a rule less violent in recent years. About a quarter of the distance from the northern point, and extending from there on to the northern end of the island, was exposed a black coral reef one hundred and fifty feet at the widest point, and sloping from the land to the sea; it is probably seven feet above the water line, where it disappears under the sand and shingle of the upper beach. The geological significance of this elevated reef is apparent. Its surface was sculptured into holes and ridges by the action of the water, while its structure was most compact and must have offered great resistance to ordinary weathering; some of the pits in the surface were large enough to hold several gallons of water.

The east and last side of the island to be considered shows the effect of many furious storms; indeed, it is all the industrious

[2] Since the preparation of the above article I have received a letter from Mr. Y. Nagata, a Japanese who was on the island during our visit. He states that on September 2, 1902 (a month after our departure), a storm of unusual violence broke on the island from a southerly direction, carrying away the rough houses, destroying many of the trees, and forcing the colonists to retreat to the highest point for safety. They were left without food other than fish and birds from that date until December 25. During this time sixteen of their number perished.

polyp can do to build its masonry of coral rock as fast as old ocean is pleased to here heap up the land-forming materials. Near the north end the land attains a height of seventy-five feet, which was the highest point found. In this vicinity the beach is made up of

FIG. 4. One of the curious spaces inland on which, though surrounded by dense woods, no trees or shrubs will grow.

six successive bench-like steps. These mark the gradual receding beach lines and point unmistakably to successive elevations. The old benches are quite uniform in character, being twelve feet deep and thirty or forty feet in width. Rounded blocks of coral which go to make up the upper ones are often as large as a man's head. Intermingled with the stones are shingle and sand of a coral

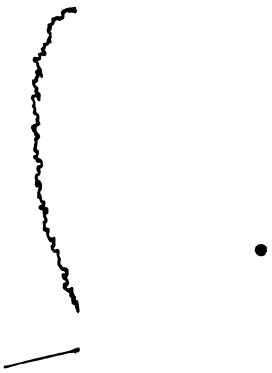
nature, but the grinding and sorting process of the waves is clearly seen; the larger and rougher materials remaining in the upper beaches, while shingle and coarse sand form the lower ones.

In the middle of the island along this side the highest point is not to exceed forty feet, while at the southeast point an elevation of sixty-five or seventy feet is attained. Turning to the interior of the island we found the surface to be, generally speaking, quite level, though the eastern half was broken up into minor surface irregularities. A little to the northwest of the centre were four separate deposits of loose black alluvial soil, which undoubtedly mark the location of as many dry lagoons.

Generally speaking the island has been built up about these spots as a centre. The surfaces of these old lagoons are lower than the surrounding land, but still are in the neighborhood of twenty feet above sea level.[3] The western and northwestern portion of the island is made up of sand more or less mixed with humus. The eastern and southeastern portion is composed of coarse blocks of coral, coral shingle, huge coral boulders, and a great quantity of coral branches the prongs of which are ofttimes scarcely broken. A hundred and fifty yards from the coast line on every side the whole surface of the island is heavily wooded, excepting that scattered about here and there are to be found irregular patches, from a few rods to a few acres in extent, which are entirely destitute of trees and shrubs (Fig. 4), for which the composition of the ground offers no solution.

The extent of the coast line is a little over four miles, while the area of the island (estimated) is about 740 acres. A somewhat hasty survey of the island was made, from which field data I was able to draw the map given on another page. The following table

[3] Mr. Sedgwick, in carrying on the investigations of the Guano Company, made a number of excavations in various parts of the island, but especially in the bottoms of these old lagoons, which were now overgrown with thick grass, shrubs and trees, over which towered fine coconuts of great age. In these depressions exist varying conditions in the under strata, though the surface is uniformly composed of alluvial deposits varying in thickness from eight to fourteen inches. Underneath this, in the coconut patch, were found coral sand and earth from six to ten inches, then a layer of coral sand with pebbles, and occasionally solid base-forming coral in a slab, under which was found broken coral. In the two other larger alluvial patches beneath the black earth was light clay-colored mud composed of fine particles of coral, and below this were larger pieces of coral as far down as the excavations were carried, which was from six to eight feet. The investigations of the Chemist were not nearly as complete or as conclusive as it had been planned to make them. A limited quantity of guano was found which gave a test of 70 per cent. phosphate of lime; but the great majority of the samples secured were not so flattering.



of the coast meander lines were taken with a compass and chain and may be regarded as approximately correct. Starting about 1500 feet from the southwest point the readings would be as follows:

1. NE. ½ N., Magnetic ..... 6900 feet.
2. E. by S., Magnetic ..... 600 feet.
3. S. ½ E., Magnetic ..... 6000 feet.
4. S. by W. ½ W., Magnetic ..... 900 feet.
5. SW. by W. ½, Magnetic ..... 600 feet.
6. W. by S., Magnetic ..... 300 feet.
7. W. by N., Magnetic ..... 6000 feet.

CORRECTIONS.—Corrected bearing of line 3, ¾ of a point to the east. Corrected unmeasured portion of line 1 by adding 1500 ft.

On all sides of the island, usually well up from the water, was abundant driftwood and wreckage. Great logs of unknown origin, sometimes fifty feet in length, with broken branches and scarred trunks were common. But it was well toward the north point that a single great "Northwest" log had gone ashore and been driven a considerable distance inland. Applying a tape I found the log twelve and a half feet in length by forty-two inches in diameter. Both ends had been cut square, and into the butt end was driven a large wooden wedge. We regarded this bit of silent evidence as indicating the natural relation existing between the American continent and this all but lost island, and looked upon it as a forerunner of the ultimate annexation of Marcus by the United States, an event which since our visit has been fully recognized. To the naturalists the story of the voyage of this adventurous log, detailing its history from the time of its leaving its home at Puget Sound until at last, wind and current-driven across the Pacific, it reached its final resting place, high on this isolated spot, would indeed be interesting and instructive could it be accurately told.

GEOLOGY.

From the description of the physical features which has been given it may be gathered that the island is to be considered as an ancient triangular atoll which has been elevated above the sea. The chief reasons for so regarding it are, its proximity to regions of known volcanic disturbances, its old dry lagoons, the elevated table of coral rock exposed at the southern side as well as the more recent one at the northern end, the steps or bench-like beaches on the eastern side, the huge blocks of coral rocks scattered over the surface which are above the reach of the highest seas, in addition

to the size and condition of the coral boulders which make up a large part of its surface.

The difficulties encountered in examining the geology of the island were considerable. The density of the vegetation at times made it impossible to see to any distance, and at all times rendered locomotion very difficult; however, I crossed and recrossed the island a number of times in every direction, in addition to making a detailed examination of the appearance of the seaward slopes, and carefully noting and photographing every important point that might throw light on the island's past history.

Turning to soundings taken by the U. S. S. Tuscarora[4] across the Pacific in March, 1874, we find, beginning on the 160th Meridian, 350 miles to the east of Marcus Island, that bottom consisting of yellow mud was found at a depth of 3023 fathoms; at the 154th Meridian, in the vicinity of Marcus Island, the sounding instrument secured coral and lava at a depth of 1499 fathoms; while at the 152d Meridian the bottom was found to be composed of ooze at a depth of 3023 fathoms below the sea level. So that from east to west Marcus Island may be regarded as the summit of an elevation in the ocean's floor,[5] forming a peak or fold which approaches near enough to the surface to admit of its being used by the reef-building corals as a lodgment.

The region to the west and northwest is one noted for its volcanic activity; while Rota, an island north of Guam, according to Quoy and Gaimard, has coral rocks upon its hills, more than 600 feet above the sea. The islands to the north of it are as yet little known, but like Rota give evidence of change of levels; while our experience on the night on August 5th, hereafter mentioned, leads me strongly to suspect that Marcus Island is not by any means a fixed island, and may yet be still further elevated.

Having once accounted for the floor of the ocean approaching near enough the surface to admit of a coral growth, the next step is an easy one, for by well known laws of nature, reef-building corals always tend to grow outward from a central point. The old

[4] Soundings taken by the U. S. S. Tuscarora in the vicinity of Marcus Island:—

Degrees:	160 E.	159 E.	158½ E.	158 E.	156 E.	154 E.	152½ E.	150 E.
Depth:	3023 ft.	2938 ft.	2042 ft.	2173 ft.	3273 ft.	1499 ft.	3023 ft.	3287 ft.
Bottom:	Yel'w mud.	Mud lava.	Corals.	Corals.	Ooze.	Cor'l lava.	Ooze.	Ooze.

[5] I regret that my efforts to secure information concerning the floor of the ocean to the north and south of the island from the various cable companies who have made soundings in these waters were unavailing; so that it yet remains to be ascertained whether Marcus Island is simply the summit of a single subterranean mountain or a peak of a range.

corals in the centre of the growth die from want of suitable food, and as a rule a simple lagoon surrounded by a ring of coral results. Through the action of the waves fragments of coral are detached from the outer edge of the reef and piled on its surface together with shells and other land-building materials. In the lagoon, which at this time must have been more or less cut off from the sea except in the periods of storms, there begins to form an ooze which is augmented by the decaying vegetable matter supplied from the hardy shore plants growing on the ring of new formed land about it.

