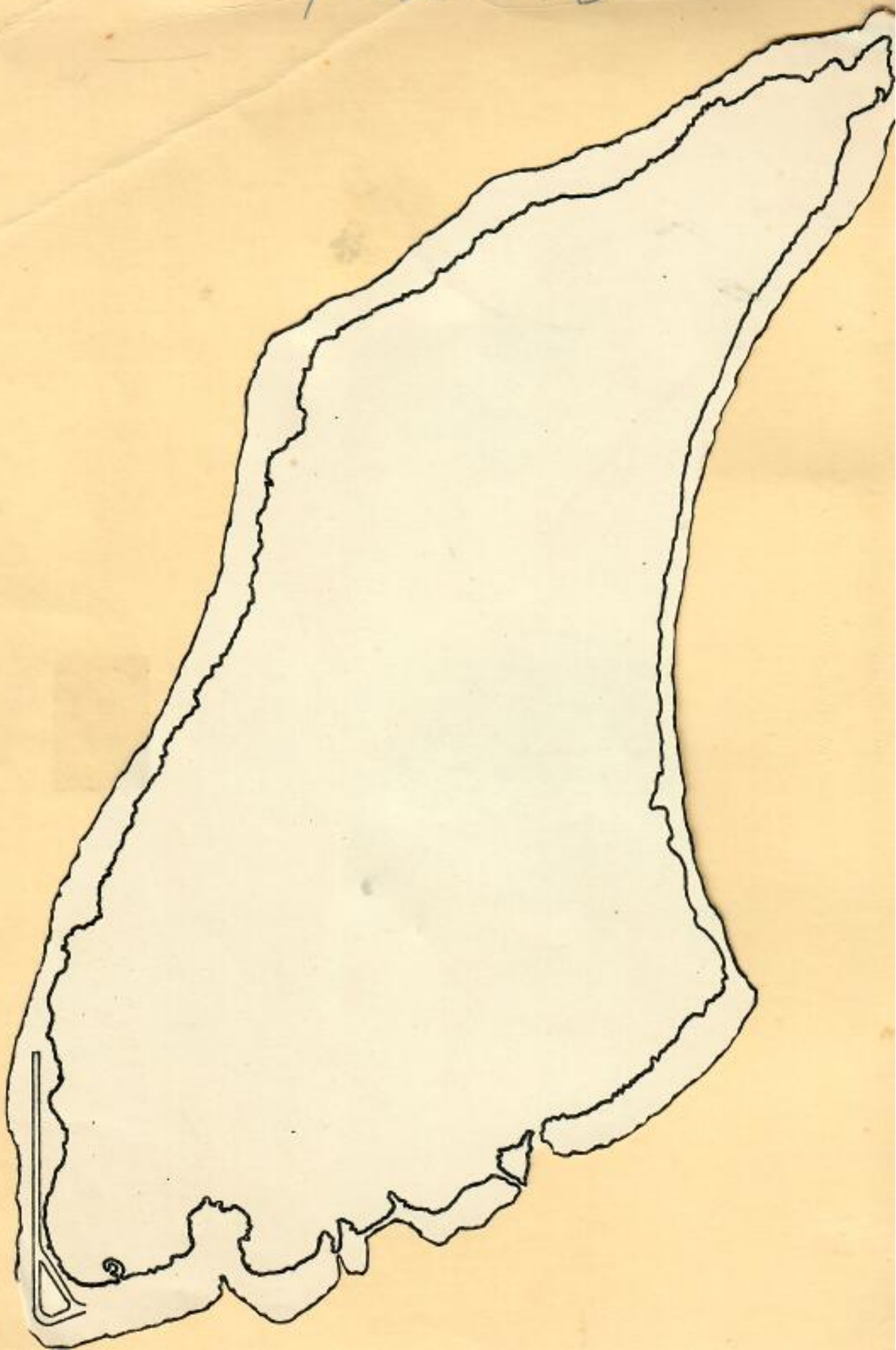


CANTON



SEA TURTLES - CANTON ISLAND

G.H. BALAZS

SEA TURTLES-CANTON ISLAND

G.H. BALAZS

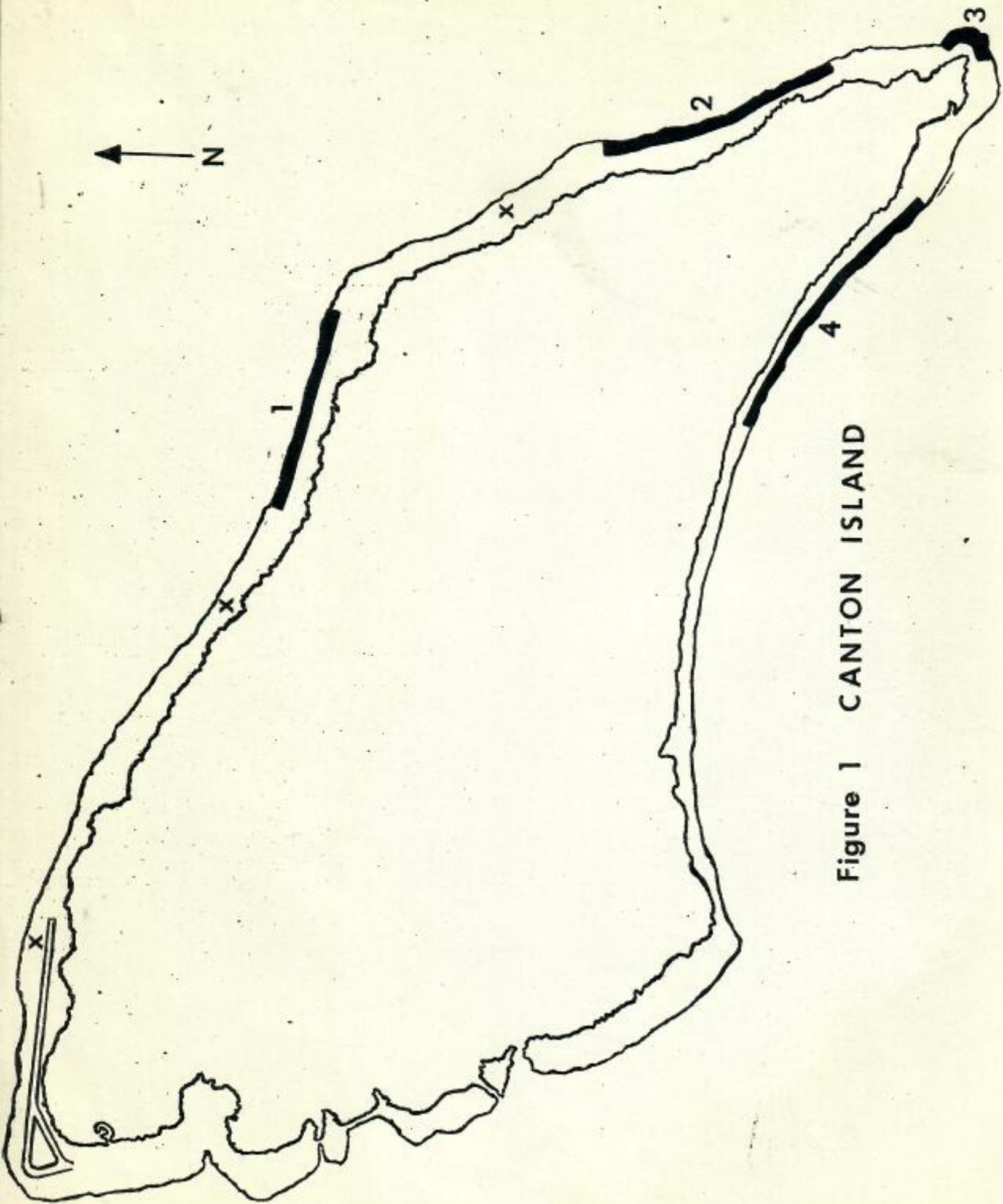


Figure 1 CANTON ISLAND

RESOLUTION NO. 5

Conservation of Islands for Science

The Symposium -

Realizing that islands, because of isolation, limited size and other environmental characters tend to develop specialized and sometimes simple and fragile communities;

Realizing the special value to science of islands as locations for the continuing studies of evolution, genetics, population dynamics, interaction between species and many related topics;

Realizing that island ecosystems, particularly of small and remote islands, having evolved in isolation, are vulnerable and easily disrupted by disturbances arising from human activities;

Being convinced that it is in the interests of mankind to conserve selected islands as sites for scientific studies, particularly remote and uninhabited islands;

Recommends to all governments concerned that they adhere to the proposed Convention of Conservation of Certain Islands for Science proposed by IUCN and scheduled for discussion at the UN Conference on the Human Environment (Stockholm, June 1972);

And recommends further that early attention be given to the selection of appropriate islands for conservation for this purpose.

