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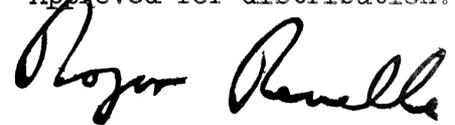
FIELD REPORT

IGY CLIPPERTON ISLAND EXPEDITION

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Approved for distribution:

A handwritten signature in black ink, reading "Roger Revelle". The signature is written in a cursive style with a large initial "R".

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Roger Revelle, Director

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## INTRODUCTION

Conrad Limbaugh

The biological and geological survey of Clipperton Island in 1958 resulted as an important by-product of the IGY expedition DOLDRUMS under Mr. John Knauss. The important findings of the field party have already helped us fill in a large blank in the biogeographic picture of the Eastern Pacific. When the material has been completely analyzed, it should be an important addition to the interpretation of the oceanography of that section of the Pacific.

Emphasis was placed upon descriptive biology and geology of the islands. Daily weather observations and sea conditions were, however, recorded. My own project consisted of shark behavior experiments.

The land party was made up of the following 13 members:

Paleontologist diver:	Mr. Edwin C. Allison Museum of Paleontology University of California Berkeley 4, California
Ichthyologist:	Mr. Wayne J. Baldwin Department of Zoology University of California Los Angeles 24, California
Radio operator:	*Mr. Robert Bucaro Scripps Institution of Oceanography La Jolla, California
Technician diver :	*Mr. James Robert Chess Scripps Institution of Oceanography La Jolla, California
Expedition doctor and diver:	*Dr. Alvin S. Hambly University of California Medical School San Francisco, California
Entomologist:	Dr. Charles F. Harbison Curator of Entomology San Diego Society of Natural History San Diego, California
Expedition leader, biologist, diver:	*Mr. Conrad Limbaugh Scripps Institution of Oceanography La Jolla, California

Ham radio operator: Mr. Douglas Magill  
San Diego Ham Radio Club  
San Diego, California

Assistant entomologist: Mr. David Peterson  
San Diego Society of Natural History  
San Diego, California

Invertebrate specialist: Mr. Ernest S. Reese  
Department of Zoology  
University of California  
Los Angeles 24, California

Botanist: Miss Marie-Helene Sachet  
Pacific Vegetation Project  
c/o National Research Council  
2101 Constitution Avenue  
Washington 25, D. C.

Ornithologist: Dr. Kenneth E. Stager  
Curator of Birds and Mammals  
Los Angeles County Museum  
Los Angeles, California

Ichthyologist: Mr. John Wintersteen  
Department of Zoology  
University of California  
Los Angeles 24, California

The four members whose names are marked with an asterisk remained on the island for the full period from 7 August to 25 September 1958. The rest of the party also landed on 7 August 1958, but were removed according to plan on 25 August 1958.

Prior to our first visit in October 1956, the island had been poorly collected. The flora and fauna collections made during these two expeditions have increased the number of known organisms from that area severalfold.

This low, barren island is an "almost" atoll, a ring of consolidated coral rubble surrounding a slightly brackish lagoon. A 55-ft high trachyte rock pierces the ring in the southern corner of the island. The surf breaks almost continually around the entire island, and there is evidence of the island having been completely washed over at various times in the recent past.

Skiff landings and launchings to and from the island are usually difficult. The northeastern anchorage offers very little protection from the weather, and the bottom does not hold an anchor well. During the month of August, however, skiff landings could be made almost every day at the northeastern landing area, and we had no difficulty in landing or removing the first group.

A turbulent sea and high winds throughout the month of September made it very difficult to leave the island. We were able to work offshore only three days during the 25-day period. Removing the final group with their equipment and specimens was a hazardous and exhausting undertaking, and took the entire day. A small amount of equipment was lost or damaged through wave action in the course of this operation.

The weather was uncomfortable but not unbearable. Temperatures were moderate, ranging from 75° to 90°F. Rain was intermittent and violent with as much as four inches falling within a few hours. The burned appearance of the vegetation observed on our arrival suggested that the rainy season had just started. High southwesterly winds ranging up to 38 knots continually threatened our tents and crude shelters. Cover from the wind is lacking in the northeastern landing area. Fifty young palms were transplanted to this area with the hope that they will eventually afford cover there.

The high humidity damaged perishable equipment, supplies and specimens. Leather and cotton material molded quickly.

In spite of the many difficult logistic problems involved, we were able to collect rather thoroughly on and around the island; in fact, it is probably the best collected island in the entire Eastern Pacific.