Located as our embryo island is in the regions of the terrific monsoons that sweep over the west and northwest Pacific, it is not difficult to account for the frequent appearance of small fragments of pumice and other light volcanic products that, floating on the surface of the ocean, have eventually been carried over the ring of sand and shingle and deposited in the comparatively quiet water of the lagoon and there mingle with fragments of coral, bits of shell, and other forms of ocean debris which are brought thither from time to time.

We have no definite clue as to the time required to build up the land to the greatest height it can attain from the ordinary action of the sea; but from the character of its surface at the highest points, consisting as it does of boulders of coral twelve inches or more in diameter, which are mingled with smaller fragments, we are able to leave out of account the action of the wind that is so frequently a potent agent in building coral islands above the high water mark. Investigators have determined that the highest waves are but little more than a third the height of this island (75 feet), so that we must look elsewhere for the agencies that would build up this heap of sand and shingle to its present height. Perhaps the most apparent and convincing testimony would be derived from a study of the dry lagoons and the material which forms their floor. Mr. Sedgwick made excavations in all four of these, but especially in the larger central one which is designated on the map. Reviewing the conditions found there it would appear that at a time when the island had been piled up to the height of thirty or more feet, the ring of land, lagoon and all, had been of a sudden subject to a uniform uplift. Gradually this lake-like lagoon had evaporated or leached out through its porous bottom, leaving a deposit of black

alluvial earth. We may conclude that the first stage of formation must have been, geographically speaking, comparatively brief, judging from the shallow deposits here found. Looking elsewhere for confirmative evidence my attention was directed to the conditions existing in the salt water well. It had been sunk into a

FIG. 5. View at north point, seventy feet above sea level. Showing the surface of the island at the highest point, the character of the foliage, and wreckage from a Japanese boat.

concrete of coral shingle for the last five feet, which had unmistakably been formed under water. Again, mention has been made of the exposed table of coral shingle rock which had been uncovered immediately in front of the settlement during the period of a recent storm. This rock, like that in the well, showed every evidence of having an aqueous origin, and the peculiar structure of the rock laid down by the action of the waves in shallow water. I conclude that this must have been an old shore line, most probably corresponding to the one first made when the lagoon was formed.

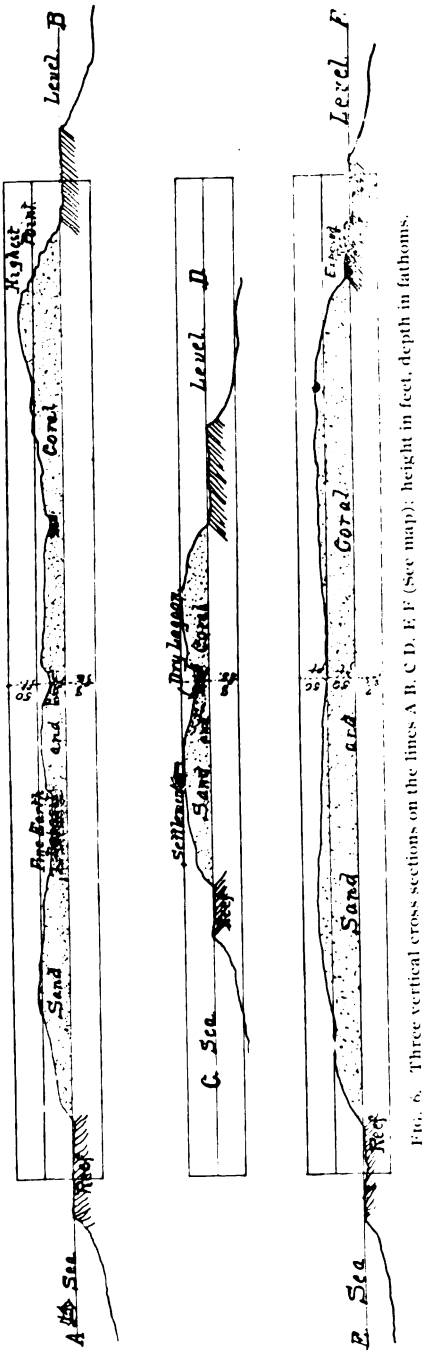


FIG. 6. Three vertical cross sections on the lines A B, C D, E F (See map); height in feet, depth in fathoms.

The condition existing at the north point (Fig. 5) was such as to leave no doubt in my mind that the reef here exposed had been formed and elevated at a period after the first described beach had been raised above the sea. Thus are we able to account for two successive elevations. The consequent change in the topography is perhaps best observed in the step or bench-like beaches, referred to above and delineated in cross section drawings A to B (Fig. 6), along the east coast. The uniformity of these beaches, taken in connection with the character of the material composing them, can only be accounted for by acceptance of a theory admitting of two or more periods of elevations in the island's history. It was interesting to observe that the northern and eastern portions of the land were most generally composed of the coarsest materials. No doubt this was due to the exposure of that side to the most extreme action of wind and sea, and the correspondingly narrow reef on that side; for, other conditions being equal, the relative size of the materials composing a beach is directly in proportion to the width of the surrounding reef. By consulting the map it will

be observed that the three points of the island are much higher than the middle of the three sides, which is due to the points being exposed to the building agencies from two directions. The same agencies of wind and tide which have formed the island have doubtless planted its coconuts, brought its vegetation and the land reptiles which inhabit it.

METEOROLOGICAL CONDITIONS.

The winds at Marcus Island in all probability vary but little from the prevailing winds in that part of the Pacific. It is well known that they are of sufficient force during the greater part of the year to cause the surf to break on all sides of the reef with great fury, rendering landing an exceedingly dangerous, if not impossible, feat during the seven months of the year from September until April. Throughout the remaining summer months the ordinary steady trade winds blow, and it is only at this season that landings can be made in safety.

We had no means of estimating the rainfall during the year, but the Japanese were able to catch enough water from the roofs in barrels, jars and boats to keep them well supplied with drinking water; and as they were especially careful to store all they possibly could I concluded that there were periods of drought. Aside from this source of supply there was no fresh water available save what little might be collected in the holes in the exposed reef at the north end of the island. There were frequent tropical rains during our stay that were considered by the residents as out of season. These caused the water to collect in the low places in the dry lagoons. When examined chemically it was found to be charged with phosphoric acid and organic matter to such an extent that it was pronounced unfit for drinking. The colony had supplemented the supply of water by digging a brackish water well fifteen feet deep back a little distance from the shore; this furnished water suitable for cooking and washing purposes only.

Thunder and lightning usually accompanied the storms. At times the electrical display was splendid, though disheartening to a naturalist. During a heavy rain on the night of August 5 there occurred what Mr. Sedgwick and myself both believed to have been a violent seismic disturbance. Though sleeping soundly the vibration caused us both to wake suddenly. We were so disturbed as to deem it advisable to make a light; on rising I felt it necessary

to hold to objects to maintain an equilibrium; so that the shock must have lasted some seconds.

The temperature varied but little in the few days on shore. By the thermometer the lowest temperature noted was 72° F., the highest 82° F.; but the heavy squally weather together with the steamy evaporation from the sand, rendered it almost intolerably hot and oppressive.

As a place of residence Marcus must be considered both healthy and habitable. In the six years that the island has been more or less regularly inhabited there has not been a single death, and no sickness that was attributable to the island or the climate.

AVES.

When in advance of setting forth on the expedition to Marcus Island we were commenting on its isolated position and anticipating the probable results of a general collecting trip thither, much hope was felt and expressed that there might be found on the island land birds which would be sufficiently different in habits or structure to throw needed light on the question of the probable source from whence certain land forms inhabiting the Hawaiian Islands had been derived. Consulting the meagre information available, I found the island reported as being five miles long, densely wooded, and rising 200 feet above the sea. Certainly a high island, well wooded and of considerable size—located where Marcus is, did seem to give promise of being a spot which might have served sea-blown land birds from the Marianas and Bonin groups as a stepping stone on their way to Laysan.

However productive of distribution figments the fancied field might have been, the reality was most disappointing. A painstaking search for land birds resulted in satisfying me that had any existing terrestrial or arboreal bird been in any way introduced on the island, it would have perished for want of suitable food. The island was little more than one-fifth the size I had expected; was less than one-third as high as reported, and, though densely wooded, the trees were of such species that no nectar-loving bird could have gained a livelihood from their blossoms; and certainly no insectivorous bird could have eked out an existence on the few small insects found; while the supply of fruits and edible seeds was all but *nil*. Nevertheless the absence of land birds was made up for, in numbers at least, by the abundance of certain sea and shore

birds. Fifty-six specimens were secured during the period spent on the island. These skins, taken in connection with very full notes made while in the field, form the basis of the following list. The measurements are given in English inches and hundredths. Where the length of a specimen is given, unless otherwise stated, the measurement was taken from the specimen in the flesh. The depth of bill is its vertical depth at the base. The colors of the soft parts were carefully noted, so far as possible Ridgeway's nomenclature of colors being used in their description.