RESOLUTION NO. 6

Conservation of Plants and Animals

The Symposium -

Being aware of the special value to mankind of the plants and animals that have evolved in isolation in many island territories;

Realizing that increased population pressures, uncontrolled hunting, development projects and unwise land use have already destroyed many of these unique resources;

Realizing also that general inventories of the flora and fauna are lacking for many island territories and existing information

on the status of endangered and vulnerable species and communities of plants and animals is often inadequate;

Being concerned to see that representative samples of this plant and animal life are conserved for the benefit of the island peoples and the world at large;

Being concerned also to see that adequate protection is given to endangered and vulnerable species of plants and animals to ensure their survival;

Recommends to all governments and administrations concerned that where necessary inventories of flora and fauna be made and that information on endangered and vulnerable species be made available to appropriate local agencies;

Recommends also that immediate action be taken to conserve areas containing these unique plant and animal resources and particularly to conserve remaining populations of endangered and vulnerable species by the creation of additional reserves and parks of appropriate size and kind;

And recommends further that adequate provision be made for supervising and protecting the resources conserved in such reserves.

RESOLUTION NO. 7

Control of Introduced Species

The Symposium -

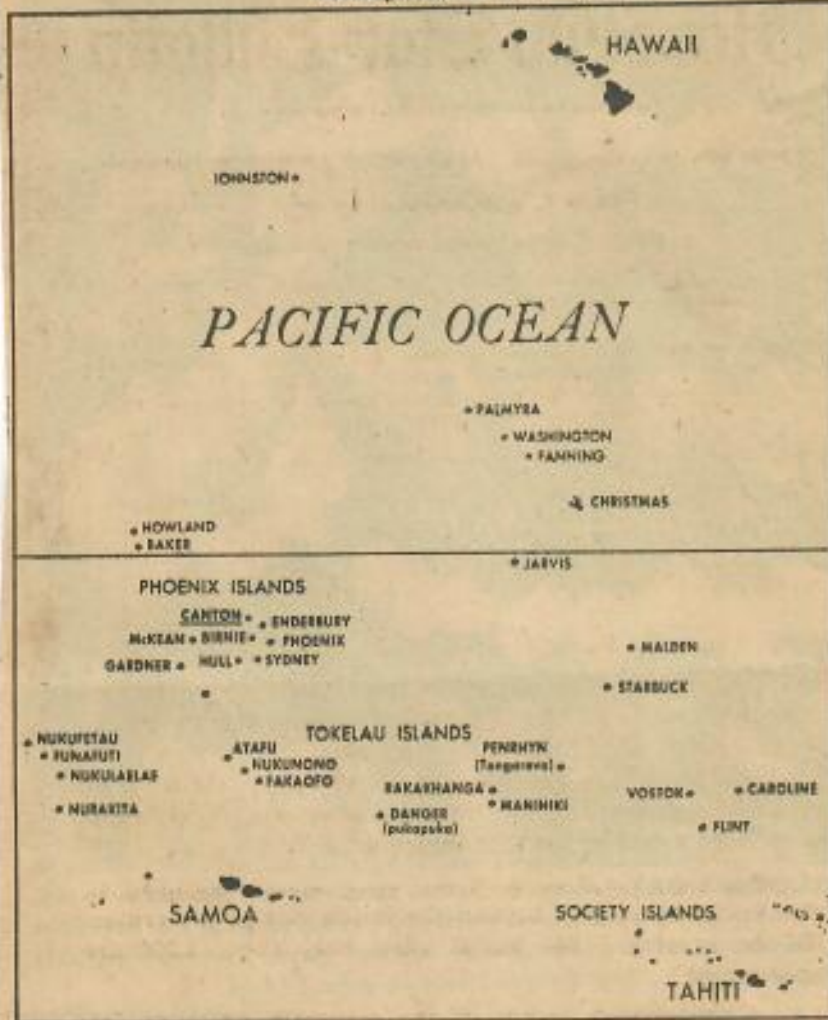
Recognizing that introduced species, particularly introduced mammals, have disrupted and modified island natural communities with effects that include extinction of local species, modification of vegetation, widespread erosion and subsequent economic losses;

Emphasizing that effective management and control of introduced species must be based on sound ecological knowledge;

Recommends to the South Pacific Commission and all governments and administrations concerned that the following conservation priorities be established -

- (1) Vigorous management action to ensure that potentially harmful foreign species are not introduced on to islands;

HAWAII LIBRARY



A Trip to Canton Island

GOVERNMENT officials and representatives of private firms flew 1,600 miles southwest from Honolulu last week to Canton Island in the Phoenix group.

Their purpose was to inspect facilities constructed there for an Air Force test missile tracking station. Those facilities are no longer being used and are in a caretaker status.

Canton Island was leased by the United States from Britain for the tracking station, but will become part of the Republic of Kiribati on July 12. The new nation will have its capital on Tarawa and will include the Gilbert, Phoenix and Line Islands. It will extend 2,700 miles but will have a population of only 60,000.

At its closest point, Washington Island, Kiribati will be 1,200 miles

Canton Island may become useful to fishermen from Hawaii.

south of Oahu, making it the foreign nation closest to Hawaii and much closer than any U.S. state.

Hideto Kono, state director of planning and economic development, made the trip to Canton last Wednesday and describes it as strictly exploratory. The idea, he said, was to examine the facilities in place with a view to whether there is a potential for further use — for fishing or research or possibly small-scale tourism.

KONO NOTED that Canton might enable fishermen from Hawaii to operate in southern waters during the winter months. But he stressed that any operations on Canton would have to be self-sustaining, that there would be no funds available from the state.

And although he found the facilities on Canton to be well-maintained,



he said considerable additional fixed costs would be entailed in establishing any operations there.

In addition to Hawaii, Canton Island is of interest to American Samoa, which is 600 miles south.

American Samoa was represented on the U.S. team in negotiations regarding Canton Island conducted in Honolulu in January and in Suva, Fiji, early this month.

Those talks produced a draft treaty of friendship between the United States and Kiribati in which both governments agree to encourage cooperative arrangements and fishing ventures between their nationals and appropriate government entities. They also agree to encourage joint utilization of the American-built facilities on Canton Island.

AMERICAN SAMOA'S interest is to insure access to Kiribati's waters for fishing vessels serving its canneries, and access to the Canton Island facilities for vessels based in American Samoa.

Hawaii has an additional link with these matters because Fred Rohlfing, the former state legislator, is currently director of the American Samoa office in Hawaii and participated in the negotiations as special counsel.

Missile Base at Canton Isle Closed

The Air Force quietly closed its Canton Island missile base Dec. 31, the Star-Bulletin has learned.

The facility south of the equator and north of American Samoa was used for five years for testing ballistic missiles fired from Vandenberg Air Force Base, Calif.

A Hickam spokesman said a current lull in activities caused officials to place it on a "caretaker" status.

Air Force missile testers felt the Army's test center at Kwajalein is sufficient for present Air Force requirements in the interest of economy.

The peak period at Canton was November 1971 when about 500 personnel were on the small atoll.

The missile tests helped gather data on trajectories, a spokesman said.

News media personnel never were allowed to visit Canton because, a Hickam spokesman said in 1974, of "the classified nature of some operations."

Missiles from Vandenberg have been fired at Kwajalein, Eniwetok and Canton in recent years. Other recent missile firings included Wake to Kwajalein and Johnston to Kwajalein.

In years past Canton was utilized by the Navy or Federal Aviation Administration as a refueling spot for transpacific air carriers. It is in the Phoenix Islands chain.

MARCH 29, 1976

JOHN GRIFFIN

by the way

collected notes and comment

Canton, anyone?

Canton Island — a large, almost uninhabited yet well developed coral atoll some 1,700 miles southwest of Hawaii — is currently the scene of an economic holding operation.

It involves an interesting international legal situation with some implications for Hawaii.

Everybody agrees that Canton, the largest of the Phoenix Island group, is part of Kiribati, which became independent from British rule last week, with Governor Ariyoshi heading the U.S. delegation to the ceremonies. No problem there.

The problem is that Canton has an abundance of American-endowed riches that need to be protected now and possibly developed for Kiribati's economic use later.

Canton was the site of a U.S. missile tracking facility, and much good base equipment remains — a power plant and other buildings, trucks and other equipment, a dock, an airport with a 6,000-foot runway that can take jets.

Kiribati, Hawaii and American Samoa all wanted the U.S. Defense Department to keep its civilian contractor employes on the island as caretakers until the new government can get organized and get its finances in order. But the department rejected the requests and took its people off Canton last week.

THE SOLUTION worked out was to use six caretaker-technicians from American Samoa to keep the island occupied along with a couple of Kiribati citizens to represent their government.

American Samoa could get officially involved because sovereignty over Canton was long in friendly dispute between the U.S. and Britain. And, although the U.S. eagerly gives up its claims in a treaty initialed in May, the catch is that the treaty won't be signed until August. After that it won't take effect until ratified by a U.S. Senate now heavily occupied with SALT, as well as energy and inflation matters.

So the U.S. legal claim remains technically alive, and the interim solution was for the Interior Department to name American Samoa Governor Peter Coleman as "civil administrator" of Canton from the U.S. point of view. He'll serve till the treaty's ratified.