Most of the persons involved seemed to have attained or exceeded their goals, as is evidenced by the following reports.

#### INVERTEBRATES

Edwin C. Allison

Observations and collections briefly outlined here are limited to those invertebrates that could be expected to leave significant fossil records, namely foraminifera, corals, mollusks, echinoids, and ostracods. Certain other closely related groups are considered incidentally.

Clipperton Island is a near-atoll consisting of an unbroken ring of coral debris and derived rock with a diameter of about 2700 meters. Clipperton Rock, a 22-meter high remnant of the atoll's volcanic foundation, is the only feature to break a uniformly low profile.

An intertidal reef flat, locally attaining a width of about 150 meters, bounds the atoll on all but parts of the northeastern and western sides where coral development is interrupted by accumulations of shifting coral sand. The algal ridge at the reef flat's outer edge is weakly developed, even on the weather side of the island. Observations made from the water's surface and with dives using SCUBA equipment reveal beyond the outer edge of the algal ridge a gentle slope cut by scoured-out channels that open out onto a relatively barren terrace at a depth of from 10 to 20 meters. The width of this feature varies from an estimated 100 to 200

meters. Prolific coral growth marks the outer edge of the submerged terrace and the slope beyond, to a depth of approximately 30 meters, beyond which the hermatypic corals diminish in diversity and importance.

Marine invertebrates included in the study of the Clipperton fauna exhibit Indo-Pacific and Panamic relationships in a ratio of approximately 3 to 2. Selection of species capable of migrating over wide oceanic deeps separating Clipperton Island from other land areas accounts for the relative paucity of species making up the Clipperton fauna and providing its atoll form. A similarly restricted fauna is preserved in a semi-fossil state in the now non-marine lagoon.

Collections will be stored in the University of California Museum of Paleontology at Berkeley. Duplicate collections will be distributed among several other museums of the United States and France.

#### ICTHYOLOGY

Wayne J. Baldwin, Ernest S. Reese, and John Wintersteen

The purpose of our visit to Clipperton Island was to collect, study and photograph the fish fauna as intensively as possible in the 19 days allotted ashore. During this time we made 21 large individual collections in various localities around the island.

With a few exceptions owing to weather and tides we were able to operate almost every day on the reef, in the lagoon, or outside the reef in one of the skiffs. Our collection methods consisted of using powdered and concentrated derris root on the reefs or in high, isolated, tide pools; hook and line from shore and from a skiff; spear fishing; wire-mesh fish traps set on the coral shelf; and explosives.

These methods enabled us to obtain a fairly complete collection of the nearshore fishes and a few of the pelagic species that are present around the island. Our October 1956 shore collections were the first serious fish fauna collections ever made on this island. Twelve additional species were added to our collection on this trip.

#### ENTOMOLOGY

Charles F. Harbison

My primary interest on the island was in the six-legged invertebrates and their near relatives. The island produced many more kinds than we had anticipated, and some of the species will require much study before they can be definitely classified. In some groups a submission of the species to a specialist will be necessary. I cannot at this time say whether there will be any new species in the material collected, but there

is a good chance that some will be found. It is also hoped that we have collected topotypes of previously described species for the island.

A number of Orders of insects have been collected for the first time on this island, judging from past reports that are in print. Representatives of the Orders Collembola, Orthoptera, Hemiptera (Homoptera and Heteroptera), and Lepidoptera have been added to the list, and possibly five species of spiders were found. Mr. Baldwin collected mayflies on a previous trip. I collected no species of this Order. Blattaria can be listed, but I do not believe that mine are the first island specimens collected.

Before making this cruise, I examined all of the literature I could find that dealt with Clipperton Island. I discovered only a few references to Insecta. Mention has been made a number of times to flies, tiger beetles, and a damselfly, but I can find none of these determined as to species. Mr. David Peterson, my assistant and co-worker, and I have collected a long series of these insects and will later be able to state definitely what species were found.

I feel that the invertebrate fauna of Clipperton Island should be studied throughout the year. I believe many more invertebrates would have been discovered had I been able to stay with Conrad Limbaugh until the end of the cruise. We arrived during a wet season and had to collect between showers; in fact, some of the collecting was accomplished during a downpour when it was possible to collect adult tiger beetles using a sweeping method. The beetles did not leave their stretch of sandy beach along the lagoon shore. As the collector walked along the shore sweeping his net back and forth the beetles would take to flight and were thus caught. These tiger beetles were present on almost all parts of the island.