Larus vegae (Palmèm.). **Pallas' Gull.**

I was so fortunate as to secure from the Japanese manager of the little colony of wing hunters a single specimen of this interesting species. My informant had resided on the island the greater part of six years, during which time he had secured specimens on four different occasions, but always in the winter months. The specimen before me was taken in March. The head and neck is whitish streaked with brown; the mantle is grayish brown, brown and whitish so mixed as to give a mottled appearance to the whole back and wings. The rump feathers and upper tail coverts are whitish with irregular brownish splotches and bars; the tail feathers are blackish or brownish with two fairly well defined white bands and whitish tips to all. The outer tail feathers are mottled brown and white throughout their length; the quills are umber brown, both shafts and webs, except the inner edge and tips which are whitish. The secondaries are also tipped with white; the breast is brownish mottled with whitish, while the crissum and under tail coverts are white occasionally spotted with brown. The legs are light colored in the skin, indicating flesh color in the living bird. The bill is blackish except for a space at the base of both the upper and the lower mandibles which is light colored. The measurements are: Length 25.50, wing 16.25, tail 6.55, tarsus 2.30, toe 2.50, culmen 2.10. I should judge the bird to be in the second winter plumage. To my knowledge the nearest previously published record of this species in the northwest Pacific is an example taken by Mr. Holst on Peel Island, of the Bonin group (See Ibis, 1890, 105), which is some 600 miles distant. My Japanese informant told me of another species, "smaller and with a blue back," which he had shot two years before. No specimen of it was obtained.

Sterna fuliginosa Gmel. **Sooty Tern.**

This tern is by far the most abundant bird on the island. They literally swarm over the reef, while on the sandy shore from almost the waters' edge to a considerable distance inland, especially under the trees, the ground was so covered with the old and young in all stages that one had to use great care to avoid stepping on them. During the day the noise made by this concourse was nerve-racking; but at night when the parents were all home from the sea and were in anxious search for their young, the cries of

FIG. 7. On the south beach looking east. The birds are principally the young of the Sooty Tern, *Sterna fuliginosa* Gmel.

Wide-awake, wide-awake, together with the scolding, angry *K-r-a-a* was almost distracting. It would be useless to attempt to estimate the number of individuals on the island; probably to say that there were hundreds of thousands would convey a conservative suggestion as to their abundance.

In certain centres of fashion there exists a great demand for the skins and wings of this particular tern; they are made use of in producing some of the wonderful creations of the milliner's art. As a result of this demand the enterprising, though destructive, colony of Japanese, previously referred to, had been established on the island to kill birds and prepare their skins for export to New York, Paris and Berlin, by way of the home office in Japan. While we were there some thirty men were engaged in the work. Certain

members of the party did nothing but catch and kill the birds for the especially trained taxidermists to skin. The bird-catchers did their work for the most part early in the morning or during the evening hours. This enabled them to select fine adult specimens that were at sea fishing during the day. Their equipment consisted simply of a bambu pole, or occasionally a net on a long pole, and a large light basket. One man in two hours will kill a basket full of birds. In one of these baskets I counted seventy-five perfect specimens. The skinning is accomplished at an astonishingly rapid rate. One man, they assured me, held the world's record for making bird skins, having made in one day of ten hours, under test conditions, one hundred and thirty complete skins. In such undertakings quantity, not quality, is the thing chiefly considered. As a result, few indeed were the skins that would have been received in a museum collection. The average day's work fell far below this record pace; probably the usual number would not exceed fifty skins. Still, during the six months from March to September not less than fifty thousand birds are there slaughtered as a sacrifice to the cruel goddess of fashion.

The birds were in all stages of development, from the downy nestling, just showing a few pin feathers, to the young of the year which were able to go to sea and secure their own food. The chicks, when very young, are streaked with brownish gray and dull white on the back, while below they are a uniform whitish color. This down soon begins to give way to the pin feathers which follow the down capsules as a continuation of the same shafts. The feathers appear over the back and wings first, followed by the feathers on the lower parts. In the meantime the wing quills and rectrices have partially developed; the head is the last to feather. Often the down remains about the base of the beak until the bird is able to fly short distances.

The parent birds here, as elsewhere, make no attempt at building a nest. Since they prefer to sit on the sandy shore, and on hot days to retreat a little farther inland under the shade of the trees, they deposit their single egg any place they happen to be at nesting time. Though they rarely go farther than three or four hundred yards inland, their young and eggs are to be found occupying almost every square yard of this Sooty Tern belt, which runs on the upper beach practically the entire distance around the island.

I never saw one alight in a tree; they are always found roosting on the ground, where they nest. From the Japanese I understood that a few birds remain on the island throughout the year.

Their food is made up entirely of the small surface-swimming fish; for these they can go as far as three or four hundred miles out to sea and return the same night to roost. On several occasions as we were nearing the island we would see small parties of terns on their homeward journey. Not infrequently a pair of old birds would be accompanied by their brown-bodied young. The inexperienced birds sighting our ship and regarding it as a suitable place to alight and rest would fly straight for the vessel, whereupon the parents would set up a cry of *K-r-a-a*, *k-r-a-a*, whereat the young birds, obedient to the warning, would change the course and submissively follow the parent birds on out of sight in the distance.

In August many of the old birds were moulting. During this period they seem to behave not unlike our cage canaries—sit about dejected, and appear to take little interest in things, indeed hardly moving out of the way as one walked through the brood. With this species the feathers seem to come off more or less in patches, usually first about the head. From the series secured I have selected and measured two adults and two immature birds which will show the comparative size of the young when able to shift for themselves.

No.	*Sex.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*
2083	♂	15.50	12.00	5.25	.90	1.00	1.75	.45
2082	♀	15.70	11.70	5.20	.85	1.00	1.75	.45
2084	Im.	13.75	11.25	4.50	.90	1.00	1.35	.35
2086	Im.	14.25	10.25	5.00	.90	1.00	1.40	.35

REMARKS.—Bill and feet of immature birds reddish brown.

Judging from the stage of advancement attained by the brood in August the eggs must have been deposited in May or early in June.

It is worthy of record that on examining the thousands of tern skins which the Japanese had prepared I could not find one of the Gray-backed Tern (*Sterna lunata*). None of the Japanese had ever seen a tern with a blue-gray back; so the island may be regarded as out of the range of this species.

Anous stolidus (Linn.). **Noddy.**

The Noddy, ranging as it does, practically all over the Pacific Ocean from Laysan down to Australia and the Chatham Ids., was one of the birds I had expected to find on Marcus; nor was I dis-

appointed. Judging by their numbers the island is well suited to the nidification of this tern. The nest, unlike that of the last species considered, is more commonly placed back some distance from the shore line; the preferred site is in the forks or on the limbs of the trees which grow to good size and form a thick woods in the interior. Though trees are preferred it is not uncommon to find them nesting on the ground, on fallen trunks, piles of stone or on the branches of the thick undergrowth. Rarely were nests seen more than twenty feet from the ground, and being in every stage—from just building to nests that had been deserted by the young birds—it is safe to conclude that there is no fixed time for the deposition of the eggs. There was no uniformity in the size or in the choice of the material used in the construction of the nest. The rule being a nest twelve to sixteen inches across by from two to eight inches in depth, which was composed almost entirely of twigs and sticks gathered from the ground and piled slovenly together, with a slight depression in the centre barely sufficient to keep the eggs from rolling off. As a lining, a few fresh leaves picked from the trees were commonly added; in different nests I found a few white bones, a piece of shell, some strings (from the settlement), small bunches of sea weeds—in short, any odd bits that took the birds' fancy. Some of the nests bore evidence of having been used over several times; fragments of egg shell were found in them that had been covered over with sticks, on top of which a fresh egg had been deposited. Nests were noted that were as deep as fourteen inches, and were so plastered with the excrement of the birds as to leave no doubt that they had been repaired and used year after year.

The young birds are exceedingly interesting by reason of the variation of their color while in the down; no two seem exactly alike. The forehead and crown are usually a dull white, but the body may vary from a light mouse-brown to a deep sooty brown. As they advance in age they take on the feathering of the young and immature birds, which does not vary much in color.

One or both of the old birds will always be seen about the nest at all times; not uncommonly both parent birds are sitting on the nest, one on either side of their offspring, all three making a very contented and happy looking family. Seldom do the old birds go far out to sea in search of food. If this species is to be seen in any numbers an experienced and observant navigator can feel certain

of being within fifty miles of land—usually, though not always, a low coral island. Fish of the small varieties, commonly flying-fish, is the staple food; but on several occasions I found what I believe to be fragments of squid in the stomach contents. A good sized flock was nearly always to be seen sitting on the sand beach close down to the water line, apparently sunning themselves and enjoying the roar of the ocean; for they would remain hours at a time in this way, and never did I observe them picking up food on the beach after the tide had gone out.

The birds with eggs sit quite close, allowing one to lift them off the nest, a familiarity which they resent only by picking with the beaks; but when the young are out of the shell they sit on the branches close by and never fail to swoop close to the head of an intruder, uttering their hoarse *K-r-a-u-k*, *K-r-a-u-k*, a warning which is taken up by others of their kind who come to the spot to assist their distressed neighbors. This coarse call, when taken in connection with their color, has done much, I fancy, to gain for them the not inappropriate descriptive name of "Sea Crow."

A critical comparison of the specimens secured with those in the Museum collection resulted in finding them to agree with the specimens from Guam in being slightly darker than September adult Laysan and Midway Island birds. The feet, including the soles and webs, in both adult birds from Marcus were quite black, while all the specimens from the Hawaiian Islands show more or less yellowish brown in the dry skin. The measurements carefully taken from the two adult birds agree very closely with those from Guam birds, and differ quite appreciably from those given by Mr. Saunders at page 139, vol. xxv of the Catalogue of Birds.

No.	*Sex.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*
2081	♂	17.50	11.10	6.50	1.00	1.55	1.70	45
2080	♂	....	11.10	6.50	.95	1.50	1.70	50

REMARKS.—Feet blackish.