Dec 18, 76 S-B

Canton Isle's Friendly Shark

A 27-foot whale shark trapped in a lagoon at Canton Island has decided to stay there even after a Navy team from Pearl Harbor dynamited the reef in order to free her.

The whale shark is so friendly her rescuers took to riding her back, six at a time.

The 36 civilian caretakers of the Air Force base no longer in use nicknamed the creature "Mimi."

Cmdr. Harvey T. Stewart Jr. of Explosive Ordnance Disposal Group One said "Mimi" had become as gentle as a pet dog.

MEN HITCHED rides in the nine-square-mile lagoon by grabbing the dorsal or pectoral fin.

"When I swam up to her, my feelings were about the same as when I first picked up a snake," Stewart said. "I really didn't want to just grab that 27-foot shark, because I didn't know if it would be a matter of me grabbing her or her grabbing me."

The Navy team blew the reef with explosives when "Mimi" was four

miles away.

"At first we tried to entice her with ground fish but she wouldn't have any part of it," Stewart said.

Leighton Taylor, director of the Waikiki Aquarium, advised the team to leave "Mimi" where she was.

The whale shark became trapped in November 1975 and the Navy team was called to the scene last October.

There's no way of knowing how big "Mimi" is but a 38-footer caught off Florida in 1912 weighed 26,594 pounds.



FROM THE DESK OF

Joyce Haas

George,

When I returned from vacation I found that we had another dead turtle near where the first one was found, about 3/4 mile from A-Site.

Hope the pictures are helpful.

Joyce

J. E. Haas
Canton Island 96736

Z.P. 96736

13 July 1977

Dear George,

I hope I'm sending what you wanted. The dogs got into the box of bones and strew them all over, so if you find some other kind of bone in the bunch it's because I picked up everything I could find.

We've seen quite a few turtles when outside the island fishing. Also, last week, when I picked up the bones, we found fresh tracks onto the beach at the same area.* The tracks led onto the rise on the beach, but he just made a U-turn and went back into the ocean. There are also some fairly recent nests.

We went lobstering once last week and once this week, but we didn't find any turtles. Last week there were three sets of fairly recent tracks, though.

The other guy in the "we" I refer to is Charley Apuna. He says he remembers you from your trip--or at least he remembers the turtle man because he and Paul somebody sat on the beach with you one night at the old beach house.

My brother-in-law filled me in on turtles' sexual activities when we were in Honolulu in April. He worked for a Dr. Frair at King's College--Frair does research on turtles.

Let me know if there's anything else you need. Oh yes, we did not find a tag.

Jaime Daas

* As where we found the tracks

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): Canton Island

Date: 7/10 Time: 8-9am Location (indicate
on chart): _____

Observation made from: _____ shore;

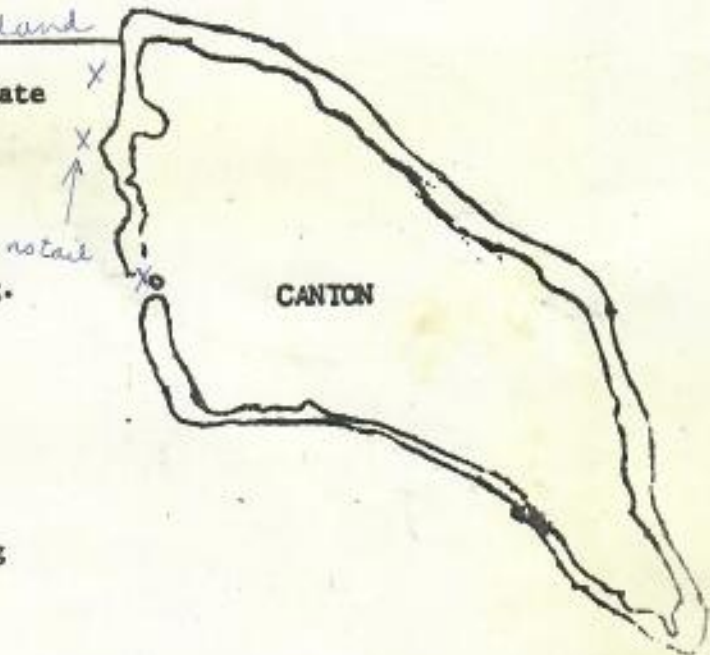
boat; or while _____ skin _____ SCUBA diving.

Estimated size (shell length): 2 1/2 ft.

Turtle seen on: surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. Haas

Address & Tel. No. (optional): Canton Island

Date: 6/05 Time: 9 a.m. Location (indicate
on chart): _____

Observation made from: shore;
 boat; or while skin SCUBA diving.

(4)
x

Estimated size (shell length): 3 ft.

Turtle seen on: surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):



Other comments: _____

THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): Canton, Island

Date: 9 May 77 Time: 12:30 Location (indicate
on chart): _____

Observation made from: shore;
 boat; or while skin SCUBA diving.

Estimated size (shell length): 2 1/2 ft

Turtle seen on: surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

just inside a small reef.

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): _____

Date: 5/30 Time: 12:30 Location (indicate
on chart): _____

Observation made from: X shore;
_____ boat; or while _____ skin _____ SCUBA diving.

Estimated size (shell length): 3½-4'

Turtle seen on: X surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

approx. 15 turtles seen, same location as 5/29.

tide higher and water cloudier. Observed 2

Other comments: males close up.



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): _____

Date: 5/29/78 Time: 11AM Location (indicate
on chart): _____

Observation made from: X shore;

_____ boat; or while _____ skin _____ SCUBA diving.

Estimated size (shell length): 2 1/2' x 3 1/2' to 4'

Turtle seen on: _____ surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

approx. 40 turtles (not Hawksbill) in knee-deep water inside

reef. Of 7 I went up to, only 2 were females, smaller than the

Other comments: males. (females seen had reddish) coloration on
shell. No mating observed or tracks on shore.



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): _____

Date: 2/05/78 Time: 12:00 Location (indicate
on chart): Southside

Observation made from: X shore;
____ boat; or while ____ skin ____ SCUBA diving.

Estimated size (shell length): 2 1/2-3

Turtle seen on: X surface; or at depth of
approx. ____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

no tail, brown shell

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): _____

Date: 2/05/78 Time: 1:30 Location (indicate
on chart): A-SITE

Observation made from: X shore;
_____ boat; or while _____ skin _____ SCUBA diving.

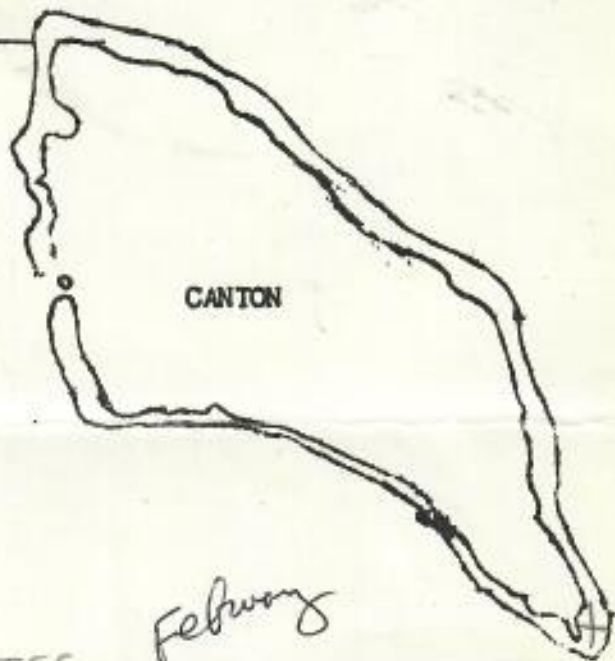
Estimated size (shell length): _____

~~Turtle seen on:~~ _____ surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

FRESH TRACKS & 2 DIGGING SITES

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: HEINIE KAAUAMO

Address & Tel. No. (optional): _____

Date: 5/07/78 Time: 6 a.m. Location (indicate
on chart): A-Site tower

Observation made from: X shore;
_____ boat; or while _____ skin _____ SCUBA diving.

Estimated size (shell length): 400 LBS

Turtle seen on: _____ surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

Was laying eggs - 1 laid - then started back
to sea.

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): X 266

Date: 1 FEB 77 Time: 4:30 Location (indicate
on chart): _____

Observation made from: _____ shore;

X boat; or while _____ skin _____ SCUBA diving.