In this preliminary report I will outline briefly methods used in making the collections. Coleman lanterns were tried but were not especially useful. Mr. Peterson collected a nice series of long-horned grasshopper males by tracing the sound they make at night, - this being beyond my own range of hearing. The water net was tried in the lagoon at a number of places but only resulted in the capture of numerous individuals of one species of isopod. I found no naiads of the one common species of damselfly. This species has heterochromatic females, as was proved by collecting a number of mating pairs. The beating net was very useful and I used it, in fact, for most of my collecting. I changed bags as the work at hand required.

The entomologists turned over rocks, logs, and other litter to collect centipedes, isopods, and land crabs. One of the choice collecting spots was the cocoanut in its husk, as found on the ground in the shade of the palms. These, if the husk at the stem end had started to rot, contained many interesting invertebrates. The old nuts, when opened by tapping sharply at the distal end with a hive tool, were occupied by many interesting creatures, including spring-tails and the eggs of lizards.

In cooperation with Dr. Kenneth Stager of the Los Angeles County Museum, the entomologists were able to collect parasites from the birds killed by him. Half of these specimens will go to the Los Angeles County Museum.

Four nests representing two species of birds were collected and later examined for parasites. The bird species whose nests were taken were the white-headed Noddy Tern and the brown booby.

The entomologists plan to deposit duplicates of all species, as far as possible in the several institutions taking part in this most interesting collecting trip. These institutions are: Los Angeles County Museum; University of California at Los Angeles; University of California at Berkeley; National Academy; Museum of Paris; and San Diego Natural History Museum. Crab specimens will be submitted to Mr. Chace of U.S. National Museum, and the lizard material will be sent to Mr. Brown.

#### BOTANY

Marie-Helene Sacht

In the past several years my work in bibliography of coral islands, performed for the Pacific Science Board of the Academy and for the Geological Survey, had given me a chance to become familiar with the literature on Clipperton Island. As soon as I heard of the projected expedition, I was able to rapidly survey this literature, to spend some time reading, abstracting and translating most of it, and to collect maps and photographs. I brought a set of the abstracted papers along for the use of the other members of the party.

My principal work consisted in surveying the vegetation and flora of the atoll.

Despite earlier descriptions, Clipperton Island has an almost continuous vegetation cover. Some of the older gravel and boulder ridges, some areas of exposed consolidated rock, and the places that have been recently scoured by ocean waves and overlain by sand and gravel, are the only large areas devoid of vegetation. Of these, the latter are being colonized by plants from the adjacent surviving vegetation patches. The cover is uneven in density; in places much of the ground is exposed while in others the cover is complete. The general height of the cover varies from a few centimeters to a few decimeters, with scattered, denser, slightly taller clumps of scrubby plants, a large grove of coconut palms on the southwestern coast, and a number of small groups of palms scattered about the continuous rim of the atoll.

The most obvious characteristic of the vegetation is its striking pioneer nature. Few stable plant communities can be recognized, and the flora consists entirely of pioneer species and weeds. Prior to the 1958 visit only five species of higher plants had been recorded in the literature, a few more could be recognized from casual mention in published descriptions of the atoll, and specimens of 16 species had been received from recent visitors to the island. To this land and lagoon flora of 17 species, nine new records of higher plants have been added, and at least three mosses, a lichen, several fungi, and an undetermined number of algae. Eight sets of

specimens of the higher plants were collected and will be deposited in various herbaria in the United States and Europe, including the Museum National d'Histoire Naturelle in Paris, and the U.S. National Museum in Washington, D.C. No attempt was made to collect algae from the reefs, as this was the province of the marine biologists.

An effort was made to survey the surface features and soils of the island and to establish some correlation between these and the vegetation. Soil and rock samples were collected and will have to be examined and analyzed before more than very general conclusions can be drawn.

#### ORNITHOLOGY

Kenneth E. Stager

As a member of the Clipperton Island shore party working on the island between 7 August and 26 August 1958, I was able to make pertinent observations and collections with regard to the avifauna of this atoll.

Particular attention was given to the listing of species of birds inhabiting the island, and the number of identified forms was doubled from that of previous combined observations. The distribution of particular species on the atoll was noted, and comparisons were drawn between existing populations and those previously reported. Population counts were made, and the breeding status of each species was noted. In many instances it was possible to record observations of behavioral patterns and phyto-avian relationships; the latter had not previously been possible, owing to the absence of vegetation. Attention was given to the serious predation problem confronting terrestrial nesting birds, owing to the presence of feral pigs on the island. It is now felt that this problem has been eliminated as the feral pig population was substantially reduced, if not eliminated entirely, by myself.