Micranous marcusi. New species. **Marcus Island Tern.**

Type. No. 2089. Bernice Pauahi Bishop Museum. Adult male. August 3, 1902. Marcus Island. Wm. Alanson Bryan.

Range. Marcus Island and adjacent waters of the northwest Pacific.

Specific Character. Lores deep black; cheeks black, though less intense than the lores; nape and shoulders sooty black with a

very slight indication of plumbeous, averaging a trifle larger than *M. hawaiiensis*. Feet in life (old and young) orange-brown, drying darker.

Description of the Type. Male: Forehead and crown almost white; back of the neck black with a slight plumbeous tinge: back, wing coverts, breast and under parts a uniform black; primaries and secondaries black; tail feathers blackish with a plumbeous tinge like the back of the neck; under tail coverts shading into harmony with the tail feathers; black of the lores extending about the eye except for a small spot on the lower lid; throat, chin and neck underneath black; feet in life orange-brown, drying darker (often black). Length in the flesh 14.50, wing 9.10, tail 4.85. tarsus .80, toe 1.30, culmen 1.80, depth of bill .30.

Adult Bird. Museum number, 2090. This March specimen is uniform with the type, except that the feet have retained the yellow color in the dry skin. Wing 8.80, tail 4.75, tarsus .80, toe 1.30, culmen 1.60.

Half-fledged Nestling. Top of the head back to the nape pure white with dark bases to the feathers; lores, cheeks and sides of the neck black; one-third of the lower eyelid white; back of the neck black; wing coverts and breast sooty black; wing and tail feathers black, darker than the back; throat, sides of the body and abdomen still covered with dark brown down; feet orange-brown in life, drying almost black; bill black.

Critical Remarks. This tern seems to be a western representative of the Hawaiian form, to which it is closely allied. Comparing the Marcus specimens with the twelve old and young birds secured by me at Midway in September, I found all the Midway birds with black feet in the flesh. Of this point I made especial note in the field. The adult birds from Midway have whiter heads and much lighter tails, and are more plumbeous over the shoulders and back of the neck. Comparing the Marcus Island birds with specimens from Oahu and Hawaii, the latter are decidedly more plumbeous all over than either Marcus or Midway birds; however, the feet have evidently been some shade of yellow in life. Laysan examples are colored more like the Oahu birds, except that the feet are dark, "parched coffee color."

The plate of the Noio given by Mr. Scott B. Wilson in Aves Hawaiiensis is a very faithful drawing of a typical Oahu bird. The

Honorable Walter Rothschild's plate in Avifauna of Laysan agrees in color with Laysan birds before me, and, I fancy, was delineated from a bird secured on that island. Both the above plates and descriptions are at variance with one another, and the Marcus Island bird sufficiently to warrant the recognition of the western form under a new name.

I regret not having a specimen in our collection of the species recently described by my friends Messrs. Heller and Snodgrass from the Galapagos under the name of *Micranous diamesus*. They remark that the Galapagos form differs from an Oahu bird sent them from this Museum "in being darker on the shoulders, on the lower parts and sides of the neck and on the sides of the head, and in having a longer and stouter bill and longer middle toe."

A perusal of the following table of measurements made up from adult males taken in the same season, but selected at random from the Museum series, shows *marcusi* to be a trifle the larger bird of the two species; also that the Midway specimens are intermediate in size.

No.	*Locality.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*	*Sex.*
2089	Marcus.	14.50	9.10	4.85	.80	1.30	1.80	.30	♂
2090	Marcus.	....	8.80	4.75	.80	1.30	1.60	.30	♂
9965	Oahu.	13.00	8.35	4.75	.75	1.25	1.60	.30	♂
5554	Oahu.	....	8.70	4.75	.77	1.30	1.60	.30	♂
2141	Midway.	14.20	8.80	4.70	.75	1.35	1.72	.30	♂
2133	Midway.	14.25	8.90	4.50	.75	1.35	1.75	.30	♂

I have had much pleasure in making a very careful comparison of the Marcus specimens with the thirty-four examples of this genus already in the Museum, with the result given above. In arriving at this conclusion I have resorted to characters taken from my notes on freshly killed birds, on Oahu, Midway and Marcus Islands. One of the unfortunate conditions imposed by Lieutenant Akinote was that we would not be allowed to land and use fire-arms. As a result the status of *M. marcusi* rests on the three specimens, two adults and one half-fledged young, which I was able to secure—one from an old Japanese, one fledgling from the nest, and one (the parent of the young bird taken) was obtained by me through my exertions with a bambu pole. The species was not abundant in the first place, in addition to which they were quite wary, else my series would have been more complete, for the orange-colored feet of this black tern attracted my attention at once.

At the time of my visit the nesting season was well over, many nests unmistakably of this species having been deserted by the

young birds. The nest from which the young bird was secured may be taken as fairly representative of all seen. It was placed at least fifteen feet from the ground in the vertical fork of one of the large trees growing well in towards the centre of the island. It was about eight inches across and five inches deep with a depression in the top to retain the eggs. Short sticks and straws were used to some extent in its construction, but the bulk of the material was made up of sea moss, which together with a few dead leaves were piled on top of the sticks. The whole was so plastered with the excrement of the birds as to make it a solid whitish looking mass that gave off anything but a pleasant odor. Probably not one in a hundred of the terns nesting in the trees were of this species, while its ratio to the sooty tern was not more than one to a thousand.

Gygis alba kittlitzi Hartert. **White Tern.**

This beautiful little tern was quite common on the island, where, fluttering softly about in the shade of the forest, they left with me a never-to-be-forgotten impression. So pure and white; such innocent, large, dark eyes; such trusting, fearless, gentle manners. Little wonder they are all but worshipped by the rough sailors, who have named them "love birds" or "sea fairies." A pair will always keep close together, and a sailor will tell you that if one is killed the mate will soon die of sorrow and loneliness. As a result, partly owing to tender hearts, partly owing to the old clinging superstitions of the sea, few white terns meet death at the hands of these hardy men. But fashion has a more merciless way, for the birds are much sought after by the feather dealers. Fortunately for the birds themselves it is almost impossible to kill one without in some way staining its plumage; then, too, their dark blue skin will show through the thin layer of feathers and render them unsightly and unsalable unless extra precautions are taken in removing and making up the skin. The added labor required to do this more than makes up for the advance in the price paid; hence, comparatively few of these birds are killed. Could not this be considered as a new phase of the old story of protective coloration?

Preferring the deeper shade for their nesting site, where they are to be found day or night, they will deposit a single egg, usually in the crotch of a tree, or in a crevice of the rough bark of some slanting limb; here, without a sign of a nest or protection of any

kind, the egg will be incubated, the young come out and sit until it is able to fly short distances. On some occasions I found nests as high as twenty-five feet from the ground, on others as low as

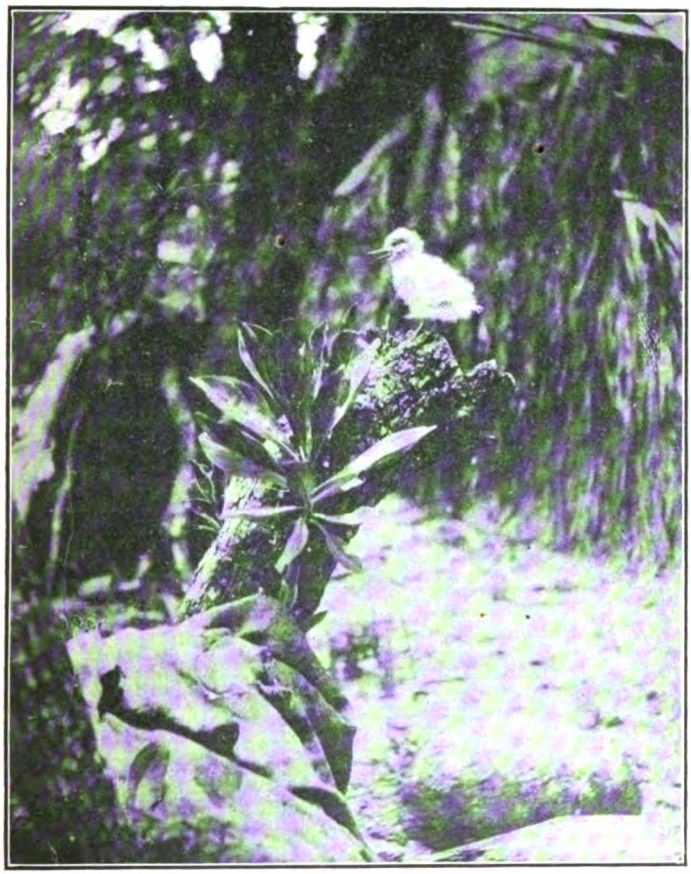


FIG. 8. Typical nesting site of the White Tern, *Gygis alba kittlitzi* Hart. The single egg is often skilfully deposited in an irregularity of the bark on a slanting limb, where, without any attempt at nest making, the young is hatched and brought to maturity.

a foot from the ground, but at no place did I see one on the ground. The young in August were most all in the pin feather and were curiously marked with rusty or clove-brown edges to part of the feathers of the back and head. Many were able to fly about with

their parents, but a few eggs were still to be seen, indicating an extended period of nidification.