Estimated size (shell length): 3 ft

Turtle seen on: _____ surface; or at depth of

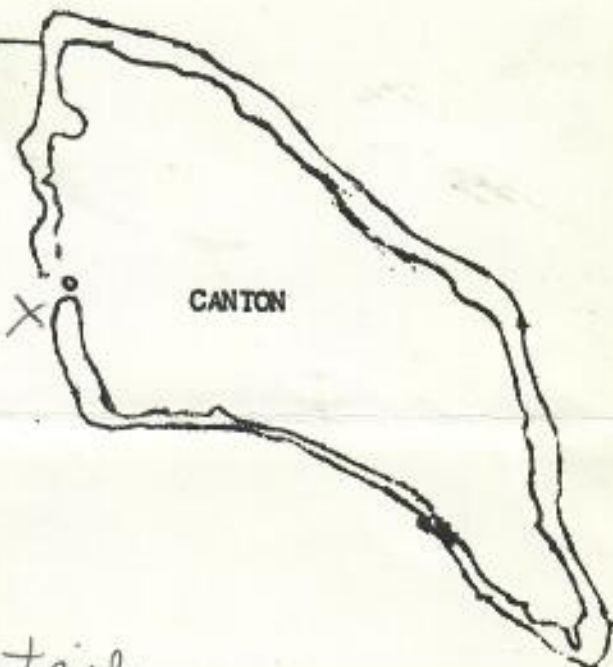
approx. 1 ft. Distinguishing

characteristics (species I.D. if known, long

tail, shell color, tags, injuries, etc.):

Seen 3 times - med green, no tail

Other comments: _____



J. E. Haas
Canton Island 96736

THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): X 266

Date: 11 FEB 77 Time: 11:00 Location (indicate
on chart): _____

Observation made from: _____ shore;
while net fishing in 2-3 ft. water
_____ boat; or while _____ skin _____ SCUBA diving.

Estimated size (shell length): 3 ft

Turtle seen on: X surface; or at depth of
approx. _____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

Brown-green, no tail visible. There is a sandy beach,
water for 30-40 ft, then a reef - turtle was on or above

Other comments: The reef is about a foot of water.
Remained there entire time of fishing (15 min).



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): CANTON x266

Date: 3/13/77 Time: 2pm Location (indicate

on chart): at reef, 1 ft of water

Observation made from: shore;

boat; or while skin SCUBA diving.

Estimated size (shell length): 1 ft

Turtle seen on: surface; or at depth of

approx. ft. Distinguishing

characteristics (species I.D. if known, long

tail, shell color, tags, injuries, etc.):

brown, no tail seen



Other comments: _____

THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. HAAS

Address & Tel. No. (optional): OUTRIGGER EAST HOTEL
427-5104

Date: 3/27/77 Time: 1:00 pm Location (indicate
on chart): _____

Observation made from: X shore;
____ boat; or while ____ skin ____ SCUBA diving.

Estimated size (shell length): 3ft

Turtle seen on: X surface; or at depth of
approx. ____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

3 to 4 turtles - 1 either had 2 heads, a big tail, or was
mating (I don't know how they do it, but they looked

Other comments: suspicious). All remained all the time
we were net fishing - 30 min. approx. Outside a
small shallow reef.

THANK YOU FOR YOUR COOPERATION



SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: J. Madsen

Address & Tel. No. (optional): Box 1158

Date: JAN 1, 77 Time: 1230 PM Location (indicate
on chart): A. site ocean side

Observation made from: X shore;

 boat; or while skin SCUBA diving.

Estimated size (shell length): 2 1/2 FT.

Turtle seen on: X surface; or at depth of
approx. ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

Long Tail - DARK color

Other comments: About 5 ft from beach



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: John Madson

Address & Tel. No. (optional): Box 1158 - B. 212

Date: Dec 26, 76 Time: 5:00 PM Location (indicate
on chart): By The Pier

Observation made from: X shore;

 boat; or while skin SCUBA diving.

Estimated size (shell length): 3 FT.

Turtle seen on: surface; or at depth of
approx. 5 to 6 ft. Distinguishing

characteristics (species I.D. if known, long

tail, shell color, tags, injuries, etc.):

Light in color - long tail

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: John Madsen

Address & Tel. No. (optional): Box 1158 - Pb. 212

Date: Dec. 15, 76 Time: 1:30 P Location (indicate
on chart): By The Pier

Observation made from: X shore;

 boat; or while skin SCUBA diving.

Estimated size (shell length): 3 FT

(2) Turtle seen on: X surface; or at depth of
approx. ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

Light BROWN in color

Other comments: _____



THANK YOU FOR YOUR COOPERATION

SEA TURTLE SIGHTING REPORT

(Please return to: George H. Balazs,
Hawaii Institute of Marine Biology;
P. O. Box 1346; Kaneohe, HI 96744;
Tel. 247-6631)

Observation made by: Ed Egan

Address & Tel. No. (optional): Loy Rubinstein
805-866-7607

Date: 10 Aug 78 Time: 10³⁰ Location (indicate
on chart): _____

Observation made from: ^ shore;
____ boat; or while ____ skin ____ SCUBA diving.

Estimated size (shell length): 45 x 29"

Turtle seen on: x surface; or at depth of
approx. ____ ft. Distinguishing

characteristics (species I.D. if known, long
tail, shell color, tags, injuries, etc.):

between green & brown, ^{Animal} Traveled approximately 500 ft. on access road
going westerly. female, looks like is carrying eggs.

Other comments: _____



THANK YOU FOR YOUR COOPERATION

GLOBAL ASSOCIATES

P.O. Box 938 / APO San Francisco 96401

29 May 75

Geo. H. Balazs
Univ. of Hawaii
Coconut Island, PO Box 1346
Kaneohe, HI, 96744

Dear Mr. Balazs,

In case it may be of interest to you, the following information is provided:

On 28 May 75 a dead sea turtle was found on the north-west shore (windward side) of Canton Island

Apparently male (pictures enclosed)

Length of shell (measured along the curve) 33 inches.

27 MPPS

Width of shell (measured along the curve) 29 inches.

Body was starting to deteriorate but looked in reasonably good condition (no flippers missing, etc) There appeared to be slight damage to the shell around the right "shoulder".

Sincerely

Phillip J. Stack

Lt. Col. Phillip J. Stack
SAMTEC/OL
APO San Francisco 96401



(head
alt



6/72

Hermit crabs



PACIFIC SCIENTIFIC INFORMATION CENTER
BERNICE P. BISHOP MUSEUM

P. O. Box 6037, Honolulu, Hawaii 96818 • Telephone 847-3511

March 28, 1978

Mr. George Balazs
Hawaii Institute of Marine Biology
P.O. Box 1346
Kaneohe, HI 96744

Dear George:

Herewith I'm returning your slides of the two canoes found washed up at Canton recently.

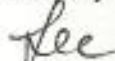
We've had several of our resident "experts" view these slides, and I'm sorry to say that we're no closer to a positive identification than before. No one is willing to hazard a conclusion based on what they consider insufficient illustrations. There does seem to be agreement that both canoes are dugouts and formerly had outriggers attached, but without the outriggers identification is difficult, as they are usually quite distinctive. When you are dealing with the entire Pacific, the problem becomes speculative, to say the least.

I've been through Hornell's Canoes of Oceania several times, with ambiguous results. Initially the canoe in slide 38 appeared to closely resemble the Samoan paopao, but now that I've seen models I find the bow is not vertical enough; it has features which appear in canoes as widely separated as Ponape (the wuar or var) and Fiji (takia). Without the outriggers, Dr. Sinoto has suggested looking for similarities to the internal seat supports, which seem to be a rather unique feature. Although not exhaustive, my search has been unsuccessful. The canoe in slide 36 is probably Melanesian, per our consensus, and brought to Canton by the equatorial counter-current; we can't seem to pinpoint it beyond that.

Sorry this could not have been more definitive, but the lack of evidence is complicated by a reluctance on our part which amounts to a lack of expertise!

Many thanks for the two copies of your recent Bibliography of the Hawaiian Monk Seal.

Aloha,



Lee S. Motteler
Geographer

AMERICA'S LOST ISLANDS

LIBRARY OF
GEORGE H. BALAZS

—Earl A. Selle

You've seen—incredibly—four "lost" American islands in world headlines more than, say, Louisville, Lisbon or Leningrad. Lost they are to many a Pacific pilot, commercial or military, for the top-secret curtain has banged down on two of them. A continuously bomb-brutalized one is off limits to all by either air or sea while a fourth is slowly dying as a longtime lonely ocean sentinel.

Toothpickish 20-block Johnston is "lost" in the longitudes some two jet hours southwest of Hawaii. Rendered taboo to the outsider by the U.S. Air Force, it is the houser of 13,500 tons of that hated nerve gas, yet from it exciting experiments by University of Hawaii scientists may save thousands of Pacific natives from excruciating deaths.

The dozen square miles of sun-baked forlorn Canton are 2,000 miles south of Hawaii. At one time this little atoll served magnificently in the pioneering of Pacific air travel. Now verboten to all, it strains its big ears and eyes toward that always inflammable Asia.

Eleven mile-long Kahoolawe is midway in the Hawaiian chain. Already the world's most bomb-blasted island, it continues to be the butt of a stubborn U.S. Navy which refuses to desist in its 30 years of frightening target attacks by air and sea.

Historic V-shaped 2.5 mile-square Wake—2,300 miles northwest of Hawaii—is step-by-step fading back into its "lost" past as Tokyo-bound jets overfly it and the Vietnam war winds down.

For nearly four decades Wake, discovered and christened as San Francisco four centuries ago by the Spaniard Alvaro de Mendana,

has mothered the busy criss-cross of Pacific air traffic. But the day approaches when this triple atoll of Wake itself, Peale and Wilkes may be phased back close to the desolate memories it once knew.