Small fish seemed to be, if not the only, the chief food of this tern. On more than one occasion I saw them fluttering to and fro about the nest holding two silvery fish crossed in the beak. The interesting part the white tern takes in the exploits of the man-o'-war hawks will be described in the notes on that species.

No.	*Locality.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*	*Sex.*
2094	Marcus.	●	9.10	4.30	.55	1.00	1.50	.40	♂
2093	Marcus.	12.00	9.35	4.30	.47	1.00	1.55	.40	♂
2092	Marcus.	12.00	9.10	4.25	.50	1.00	1.55	.40	♂

Diomedea immutabilis Roths. **Gooney.**

Only one bird was seen alive, and I was able to secure but one from a Japanese who had shot it on the island. He informed me that it had been taken early in the spring, and it was one of ten birds—all they had been able to get during the year.

The story of the Marcus Island colony of goonies is one of death and extermination. In the beginning of the operations of the Japanese company on the island goonies were fairly abundant. Not being able to find guano by their crude methods, they developed a scheme whereby they were able to make a marketable commodity by killing the birds and boiling them down in great kettles. The resultant, consisting of the flesh, bones and viscera, was barreled and shipped to Japan where it was used as a fertilizer. The long wing feathers of all the birds were pulled out and carefully preserved to be shipped to America and Europe and sold as "eagle feathers", which were in great demand for trimming on ladies' hats. The feathers from the breast were plucked off and sold by the pound. A profitable business was thus developed, with the deplorable result that within six years the entire colony of these splendid birds has been exterminated.

I was told that they had been so exceedingly abundant in former years that a man could kill three hundred birds in a day. The last year or so, as the colony had dwindled down, it had been the practice to kill the birds for the feathers only. All over the island were found the heaps of white bones of the birds that had thus been destroyed. I saw two or three eggs half buried in the sand that had been lying there a long time, as they were bleached out white and were very fragile.

The skin secured was that of typical *immutabilis* and measured: Length 30.50, wing 18.00, tail 5.65, tarsus 3.10, toe 4.20, culmen 4.00, depth of bill 1.35.

Diomedea nigripes Aud. **Black-footed Albatross.**

Not a single bird was seen on the island, and indeed few at any time at sea. I learned that they had formerly been almost as abundant as the white-breasted species, and had been exterminated simultaneously with them. The bird hunters did not secure a specimen during the season of 1902.

Priofinus cuneatus (Salvin.). **Wedge-tailed Shearwater.**

This "Mutton bird", as it is commonly called by sea-going people, without in any way distinguishing it from its numerous cousins, was found with eggs and young in all stages of development. As the species has been previously reported from Sulphur Island (Bonin group), Krusenstern Island (Marshall group), as well as from Laysan and Kauai of the Hawaiian group, it was not strange that it should be found at this spot, which is more or less intermediate between them all.

Flying largely at night as the species does, and consequently spending much of the day sitting about on the ground or in their burrows they are quite available for specimens, though they invariably make good use of their beaks and claws before they are finally taken. The shady interior was most frequented by them, especially the edge of the soft alluvial earthy deposits which are well suited to their burrowing habits. None were seen on the southwest point, though this portion of the island was mainly coral sand and leaf mould and quite thickly wooded. They are to be seen, a pair together, during the day dozing under a log, about the roots of the trees, under low bushes or in holes. A hole which I dug out in one of the alluvial patches was eight feet long, six inches in diameter, and eighteen inches below the surface. From it a parent bird and a downy young were taken. On the wing they fly rapidly, going far out to sea for their food. While we saw individuals almost every day during our journey to and from the island, they were far more plentiful inside a circle with a radius of say three hundred miles, a distance which they can easily go and return during the same day.

A careful study of the adults secured, in comparison with other skins from Laysan, shows no variation in color worthy of remark. The nestling in the down has not been heretofore described. A specimen (Museum No. 2116) not more than five days old is a smoky lilac-gray over the back and top of the head, and very light pearl gray on the under parts, darkest on the abdomen. The bill was olive-gray at the tip, darker at the base, drying darker. Feet bluish light flesh-color, drying buffy. I append the measurements of the seven specimens.

No.	*Locality.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*	*No.*
2111	Marcus.	18.50	11.50	5.70	1.75	2.25	1.55	.50	♂
2112	Marcus.	18.25	11.25	5.45	1.90	2.32	1.55	.50	♀
2113	Marcus.	18.50	11.50	5.55	1.90	2.25	1.60	.50	♂
2115	Marcus.	....	11.40	5.55	1.87	2.32	1.55	.50	♀
2114	Marcus.	18.25	11.40	5.45	1.90	2.20	1.55	.50	♂
2110	Marcus.	18.50	11.55	5.55	1.85	2.35	1.55	.50	♂
2109	Marcus.	....	11.55	5.55	1.85	2.20	1.45	.50	♂

Though I took pains to look, I saw no sign of Bulwer's Petrel, Bonin Petrel, or the Hawaiian Storm Petrel; though one might, with good reason, expect to meet with them on this island.

Puffinus nativitatis Streets. **Christmas Island Shearwater.**

The seven specimens of this Shearwater that were secured form an interesting series, ranging from the young in the down through the different stages to the fully adult. The species is not uncommonly found sitting under the same bushes and roots in company with its wedge-tailed cousin and the Red-tailed Tropic Bird. There appears to be no contention among them. Unlike *P. cuneatus* they were never seen to burrow in the ground, choosing a dark cool place under any sheltering bush or root. They lay but a single smooth white egg. The season for eggs had passed by the first of August, there only being an occasional infertile one to be seen. But the variation in the size of the young bird was conclusive proof that the period of deposition was a long one.

The nestlings, in the first down, are interesting little balls of a drab color all over, without variation other than being a trifle darker on the head and rump. At this age they look not unlike powder puffs as they sit on the nest with their heads drawn in, just leaving their blue-black bills sticking out to suggest the handle. As the nestling gets older the down, which continues to grow longer and coarser, is finally followed by the first feathers. It was

interesting to note that each filament of down was the forerunner of one of the barbs in the web of a feather, and that as the feather came out and assumed proportions the filaments were sloughed off one by one, thus accomplishing the transition from down to feathers by a gradual process. The feathers of the back and wing coverts first appear; these are followed by the feathers of the breast and under parts. By the time the abdomen is thoroughly covered the wing and tail feathers are an inch or more out of the capsules. At this age the bird presents a very ridiculous appearance, having the head and neck almost bare, the body covered with short feathers, and the rump and upper and lower tail coverts still retaining the down of early youth. The head and neck are the last to feather; by that time the young bird is able to make short excursions on its own account. All during this period of growth the young birds are exceedingly fat.

In the adult the sexes are not distinguishable in plumage, and show practically no variation in color; however, the female will average a trifle the larger. The feet and toes, as well as the bills, of both old and young at all stages are black, and never yellow at the base as figured at page 45 in the Avifauna of Laysan.

Just what their food was I was not able to learn to a certainty, though I believe small squid form a considerable part of it. I never saw one regurgitate fish, though the instant the old ones are caught, or the young ones disturbed, they disgorge the entire contents of their stomachs, which, in addition to having an offensive odor, has the color and consistency of the oil to be commonly seen on opening a tin of salmon. It is almost impossible to get a specimen to the skinning table without getting this fluid on the plumage. On Marcus Island this species is less plentiful than the foregoing, though it is to be seen far out at sea, often hundreds of miles from the nearest land. Three adults give the following measurements:

No.	*Locality.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*	*Sex.*
2102	Marcus.	14.50	10.00	3.80	1.65	1.90	1.25	.40	♂
2103	Marcus.	14.00	9.50	3.55	1.60	1.90	1.20	.40	♂
2104	Marcus.	....	9.75	3.60	1.60	1.95	1.20	.40	—

The male bird, No. 2103, was covered with no less than forty of the sticky seeds from one of the principal trees on the island, an interesting specimen, showing the part these birds take in distributing certain non-edible seeds.

Phaethon rubricauda Bodd. **Red-tailed Tropic Bird.**

This interesting bird, as the generic name bestowed by Linnæus implies, follows the track of the sun throughout the tropics where it is found nesting on almost all of the low bird islands throughout its extensive range. At the island whose avifauna we are considering it was quite abundant, as instanced by one of the Japanese, who, for wanton destruction, killed thirty-five specimens in less than two hours. Though to be met with all over the island, they prefer the deeper shade and more quiet parts for rearing their young. This function must occupy the greater part of their time, judging from the fact that fresh eggs were secured on August 5, while at the same time young of the year were ready to leave the nest.

The nest is a simple depression in the sand or earth under a log, bush, root, or tilted stone. No lining is added, and never more than one egg is laid. Both birds assist in incubation; often both will be seen on the nest at the same time. They will not leave the egg when disturbed, but, to the discomfort of the intruder, will make a hoarse undescribable clattering noise, lasting several seconds.

The downy chick when first hatched is one of the most interesting little birds I ever saw. The upper parts are colored a fine light smoky gray, the under parts almost pure white. The down is exceedingly long and very fine, forming about the head a hood, suggesting a court wig, out of which the small bead-like eyes peer inquiringly, giving the chick a most dignified expression. The feathers on the wings appear first, and, like the whole upper surface, are barred and spotted with black in the first plumage.

Fish is the principal, and, so far as I know, the only food of both young and old. One young bird I secured gave up three flying-fish from six to seven inches long, together with a quantity of the salmon oil slime elsewhere referred to. The three fish must have weighed very nearly a pound. If the fat and heavy condition of the young is any index, the old tropic-birds are experts at fishing. This bird, so easy to capture on the nest, is one of the most difficult to kill that has come under my notice. By the ordinary method of compressing the lungs and heart between the fingers and thumb, ten to twenty minutes must elapse before the bird is dead past reviving in the collecting bag. The tenacious hold they have on life,

coupled with the copious way they bleed when injured, has won for them great respect in the minds of the sailors, who will rarely harm one for fear of visiting some calamity on his vessel by so doing. I have carefully taken the following measurements from the four birds secured.

No.	*Locality.*	*Length.*	*Wing.*	*Tail.*	*Tarsus.*	*Toe.*	*Culmen.*	*D. of B.*	*Sex.*
2072	Marcus.	28.00	12.70	14.00	1.00	1.90	2.30	.85	♀
2073	Marcus.	26.00	12.40	11.50	1.00	1.80	2.40	.80	♂
2071	Marcus.	....	12.20	13.75	1.00	1.85	2.50	.90	♂
2074	Marcus.	....	12.20	15.25	1.00	1.75	2.25	.90	♀

Sula cyanops Sundev. **Blue-faced Booby.**

Only a few individuals of this species were to be seen sitting on the black rocks on the reef, and since I was not permitted to use a gun, I did not secure a specimen. Earlier in the season the Japanese had brought a young one to camp and reared it by hand, feeding it on fish. It had become quite tame and showed *some* signs of intelligence, as coming about for food when the fishermen opened their catches. Picking, biting, snapping and hissing at all passers-by, it was in every way a bossy, impudent nuisance about camp. During a rain storm this young booby would fly up into a stump of a tree that formed its favorite roost, and alternately flap its wings and then hold them out from its body, evidently greatly enjoying its shower bath. When sleeping it would perch resolutely on its stump, stand every feather on end, turn its long head and neck down over its back, tuck its bill under its wing, and thus be lost to the scenes about for hours at a time.

Sula piscator (Linn.). **Red-footed Booby.**

None of this species was noted on the island, and but few were to be seen on the reef. The last day we were on the island (August 7) one of the Japanese went out and got five from off the rocks, of which I secured one, an adult male, Museum No. 2075. Its measurements are: Length 29.50, wing 15.25, tarsus 1.25, toe 2.90, culmen 3.30, depth of bill 1.10.

Sula sula (Linn.). **Booby.**

On the beach underneath the trees, well above the line of the highest tides at the northern point of the island, were found the colonies of this widely distributed "Sea Fool" or Booby. Thousands of them were to be seen on the wing, sitting on eggs, or feed-

ing their half-grown young. The nest, a low flat heap, invariably placed on the ground, is a rude structure twelve to twenty inches across by from two to six inches high, composed of sticks, dry leaves and rubbish piled loosely together, in the top of which is a depression to retain the eggs. Some nests were little more than wallowed-out places in the sand. The edge of these had been finished off, as a rule, by the addition of such leaves and twigs as the mother bird could reach without leaving the nest. Owners of these more slipshod excuses for nests seemed conscious of being remiss in the performance of this preparatory maternal function. Whenever we would approach they would at once busy themselves in rearranging the meagre materials about them. Picking up a stick from one side and carefully laying it down on the other; catching up a leaf here and putting it where the stick had been. Thus they would appear entirely engrossed until we came within a few feet, when, after hissing and snapping their bills a few times, they would disgorge such food as they might happen to have, and clumsily leaving the nest would go off to sea, always returning in a few minutes to see what might have happened during their absence.

Two eggs were the usual complement, though not uncommonly only one was deposited. One is usually quite soiled, evidently by the bird's feet, while the second and last to hatch is always clean and fresh looking.

From the difference in the appearance of the two nestlings I conjectured that a period of ten days must have elapsed between the deposition of the eggs. The chicks, when first out of the shells, are repugnant looking, naked little things, but they rapidly grow a coat of fine white down which they retain until about half-grown. At this period they look like veritable "fools in the down", and make the name "booby" equally as applicable to the young as the old. The first new dark feathers to show are the coverts along the humerus, the primaries and the tail feathers. As the bird begins to feather the down is ebraded from the ends of the barbs of the feathers, which leaves the new plumage over the back clove-brown with paler edges. The eggs are incubated and the young fed by both parent birds. Fish is the food most in favor. It is taken by the young putting their bills crosswise in the open mouth of the parent bird, when they receive their nourishment without farther ado.

A hissing noise made by both old and young birds when disturbed is not unlike that made by a setting goose; but the bite of

an old booby is a thing to be long remembered. Two adult birds, Museum Nos. 2076 (ad.) and 2077 (f.), measured respectively: Length 30.00, 31.00; wing 15.50, 15.75; tail 7.75, 8.50; tarsus 1.90, 1.75; toe 3.30, 3.25; culmen 4.10, 3.90; depth of bill 1.35, 1.30.

Fregata aquila Linn. **Man-o'-War Bird.**

Sailing about high overhead this avian pirate of the tropical seas was to be seen almost every day during the course of our long, tedious voyage. It became more abundant as we approached the little speck of land that formed the object of our journey. We found it nesting, not in great numbers to be sure, but sufficiently abundant to warrant it being called very common. Having in mind previous accounts of the species nesting on low scrub bushes, on grass tussocks, and even on the ground, as well as on the face of cliffs, it took two or three days for me to give up the idea of finding it rearing its young in nests similarly placed. However, after some search I found the hawks nesting in two distinct colonies a little way from the centre of the island towards the north point; not near the ground, as I had expected, but in the very topmost branches of the tallest trees that grew about the curious open spaces in the thick wooded part of this island. Some sites were thirty-five feet or more from the ground. The bulky pile of loose sticks that formed the rough platform nest on which the half-grown young were sitting had evidently been broken from the dead limbs of blighted trees near at hand, as the fresh ends of the sticks testified. These platforms varied greatly in dimensions; some—twenty inches across and eight inches deep—had to all appearances been made new that year; some more bulky ones had been repaired and used over several times. As stated twigs were the principal building material, though dried leaves and occasionally a few white bones were seen in the nests; but without exception all were badly befouled with the birds' excrement. The young were all more than half grown and were not very closely attended by the parents, though I saw several feeding their young on the plunder they had secured from the boobies. I had read much when a boy of this natural bird pirate, that feeds on the fish caught by other sea fowl; but what I had heard and read about it did little to detract from the interest I felt in watching for the first time in my life the exploits of an accomplished robber.

I have before referred to the large colonies of common brown boobies about the north point of the island. It was in the vicinity of this colony that the man-o'-war birds were the most abundant. Here they would lie in ambush for the old boobies and tropic birds as they returned from the sea heavily laden with fresh food for their young. Sitting quietly on the tree tops, or more often wheeling high overhead industriously patroling the island, out where the surf broke on the reef, these birds would keep a sharp lookout to sea for a sight of the returning fishing fleet of boobies. Sighting one (sometimes consisting of one, sometimes of several individuals) as many as half a dozen hawks would make for them under full sail, and without a moment's warning would engage a hapless bird in battle. Swooping down upon it from every side, buffetting it with their wings, snapping at it with their long hooked bills, flying now above, now before, now below it, the hawks would so confuse their victims that eventually, feeling that the only safety for its life lay in letting go part of its store of supplies as a sop for its assailants to quarrel over, the booby would on a sudden drop one of its fish, whereat the hawk would swoop down, more rapidly than the eye could follow, and catch the food before it had touched the wave, then taking it securely in its bill would fly majestically off to feed its own ever expectant offspring. The unfortunate booby meanwhile was farther pursued by the less fortunate hawks until, reft of all her quarry, she was allowed to return to her young.

On the fringing reef hereabout were exposed a number of large blocks of coral stone that served an interesting purpose in these sea battles. If a booby succeeded in warding off or evading her pursuers from the first attack she would set a course direct for one of these rocks, the hawks usually increasing in numbers at every moment in hot pursuit. Perhaps another fish would be dropped on the way, but if at last the bird was able to make this place of safety its pursuers would mount high in air, or, to use a sea term, lay off and on, sailing back and forth always keeping the sharpest watch on the brown object sitting quietly on the rock. After a short rest and choosing a favorable opportunity when its pursuers were at some distance the booby would make a final dash for the shore. The nearer it got to the beach the more furious grew the conflict; for in addition to the hawks both the noddy and white terns would take a hand in the robbery. It often occurred that a bird that had

let go its catch one by one as it came in would here, within fifty yards of its nest, disgorge its last fish, which would be eagerly caught up by any one of its pursuers that was able to secure it. Panting and excited the old boobies would drop down on arriving at the colony in an exhausted condition.

The frigate birds showed much discrimination, selecting at once the boobies that were most heavily laden and consequently more liable to pay generous toll when brought in contact with this high-handed system of exacting customs duties. Though tropic birds were attacked they were more rapid flyers and more expert at evading pursuit. As in the story of the two dogs that quarrelled over a bone, it was not uncommon in the performances I have described to see the tiny white tern reap the most substantial benefit from one of these encounters. Battles similar to those mentioned were to be seen during the entire day, but towards nightfall they were more numerous as well as more severe.

Four young birds, Museum Nos. 2096-99, were secured from the nests. The old birds kept out of reach of a bambu pole which was my only weapon.