Only recently rebeautified—an exercise in futility says the cynic—Wake in the past has withstood murderous hurricanes and parching droughts to win its place in the history of World War II when for two nightmarish weeks a handful of U.S. Marines resisted the bombardment of the Japanese

Navy. What it will do with virtual ignominy awaits history. The Federal Aviation Administration, which made it a giant to Pacific airmen, has phased down drastically there when it handed over the administration to the air force. Ahead may be only logistical unimportance.

Three years ago Wake screeched with activity: a landing or a take-off every 15 minutes around-the-clock, or 32,000 annually. By 1971 that figure had been halved. For 1972 Wake is expected to average

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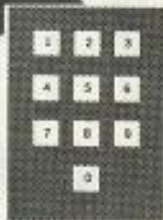
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no more than one operation every hour and a half. Next year may be as lonely as a whistle stop.

It's not just the crank-down in Vietnam which is whispering sayonara. Those Jumbo jets, commercial and military, bypass "old mother" in their 11-hour flights from the West Coast and eight-hour hops from Honolulu into Japan. She sees the Honolulu flights only for emergency refueling or when foul weather is ahead.

WAKE GETS ON THE MAP

Wake began its hemispheric importance on a bright morning in August of 1935. Dropping out of a blue sky into equally blue waters was a Pan-American Airways clipper on its pioneering flight into Asia. But de Mendana's "San Francisco" already was on many a world map. Some 230 years after the Spaniard, the Englishman, Capt. William Wake, rediscovered the islets in 1796. History drifted until 1841 when American naval Commodore Charles Wilkes landed there with the noted American artist-naturalist Titian Peale. In 1923 the exploration schooner U.S.S. Tanager gave the islets their present names.

But it was that defense by the marines which carved immortality for Wake. The world watched in awe that horrendous night-and-day bombardment. Food and ammunition expended, they flashed a final signal to Pearl Harbor: "We can fight no more. We are surrendering."

The rebeautification of Wake—this several spadesful of sand thousands of miles from nowhere—is a lonely monument to united American achievement. It all began with horticulturally-minded Dean Shosuke Goto of the University of Hawaii.

Beautify 12-foot high Wake? The campus gasped. Beautify that scatter of stunted plants amidst a few deceptively green shrubs which are fed by brackish underground water? The campus newspaper instructed the dean: "Go beautify Hades!"

In 1969 James Bispo, FAA area manager for Wake, arrived there with a few bush cuttings given him by Dean Goto's College of Tropical Agriculture. Goto quickly saw in this the opportunity for a full-blown project. Wake's chaplain, Jerome Larson, thereupon went into action.

A built-in morale builder. From among the 1600 residents he organized a beautification committee. Who among them did not want grass, flowers, plants and trees instead of coral-pebbled yards, sand-spurs and rock-piled gardens?

Clippings after clippings arrived from Honolulu. Residents speculated. Would grass grow?; indeed, would anything at all survive? In the following two years two separate teams of student tropical agriculturists from the university arrived to work shoulder to shoulder with residents in giving life to a master plan.

Botanical gardens came into being; trees, flowers and shrubs gave color to homes, the air terminal, the chapel and the new six-hole golf course which replaced the Low Tide Country Club (a three-holer) playable only at low tide. Chaplain Larson put it this way: "You just wouldn't know those old bomb craters, those old anti-tank ditches or those rusted gun emplacements any more."

From the university also arrived scores of bee hives to replace bees blown from the islet in the fierce hurricane of 1967. Cross pollination thereafter accelerated the greenery everywhere. Today Wake residents have such an abundance of honey there is talk of exporting it.

Strollers of an evening are solemnly conscious that on all sides Wake is winding down. No one has been hit by a speeding car in months. The police force has been cut to two or three, the bowling alley, the restaurant and snack bar are closed down. Two hundred FAA workers and their dependents have been phased out. The old movie house has gone but the air force does screen late films. And there's still baseball and basketball and the community newsletter goes out weekly and the radio station still fills the air waves.

Notwithstanding, Wake has become a way of life for the remaining residents. Neighborly, healthy, unequaled quiet, they say. A resident of 15 years summed up his attitude for all: "You couldn't get me off this rock for a million bucks."

CANTON IS FOR THE BIRDS

Back in the bright lights of

Honolulu, the Hawaii State Employment Service was pointing to a flyspeck on the Pacific map and inquiring of job prospects that if worst came to the worst there, could they bake a gooney bird pie?

If they could cook anything at all, then the really lost "lost island", shadeless, sun-baked Canton—190 miles below the blazing equator and nine degrees east of the international dateline—had a need for them.

The Bait: a clear \$28 per day.

On Canton they say that good cooks are worth their weight in rich gooney guano with which this nativeless oft-abandoned little atoll once abounded. But history records no one except possibly a gaunt castaway with sufficient fortitude to tackle a sinewy gooney bird pie.

Exactly 118 years ago the old blubber-reeking whaler "Canton" out of New Bedford discovered the tiny atoll by breaking up on its treacherous coral reef. Today the U.S. Air Force is rediscovering Canton for its own top secret purposes. Coordinating in base support work there with the sophisticated missile facility is Kentron Hawaii, giant Pacific engineers.

Canton since that 1854 wreck has had many faces, most of which concerned aviation. Far-sighted gooneys for untold centuries obligingly deposited thousands of tons of guano—a built-in tarmac for the "airline birds" that were to come. At one time it was a U.S. weather station which, along with FAA, stood at alert for both air and sea traffic. At another time both the U.S. and New Zealand used it as an observatory for an important solar eclipse, but in World War II forlorn allied troops there dubbed it that "damn rock". Project Mercury sprang it into space age prominence. Today it is "lost" in military secrecy.

History took 74 years of holiday between that whaler, captained by New Englander Jonas Whittier, and the flying arrival of the Englishman Sir Charles Kingsford-Smith in 1928. Canton became his emergency landing spot in his trail-blazing flight from Hawaii into the South Pacific.

The flight hustled the Powers into quick competitive measures. The U.S. hurried an inspection of its potential landing fields across



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the North Pacific. Japan eyed its own obvious stepping stones into Southeast Asia. Australia and New Zealand peered northward toward their mandated islands. Overnight little-known Canton was penciled in on world maps. It was to become the all-important midway point in the giant Pacific. Hawaii: 2,000 miles to the north. Sydney via Fiji: 3,000 miles to the south.

Nine years after the Kingsford-Smith flight the Power struggle began in earnest. Two British officials in 1937 landed on Canton with radio equipment and set up permanent housekeeping. But the U.S. wanted Canton as an essential point between American Samoa and Australia for the southward traffic already on the planning boards. President Roosevelt countered the British by ordering it and nearby Endobury under the Interior Department.

In the north, Pan-American Airways had matters under control with their flights between San Francisco and Hong Kong via Honolulu, Wake, Guam and Manila. By 1940 Pan-Am was using Canton for its flights Down Under. North and South the air reverberated to the four motors of the big flying clippers. Sydney became just two and a half days from San Francisco.

By now Washington and London were again palsy-walsy. Canton had become an Anglo-American condominium that would endure until 1989. There the two separate camps flourished on a high note of individualism. Each dawn was shattered by blaring bugles as the Union Jack and the Stars and Stripes rose on their separate flagstaves.

For all it was stark loneliness... a plane or two dropping out of the equatorial skies... and those wailing night birds which went on depositing additional layers of guano. But history called it epochal. Those flying boats had shrunk distances as did the outrigger canoe in replacing the raft.

World War II ended Canton for civilian use. American and British military forces moved in to purposelessly sit out the war. They simply were housemaids to runways and to anchorages for planes and ships which rarely came in.

Postwar decades saw Canton once more shrink back into oblivion. Long-range planes of six

nations simply flew on by high overhead. FAA, NASA—all have folded their tents and quietly stolen away, leaving the atoll shrouded in its newest role in world history. But on such matters the air force is mum

"AIRCRAFT CARRIER" JOHNSTON

Conscious of the Asian tinderbox is Johnston island—that sliver of land also under the tight thumb of the air force—which is buoyed like an aircraft carrier in a rough triangle between Canton and Wake.

Recently Johnston was briefly but hurriedly emptied of its some 600 military and civilian occupants in advance of roaring Hurricane Celeste. Established that Celeste had not uncapped any of the thousands of tons of that much-feared nerve gas for which the atoll is the uncomfortable repository, the 600 flew back to treeless "Gooney Bird Haven" from Honolulu. There, amidst the nightly bird wailings, the cynic says that Johnston is not just "lost", it's something which never should have been found in the first place. It's just a block wide.

A generation ago the target thereabouts was the unfriendly submarine. Today it is the savage moray eel which abounds in the atoll's beautiful coralheads. From the moray University of Hawaii scientists are hopeful of finding a remedy against an inexplicable toxin which has been causing excruciatingly painful deaths among natives of the Pacific.

Scientists gave this mystery killer the Caribbean name of ciguatera. It strikes at fish-eating peoples from Japan in the north to the Great Barrier Reef off Australia, from the Marquesa Islands to far Madagascar. Natives call it the step-and-a-half disease because of the suddenness with which it brings death.

In Japan alone some 200 die each year from eating the gourmet delight, the puffer fish whose toxin is a second cousin to ciguatera. Eating the puffer is akin to playing Russian Roulette inasmuch as it sends thousands to hospitals and the morgue daily throughout Asia. The Oriental eats the puffer out of sheer ecstasy; the Pacific native eats fish from necessity.

Research work on the six-foot moray which is the world's most

dangerous eel, began in 1955. From the offset it has been directed by Dr. A.H. Banner, zoology professor at the Hawaii university, who has labored desperately to pinpoint the elusive poison. The Johnston moray accommodatingly continues as an abundant source.

Hazardous is the word for the daily hunts at Johnston, tantalizing is the still-distant goal at the university laboratory. There is yet no cure and an antidote never may be found. The immediate prayer is for a dependable treatment to lessen incidents of death or painful suffering.

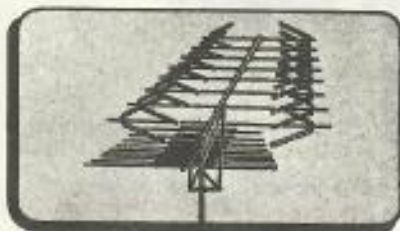
But the nearly two decades of

research on some 1,200 eels by Dr. Banner may have been far from empty years. He has reached the point where he can recommend a preliminary treatment of magnesium sulphate together with calcium glutinate, administered intravenously. Result: symptoms are relieved.

Its first big test was in Honolulu. Stricken while eating fish, the victim was rushed to the offices of Dr. Michael Okihiro. Collapse of the respiratory system already had begun. The magnesium treatment was given. The outcome: a life was saved.

But Dr. Banner recognizes this infant treatment as the barest of

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beginnings. No records exist on how many ciguatera has struck down throughout countless years in the Pacific. No one can guess how many thousands more will die before that "dependable" treatment is found.

The Hawaii hukilau—equivalent to a mainland fish fry—is an occasional source of ciguatera. Deaths without benefit of treatment have occurred. The Hawaii Department of Health bans fish from ocean areas which have a toxic potential, Johnston included.

Like the goat, the moray is more of a gourmand than a gourmet. Richard Brock of the university's biology staff, who often has pitted his own safety against the belligerent moray in Johnston waters, found this dinner menu in the stomach of one: an 18-inch baby shark, a collection of bird feathers and a very large and a very indigestible chunk of coral.

While the moray may be able to stomach many a stomach-knotting item of the sea, the mayor of the populous island of Maui found that he had arrived at the point where he could no longer stomach such a major item as the U.S. Navy. When he stepped out into his cow pasture on a summer morning to find a 500-lb. bomb nestled deep among his buttercups, he, as the saying goes, had "had it".

"STOP THE BOMBING"

He phoned Environmentalist Tony Hodges. "Tony," Mayor Cravalho hollered, "it's those damn navy planes again. We've got to shoot those people down—in court. Thirty years of horrendous total warfare against civilians has gone just too far."

The Mayor was fighting mad over those 30 years of fierce target bombardment against barren 11-mile Kahoolawe—most bombed island in the world—which lies just a jet minute off the Maui coast. Air tour guides call it "Isle of Death".

Since 1942 military planes have unleashed more than 50,000 tons of target-bound explosives against its pitifully-mutilated surface. Today it resembles a hunk of real estate which might have been torn from the moon. Nearby Maui has rocked—and there will be no let up—under a terrifying thunder coupled with fear of some major miscue.

Prior to the eventual court case, cigar-chewing Joseph Grimes, deputy secretary of the Navy, visited the scene to allow the court to understand just how the Pentagon felt about the "unjustified" civilian protestations. "I'm afraid you'll have to bury your hopes," he said. "The Pacific provides no alternative for the training of green pilots prior to their proceeding into combat in the Western Pacific."

Embattled Maui agrees about "training" since it wasn't just that wholly unexplained bomb in the Cravalho pasture which prompted the decision to go to court. There was also that mysterious bombing of Niihau island which took the navy exactly six years to admit its error. Ten tons of bombs tore up an isolated shore. But Niihau is 238 miles from Target Kahoolawe, the presumed objective.

In that smoking aftermath Environmentalist Hodges had phoned the mayor. "For God's sake, protect yourself. Install your own anti-aircraft guns!"

But Maui has had its day in court. The Navy was judged as not guilty of either air or noise pollution. Only days after the decree it was battering away again against poor Kahoolawe.

Seven mile-distant Maui has readied itself for more sleeplessness: 'round-the-clock concussions, skylighting flashes, roaring jets which herald that ever-present danger of bomber miscalculation. Sportsmen will grumble because Kahoolawe will continue closed to hunting and other recreation. Fishermen will grumble over the "No Fishing" signal for adjacent waters during bombardment. The University of Hawaii will jettison its dream of not only nuclear power plant there but also its study which showed that aquaculture would flourish in the Kahoolawe waters which are rich in phosphate, nitrate and other plant nutrients.

Recently Judith Ankerson, a Utah university ecologist, stared down from a tour plane at the 29,000 bomb-pitted acres of Kahoolawe, then wired President Nixon: "We demand you rescind that Presidential Order of one of your predecessors granting naval rights to Kahoolawe. What is happening to beautiful Hawaii is uncivilized savagery."

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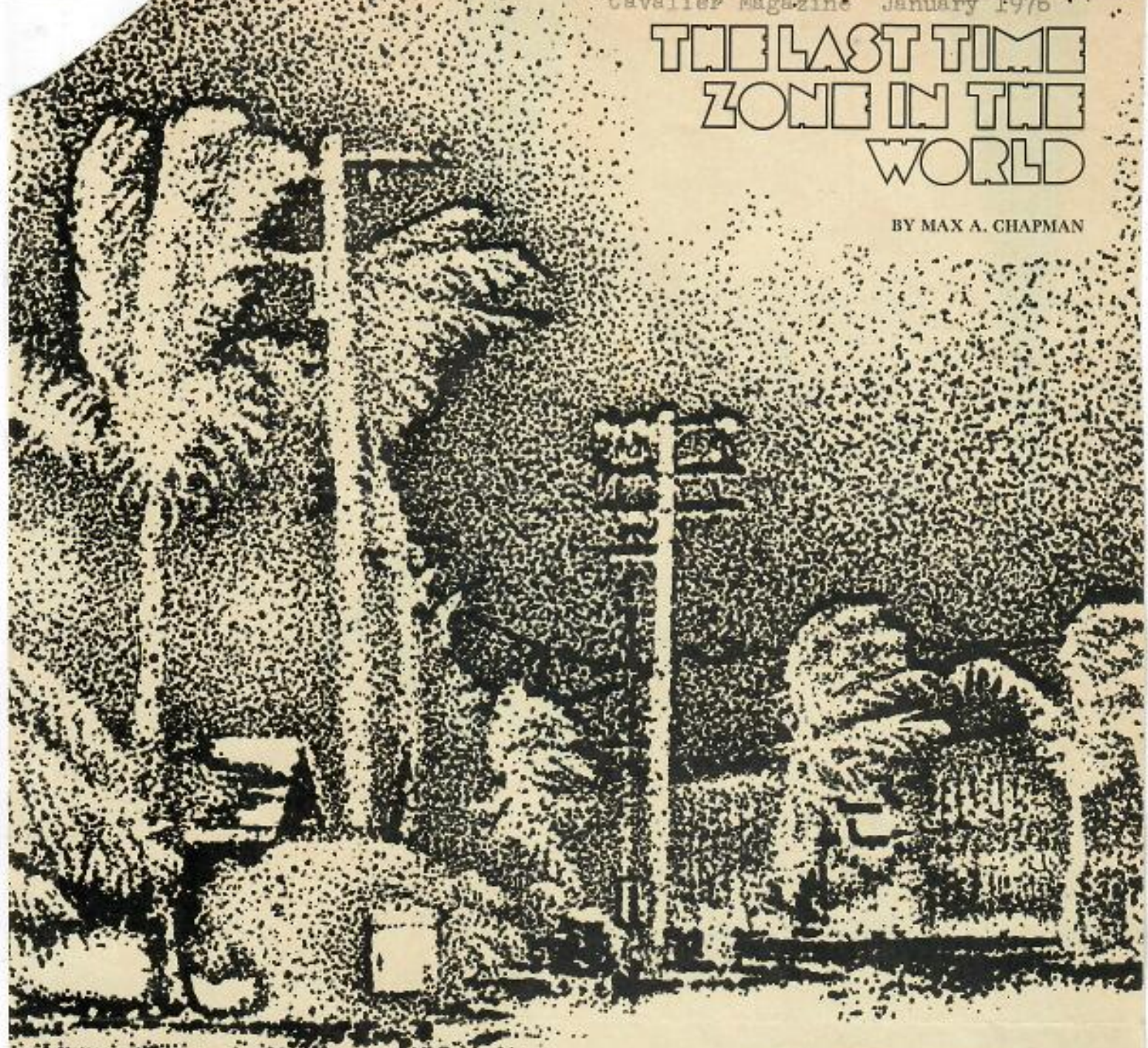
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● What American community has no private enterprise, is populated almost entirely by civilians, and is the only inhabited area for more than 500 miles in any direction? A sufficiently obscure answer would be Canton Island, in the Phoenix Islands, a breezy coral atoll two degrees below the equator and 4,000 soggy miles across the Pacific from Los Angeles. A coconut's throw east of the International Date Line, the island carries the dubious distinction, at least in local circles, of being the focal point of the last time zone in the world; a Pacific frontier without traffic lights, crowded stores or busy freeways. Today, the island population hesitates somewhere around three-hundred, and is inhabited by Americans who, for one reason or another, choose to give up many of the complexities, and many of the conveniences, of modern civilization. It had all started for me in July, 1974. Three new hires arriving at Canton Island. Alan, from Hawaii, to run the post office. Wade, from San Diego, hired as a cook, and myself, hired to run the radio station. A day earlier, in California, I had signed my name to a four-page contract and been sent on my way, expenses paid, jetting out to Honolulu to catch the plane the next morning that would take me to my final destination. The atoll would be my home for the next year, or at least that's what the contract called for. Despite the incredulous gasps of friends who more or less said they'd never be caught dead on some hot tamale adrift in the middle of the Pacific, the remoteness of the island had appealed to me. Being single, and after four years