Tringa acuminata (Horsf.). **Sharp-tailed Sandpiper.**

A single example, undoubtedly of this species, was seen at close range on August 6, on the beach towards the north point.

Heteractitis incanus (Gmel.). **Wandering Tattler.**

A poorly mounted bird, Museum No. 2100, was secured from a Japanese. It has the nasal grooves extending forward more than two-thirds the length of the bill. The measurements are: wing 6.60, tail 2.75, tarsus 1.35, toe 1.30, culmen 1.50, depth of bill .27. The tarsus is irregularly plated behind for two-thirds its length, a fact which is disquieting to the range usually assigned the two species in this ocean if taken in connection with the locality the specimen comes from, and also that it was secured during the spring months. I saw several individuals on the beach, but secured only the one measured above.

Charadrius dominicus fulvus (Gmel.). **Pacific Golden Plover.**

One bird was flushed while crossing one of the patches of alluvial deposit, and one bird was secured from the foreman of

the company. The bird measures: Length 9.90, wing 6.45, tail 2.55, tarsus 1.80, toe 1.30, culmen .95.

Arenaria interpres (Linn.). **Turnstone.**

On August 4 I saw a flock of eleven of these interesting birds at close range while they were feeding along the beach, but owing to the regulations concerning firearms I was not able to kill one, though I am as positive as I could be under the circumstances of the identity.

REPTILIA.

As was to be expected on an island scarcely more than a square mile in extent the species of reptiles were but few, in fact only a representative of each of the two widely distributed Polynesian families were secured, though the number of individuals were exceedingly abundant. I am indebted to Dr. Leonhard Stejneger, Herpetologist of the Smithsonian Institution, for the verification of the species collected.

Family **Geckonidæ. — The Geckos.**

Perochirus articulatus (Fischer).

This interesting gecko was found in abundance all over the island, especially in hollow trees or under loose bark. Usually during the daytime they kept themselves well concealed, but at nightfall they came out and were plentiful all about the thatched huts as well as on the trees and bushes. Rarely did I see them on the ground. A number of the eggs, supposed to be of this species, were found secreted under the bark on a dead tree. Dr. Stejneger informs me that this gecko has hitherto only been known from the Caroline archipelago. A good series was taken illustrating many interesting details in the varying coloration of the species, as well as showing successive steps in the acquisition of a new tail.

Family **Scincidæ. — The Skinks.**

Ablepharus boutonii var.

The skink was if anything more abundant than the gecko, but both were too numerous to admit of their being regarded as recent arrivals. In addition to inhabiting the trees and huts these active little fellows were not infrequently seen on the ground and under

stones, as well as in clumps of grass growing close down to the waters' edge. Although abundant they were exceedingly difficult to catch, being as quick as a flash and never venturing far away from some hiding place.

In addition to the specimens retained by this Museum a series of both species has been deposited in the National Museum at Washington.

PISCES.

A small collection of fish, numbering some seventy species, was made, which on examination has proved to be of more than passing interest. It has been found impossible to prepare the annotated list for publication in this paper as first planned. However, it will appear later under a separate title.

INSECTA.

I was to considerable pains to collect a series of the insects on the island, but unfortunately the specimens were all unavoidably destroyed by ants or other pests on the vessel during the return voyage. In addition to sweeping the plants and grasses with a collecting net I examined dead wood, bark, and leaves carefully, as well as making repeated searches under logs, stones and decaying flesh for specimens. Rainwater tanks about the settlement were visited by day and night, traps were also constructed of cans and bottles, and I put in several hours on two still evenings in an attempt to attract insects to alight on our tent as a screen, using a strong ascetyline light to allure them. As a result of my efforts I was not able to secure more than a dozen species all told. In fact, as a pastime on our journey to the island I made a collection of insects on board the schooner that far outnumbered the species I was able to collect on land.

A small red ant was quite common as well as troublesome, especially about the settlement. I fancy it had been imported since the colony was established. Two species of flies were very abundant, one a blow fly (*Caliphora?*) which persisted in laying its eggs on the dead birds both before and after they were skinned; the other species, a small vinegar fly, of a genus unfamiliar to me, were to be seen in moist, shady places all over the island. A small miller was common during the night, and I am of the opinion that

the skinks and geckos feed on it as well as on the small flies just mentioned.

The birds were infested with various species of *Mallophaga*. A large gooney louse was quite troublesome to the Japanese by reason of its poisonous bite which caused painful, ulcerous sores to break out on the hands and legs. Fully two-thirds of the colony were disfigured by them in this way.

The only spider that had established itself was the widely distributed web-spinning species, *Epeira nautica* Koch. Their stout webs were stretched from tree to tree in such a way as to be a nuisance as we walked through the forest. The trees and grass showed little or no signs of insect pests. In fact I found only one species of plant that had been molested by biting insects. Since these depredations were to be seen only in a very limited area, and as I was unable to secure the miscreant either by day or night I concluded the species must have been a recent Japanese introduction that had not had time to thoroughly establish itself. No species of Coleoptera were secured.

CRUSTACEA.

The small collection of crabs secured consists of eleven species, four of which were found abundant on the land, while the remaining seven were collected on the reef and may be considered as representing the commoner form to be met with in the waters about the island.

The land crustacea make up in numbers and activity for their comparative poverty in kind, and are exceedingly important agents in the economy of the island. In addition to acting as general scavengers certain of them take the place of earth worms by aiding in mixing light surface materials into the sand; while others, as the *Coenobita*, by bringing shells to serve as habitations and subsequently discarding them inland, aid in a material way to the building up of the land.

To Miss Mary J. Rathbun and Mr. J. E. Benedict, both of the National Museum at Washington, I am indebted for assistance in the determination of the species and for many courtesies.

Geograpsus grayi (M. Edw.).

By far the most common species on the island this interesting crab was everywhere abundant, especially about the settlement

and in the coconut grove. By day they were to be seen feeding on fallen coconuts and bits of refuse; at night they were even more active and were often heard scurrying about in the coconut thatch overhead. Frequently they were found in our larder helping themselves. When disturbed they would move off sideways a few steps and stop to observe the intruder, assuming an attitude of both importance and injury that was most ludicrous to behold.

Grapsus grapsus (Linn.).

Almost as abundant as the preceding species and similar to it in habits.

Geograpsus crinipes (Dana).

Judging by the specimens secured this is not an abundant species on the island.

Leptodius sanguineus (M. Edw.).

Common species on the rocks, and was frequently secured in the small mesh nets used in fishing.

Petrolisthes speciosus (Dana) var.

A number of specimens of this active crab was secured In life they are bluish all over, variously marked with small black spots.

Cœnobita olivieri Owen.

This bright red crab was an abundant species and to be seen day and night often well inland. They usually congregate about the dead bodies of birds, on which they feed; however, they are good climbers, as many of them were found well up in the trees where they had evidently gone in search of food. When disturbed in any way they simply let go their hold and dropped to the ground with a heavy thud. As a habitation the cast off shells of *Turbo radiatus* Gmel. seemed to be preferred by them, though other shells were often used.

Cœnobita compressa Guérin.

I did not find *C. compressa* quite as abundant as the foregoing species. Specimens collected inhabited the shells of *Turbo argyrostomus* Linn.

Calcinus elegans (M. Edw.).

A number of specimens were secured in the small nets used for fishing. In every instance they were domiciled in the shells of *Ricinula horrida* Lam. A color note states that the legs were a bright blue in life while the claws were brown.

Pachygrapsus plicatus (M. Edw.).

In life olive-green, with some darker spots, the whole surface washed with darker shades.

Lydia annulipes (M. Edw.).

But a single specimen of this rare crab was secured.

MOLLUSCA.

The collection of shells listed below was for the most part secured from one of the Japanese residents on the island, who, as it has been remarked before, had some taste for natural history; as a result he had devoted his leisure hours for several months to picking up shells on the beach and reef. Comparatively few of them were live shells, while many were mere fragments which served only to indicate the presence of the species. The list, although only a partial one, will serve to show the species to be met with in that part of the Pacific. No land shells were noted, and I believe there were none. Thanks are due my friend Mr. Paul Bartsch, of the Division of Mollusca, National Museum at Washington, for assistance in the determination of the species.

Conidæ.

Conus vautieri Kiener.
pulicarius Hwass.
hebræus Linn.
vermiculatus Lam.
taheitensis Hwass.
miles Linn.
catus Hwass.
miliaris Hwass var.
lividus Hwass.
striatus Linn.
archepiscopus Brug.
Conus tulipa Linn.
omaria Hwass.
clavus Linn.

Olividæ.

Oliva irisans Lam.
guttata Lam.

Harpidæ.

Harpa minor Lam.

Mitridæ.

Mitra episcopalis Linn.

Mitra paupercula Lam.

Buccinidæ.

Tritonidea undosa Linn.
fumosa Dill.
Peristernia incarnata Dkr. var.

Muricidæ.

Purpura persica Linn.
Ricinula ricinus Linn.
horrida Lam.
Sistrum morus Lam.
Rhizocheilus madreporarum A. Ads.

Tritoniidæ.

Triton chlorostomus Lam.

Cassididæ.

Cassis vibex erinaea Linn.

Doliidæ.

Malea pomum Linn.

Cypræidæ.