competitor must combine as many tricks, unusual rolls, jumps and rhythmic sequences as he can within a slope of two-hundred yards without letting the upper part of his body make contact with the snow.

The second day of the hot dog contests is usually devoted to mogul-bashing. This event requires the contestants to race the clock through a field of specially constructed "moguls" or snow mounds built down a very steep slope. The hot dogger must combine as many acrobatic maneuvers as possible without destroying the rhythm and technique of his

skiing.

Looking like rodeo riders, the skiers zoom through the moguls at accelerating speeds, attempting frightening jumps. It is a very exciting event to watch and the enthusiasm of the spectators lends an electrifying charge to the happenings.

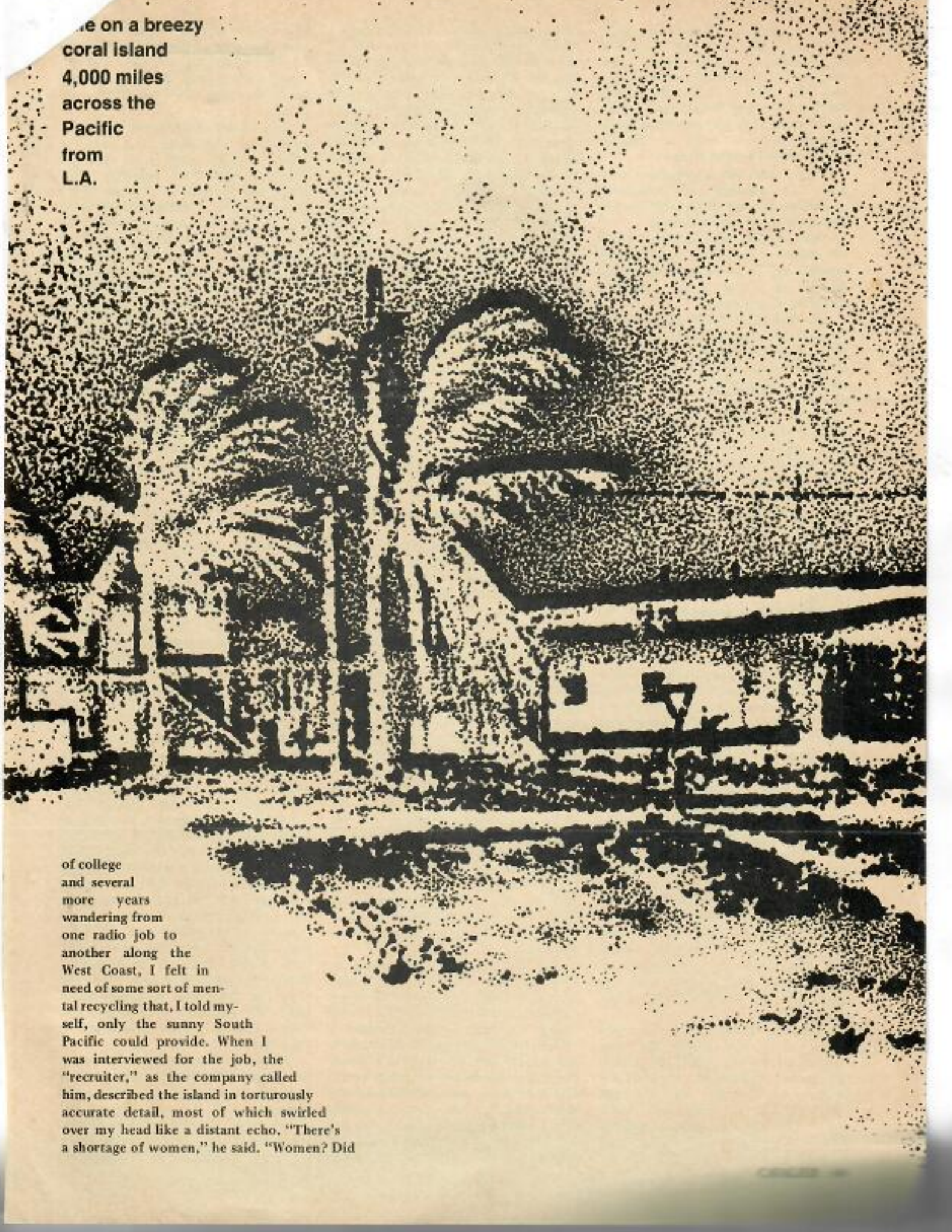
The aerial stunt competition is the final—and the most controversial—part of the hot dog contests, primarily because it is difficult, if not impossible, to prevent the entrants from attempting stunts for which they have not been properly trained. Since the exhibitionists have been encouraged to

take the maximum risks in order to accrue points, especially to make up for those not acquired in prior competitions, there are often some bad injuries as a result of falls or crash landings.

As of now there are few guidelines to insure safety in hot dogging. Because the injury potential is so high, there are a number of people who would like to see some sort of regulatory body set up to oversee these events. Hot dogging, particularly the aerial stunts, are dangerous, but it is doubtful that they will be curtailed for

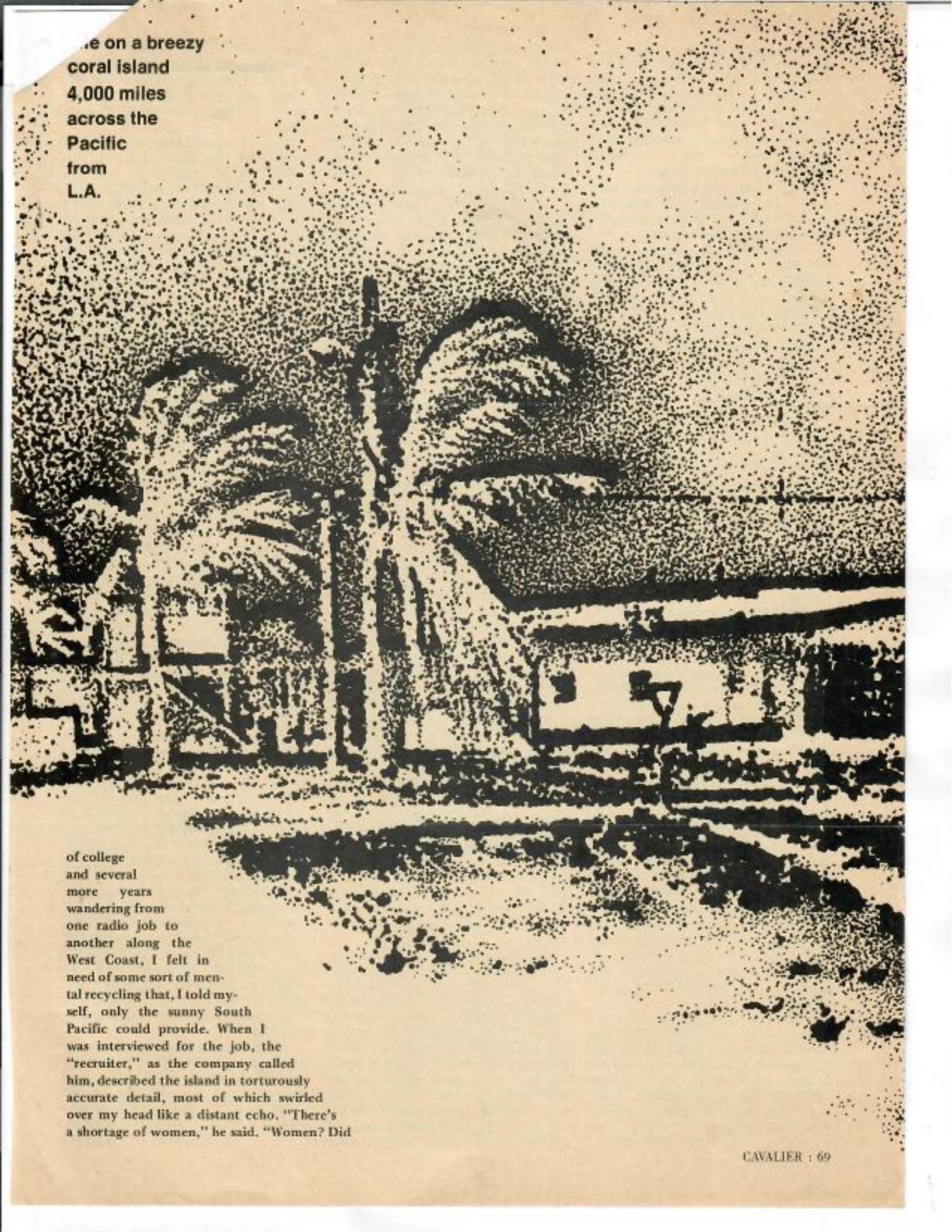
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... on a breezy
coral island
4,000 miles
across the
Pacific
from
L.A.