Cypræa tigris Linn.
reticulata Martyn.
achatina Sol.
scurra Chemn.
moneta Linn.
arenosa Gray.
talpa Linn.
helvola Linn.
erosa Linn.
arabica Linn.
caput-serpentis Linn.
carneola Linn.
mauritiana Linn.
isabella Linn.
lynx Linn.
Cypræa vitellus Linn.
poraria Linn.
Pustularia nucleus Linn.
Eponia cicercula Linn.

Strombidæ.

Strombus gibberulus Linn.

Cerithiidæ.

Clava asper Linn.

Naticidæ.

Natica marroccana Chemn.

Turbinidæ.

Turbo argyrostomus Linn.
radiatus Gmel.

Neritidæ.

Nerita plicata Linn.
polita Linn.
Neritina sp.
Neritina sp.

Pectinidæ.

Pecten pallium Linn.

Dreissensiidæ.

Septifer bicularia Linn.

Tridacnidæ.

Hippopus maculatus Lam.

Veneridæ.

Venus puerpera Linn.
Circe pectinata Lam.

Tellinidæ.

Asaphis deflorata Lam.

Pyramidellidæ.

Pyramidella sulcata A. Ads.

VERMES.

Believing that a collection of any earthworms that might occur on the island would be of interest I requested Mr. Sedgwick and his assistants to keep a close lookout for them. Although they made a large number of excavations in various places while prosecuting their investigations they were unable to discover a single specimen. The conditions in and about the dry lagoons seemed most favorable, as the soil was there composed of rich loose alluvial earth. Since no specimens were collected, or even seen, by any of our party I am persuaded that worms of this class have not as yet found their way thither.

BOTANY.

Ten species of indigenous plants were found growing at the time of our visit, none of which could be said to be peculiar to Marcus Island. The few species that have found their way thither through natural agencies are of those widely distributed, hardy, pioneer plants which are well adapted to maintain life on an isolated speck of coral sand, where rain is uncertain, soil unproductive, and storms often violent.

By referring to Figs. 2, 3, 5 it will be seen that the land is fairly well covered with vegetation of one kind or another down to the high water mark. There seems to be but little contention among the few species as all have found conditions more or less suitable to themselves, so that all work together for the upbuilding of the island and the enrichment of the soil. The coconut palm, *Cocos nucifera* Linn., the only plant of economic importance, is well established growing in the larger of the dry lagoons in the centre of the island. Perhaps three acres have been thickly planted by nature to this most valuable palm. All the trees of sufficient age were in bearing. The nuts were not especially large, nor the trees prolific, although there was sufficient fruit to more than supply the colony at all times. The Japanese put the tree to many uses; the trunk is used to form the sills and principal posts of their shacks; the leaves made an excellent thatch; the nut shells were of service as utensils; the midrib of the leaves made serviceable poles with which they secured the birds to be skinned. The trees must have been of great age, as many of them were sixty feet in

height. Their feathery plumes, lifted high above all else, gave a pleasant variety to what would otherwise have been a monotonous forest and sky line. The colony unfortunately are working a serious damage to the grove by the methods they have adopted to secure the nuts. With a large knife they hack great notches into the trees in such a way as to form a ladder of the trunk, a practice which will surely result in the death of the palms. Some effort has been made by them to extend the cultivation of the palm by transplanting young trees into open spaces. All plants thus reset seemed to be doing well. It was the opinion of Mr. Sedgwick and myself that the entire island could with little difficulty be planted to this palm.

A large boraginaceous tree, *Tournefortia servicea*, was by far the most abundant species on the island, growing and thriving everywhere it made in many places an almost impenetrable jungle. The larger trees attained a height of more than thirty-five feet, with trunks often two feet in diameter. The wood was of little service, being very brittle and decaying rapidly.

Next in importance was a splendid tree of the order *Rubiaceæ*, producing a one-celled seed. It was impossible, however, to procure sufficient material for a satisfactory determination of the species. I brought living plants with me to Honolulu which are now growing in Kapiolani Park. The tree, while thriving over the greater part of the island, found its most congenial habitat in and about the dry lagoon where trees thirty or more feet in height with wide-spreading branches covered with large thrifty green leaves made a pleasant shade. The seeds have a peculiar property of excreting a sticky fluid from the pores on the angles. This substance coming in contact with the feathers of the birds frequenting the shade adheres to them firmly. Without doubt this species is carried from island to island by birds in this way.

The common *Portulaca lutea* Sol. was well established, growing in bunches here and there all over the island, though it was more abundant on the seaward slopes.

A species of *Euxolus* was sparingly distributed over a limited area a short distance back of the camp. It showed the effects produced by some biting insect.

Of the grasses but two species were found. *Panicum pruriens* Trin. had gained a footing and was growing luxuriantly on the

rich crown earth inland. The widely distributed genus *Rottboellia* was represented by a species belonging to the sub-genus *Cœlorhachis*. The plant attains a height of ten inches, always growing in isolated bunches on the sand.

Of the three remaining species, one, a low trailing herb with reddish stems grows abundantly on the open spaces inland. The two other plants, so far as I could find, were represented by one or two individuals each. One, a bush growing six or eight feet high, had its stems thickly covered with short, stiff spines; the other species bore its asymmetrical leaves in pairs on short petioles which united into a single slender foot stock. The plants found were about six feet in height. The two last mentioned must have been of exceedingly recent introduction.

The Japanese had attempted to grow a number of economic plants. A few bananas were growing in an open space, but they had never fruited; this was most likely due to a want of sufficient rain; the soil and climate must have been suitable. A few pine-apples had been planted, and the dozen or so plants were barely alive. Tobacco, *Nicotiana tabacum* Linn., flourished on the rich soil. Leaves twenty inches long and seven inches broad were seen. Perhaps two acres were under cultivation. The Japanese were able to smoke it, but it proved to be of an inferior quality. A cabbage and a species of bean had also been introduced.

It may be of interest to note for future reference that we gave seeds of the following plants to the Japanese, who offered to plant them: papaya, watermelon, muskmelon, cherry, soursop, rose-apple, turnip, squash, raddish, spinach, cabbage, tomato, bean, corn, algaroba, ironwood, *Eucalyptus* sp., *Cryptomeria japonica* and *Poinciana regia*.

APPENDIX.

I TAKE much pleasure in finally being able to present the following account of the fish collected in the waters about Marcus in the form of an appendix to the monograph[6] of that island. The impossibility of securing anything like a complete collection of the fish about the island in the brief time at our disposal can well be understood. However, the following list, accompanied by the description of eight new species, will serve as an index to the fauna to be met with in that region.

The greater part of the collecting was done at night with a mosquito net seine and a small hand net. For the want of better equipment long-necked bottles were baited and used as traps. In addition to the night work some time was devoted to fishing with a hook and line, as well as to poisoning and the discharging of a few blasts in the deep water (four to six fathoms) outside the reef. All of the methods used were accompanied by more or less satisfactory results. A Japanese was employed for two or three days who exhibited considerable skill in spearing certain of the larger specimens secured. With a pair of close fitting goggles firmly fastened over the eyes he would dive for great distances, thus approaching his intended victim without creating the disturbance usually made by wading or swimming through the water; he was thus enabled at the same time to watch the movements of the fish. When within spearing range this astute fisherman would stealthily raise himself and hurl a slender barbed spear with great precision.

Fish was a daily article of food and furnished a welcome addition to the Japanese residents' meager fare. The supply seemed never failing, and certain species were always to be had in abundance. Many of their native dishes, though crudely prepared, were quite palatable.

I was informed by Captain Rosehill that at the time of his first visit to the island sharks were exceedingly abundant and troublesome. I learned from one of the settlers that small Japanese fishing

[6] See Pisces, page 117.

boats had called there and found shark fishing profitable some years before, but at this time few were seen and no specimens secured.

On my return to Honolulu a preliminary examination of the material secured brought to light a number of interesting specimens. The aid of Dr. C. H. Gilbert, who had kindly offered to assist the author of this monograph in mooted questions of nomenclature, etc., was accordingly sought. A portion of the collection was subsequently forwarded to him. Mr. Albert C. Herre, of Stanford University, volunteered to help in bringing this list to a completion; he has written the descriptions of all the new species and has added many notes and observations of value. Dr. Gilbert, in commenting on the collection, says (*in litt.*) that "If the Marcus Island fauna had turned out to be an extension of the Hawaiian fauna we could have sent you a list in a few days. But there are apparently very few Hawaiian species found there, the complection of the fauna being of the South Seas."

The numbers given are those of the specimens in the Bishop Museum. A duplicate series will be deposited in the Leland Stanford Jr. University. The arrangement followed is, so far as possible, that of Jordan and Evermann in their work on the Fishes of North and Middle America. Color notes were frequently taken from the fresh specimen.

In conclusion I wish here to express my indebtedness to Dr. Gilbert and his associates at Leland Stanford Jr. University, as well as to Mr. Seale of the Bishop Museum staff, for their kind and generous assistance. To Mr. Herre, who shares the authorship of the appendix, I am especially beholden. W. A. B.

ANNOTATED LIST OF THE MARCUS ISLAND FISHES.

By Wm. Alanson Bryan and Albert C. Herre.

Family MURÆNIDÆ.—The Morays.

2403. **Gymnothorax detactus.** New species.

Head 3.33 to anus, 7.20 in total length; head and trunk shorter than tail; depth 14 in total length; snout .20 of head; eye .60 of snout, 8.33 in head; gill opening small, less than diameter of eye; interorbital space, flat, grooved, its width equal to diameter of eye; lower jaw weak, inferior; teeth uniserial; a row