of college
and several
more years
wandering from
one radio job to
another along the
West Coast, I felt in
need of some sort of men-
tal recycling that, I told my-
self, only the sunny South
Pacific could provide. When I
was interviewed for the job, the
"recruiter," as the company called
him, described the island in torturously
accurate detail, most of which swirled
over my head like a distant echo. "There's
a shortage of women," he said. "Women? Did

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accurate detail, most of which swirled
over my head like a distant echo. "There's
a shortage of women," he said. "Women? Did

you say women?" I saw an image, projected somewhere on the inside of my eyeballs, of a wide sandy beach lined not only with coconut trees but also with scores of deliriously friendly Polynesian young ladies, each with a set of moist eyes and quivering lips in perfect harmony with a fragrant orchid tucked behind an ear.

"You only get a vacation once every six months," he continued, drumming the end of his pencil on the desk, as if to get my attention.

"Who would want to leave a place like that?" I answered, now actually smelling the orchid and wondering to myself what they really did wear under their grass skirts.

"It stays pretty warm all the time," he said, squeaking around in his chair. "It's about ninety-five in the daytime all year-round, and they've never recorded a temperature below seventy degrees."

Maybe they don't even wear grass skirts, I thought hysterically, doing a little calypso with my fingers across the "Welcome to Canton Island" pamphlet spread out uselessly at the front of the recruiter's desk. He tapped his pencil again, impatiently this time, and that's the last thing I remember throughout the next few days of numerous interviews, medical and dental check-ups, and then final processing.

Paperwork completed, I met the military transport plane in Honolulu that windy morning in July. The C-141 made the once-a-week flight to the atoll, and this particular day there were about twelve of us in all; the three new-hires and nine or so sleepy-eyed employees straggling back from vacation who didn't necessarily seem like they were looking forward to the trip.

Four hours and 2,000 miles later we all zigzagged our heads to see out of one of the two grapefruit-sized windows which, throughout the flight, had been clashing vibrantly with the interior decor of dancing pallets stacked to the ceiling and a few rows of baggy grey seats facing the rear of the plane. Below, the mirrored surface of the Pacific blazed like the sun itself, and right there on the front burner was a tiny knob of coral reminiscent of the little plastic island with the green tree that you find in the middle of a turtle tank.

Trundling busily down the metal ladder from the plane, the first whoosh of sticky, humid air pushed my cranial thermostat up into the vicinity of "poach," and the sun bouncing off the blindingly white coral felt like so many pinpricks skewering my eyes. Through the glare I could see what looked like fifty or

sixty people, mostly men and mostly middle-aged, hanging droopily over the rail at the terminal building and watching the disembarking passengers like they just dropped in from the moon. I learned later this was standard practice on plane days for those who could get away from their job. It was something along the ritualistic order of waiting for the stage in the Old West.

Those returning from vacation quickly pulled out their sunglasses and splintered off in various directions while the rest of us were ushered aboard a shaky old military bus, the kind you'd just as soon lose in a junkyard. I fumbled for a seat near the door, rubbing my eyes, and just when I was about to declare mental bankruptcy and ask to be carried back to the plane, we lurched forward and clattered away. I exposed my eyes just long enough to squint at a few trailers and quonset huts sputtering past, and a moment later at the administration triple-wide, we were assigned living quarters in the barracks and given a map to find our way around, as if a person couldn't impale himself on the doorknob of his choice simply by standing in one spot and making a 360-degree turn.

During the next few days I tumbled headlong into the work-a-day routine, and several weeks later, with sunglasses, Bermuda shorts and tennis shoes, I felt suitably marooned with the rest of them. For the most part it's a forty-eight-hour work week, a schedule that never ceases to boggle the mind, not to mention the bank account, with curiously whole paychecks unattacked by food costs, rent, car payments or federal tax. Room and board comes with the job, and if a person could get a private vehicle at Canton, it would be about as useful as a checkered flat at a frog jump. Although there are a few pickups and other government vehicles on the island, transportation is provided by the extremely old-fashioned process of putting one foot in front of the other, or by horse (Canton-ese for "bike," as in "fuck you and the horse you rode in on," an expression heard at least fifty times a day as the answer to any question).

The pay scale is comparable to what a person would get for a similar job in the States, but since there are no living expenses, it is possible to save \$9,000 or more a year provided a person doesn't go berserk on vacation and spend half of what he's saved. Employees are hired for maintenance, administration and support-services work which is contracted out to civilian companies who basically run the island for the government, and if it weren't for the atoll's strategic loca-

tion for a radar installation, the hermit crabs, giant sea turtles and booby birds would be peacefully alone. The air force stations just six men on the island to watch what the civilians are up to.

One of my first discoveries when I arrived on the island, and still the point of much anxiety, is that the recruiter had been painfully clear about the shortage of women. There are no families or children on the atoll; in fact, just ten liberated women who can, if necessary, stop a calculated male advance with all the frenzy and commotion of Julia Child bouncing off the pointy end of a rotisserie. Actually, the entire group is more like 300 brothers and sisters all living in the same house, with little squabbles over who's got the best living quarters or who needed a promotion and didn't get it. Otherwise, the biggest "crime" is probably when someone rides off on your horse without asking.

Although only 3,500 feet wide and two feet above sea level, Canton Island is twenty-two miles long, in a circle, simmering in the sun. The weather isn't all bad, though, considering that the microwave sky can toast a person's body to a dark brown in no time at all, and indoors, most buildings are air-conditioned. There's an average of twenty inches of rain a year, dropped in a series of quick cloudbursts weeks apart, and with the clear air, a full moon can throw an eerie nighttime moonbow against a bank of clouds.

Outside the settled area dotted with coconut trees, the rock-like coral strings down-island for miles, sprinkled along the way with dry, thirsty bushes and savage sandburs. Beside a few of the hardy tropical plants and Bermuda grass, nothing grows on the atoll unless fertile soil is brought in from Hawaii, which some people have arranged so they could grow some flowers. The coral-choked lagoon, twenty-four square miles of translucent green during mid-day, has only one narrow inlet from the sea and is stalked by sharks and eel who fritter away their days twittling their fins and chasing papio and wahoo, the local game fish. At least so far the sharks have not tried limb fricassee involving one of the local scuba divers or shell-hunters. Often, though, fishermen find the "one that got away" was really eaten right off the hook by a shark, and they'll reel in maybe a four-pound tuna head.

Of course, there's always after-work recreation at the Phoenix Lounge, that immortal cocoon of cavedrop and innuendo, and the only bar on the island. Inside the well-lit and somehow comfortable white clapboard building

(Continued on page 76)

with only wire screen for windows, rumors, and occasionally facts, about anything that has happened, is happening, or might happen are as plentiful as calories in a delicatessen. Mixed drinks sell for forty-five cents, beer for thirty, and at those prices there are few who pass up the temptation. A pack of cigarettes goes for a quarter, clearly labeled as "U.S. tax exempt for use outside the United States."

No isolated mid-Pacific atoll would be complete without a few "island rats," as they're called—men who have spent most of their adult life on one island or another working with government contractors. But even they aren't immune to a certain civilization fever that can suddenly limit a person's usefulness to making practice runs to the air terminal with his luggage and studying the slingshot powers of a prone coconut tree in case the plane is late.

At Canton, an island-wide going-away party will be scheduled, complete with all the free drinks, pupus and ear-bending a person can handle. And after a Saturday night blow-out like this, people are likely to stumble all over the island and pass out in the strangest places—beside the road, on the beach, or on the toilet—and it probably wouldn't be tolerated any-

place else but here. If you're not helped to your quarters by someone stumbling along behind you, one of the men from security is bound to come by to patiently coax you home. And in the morning in the chow hall you're just as likely to be sitting across the table from the same man, and it will be forgotten—or laughed about.

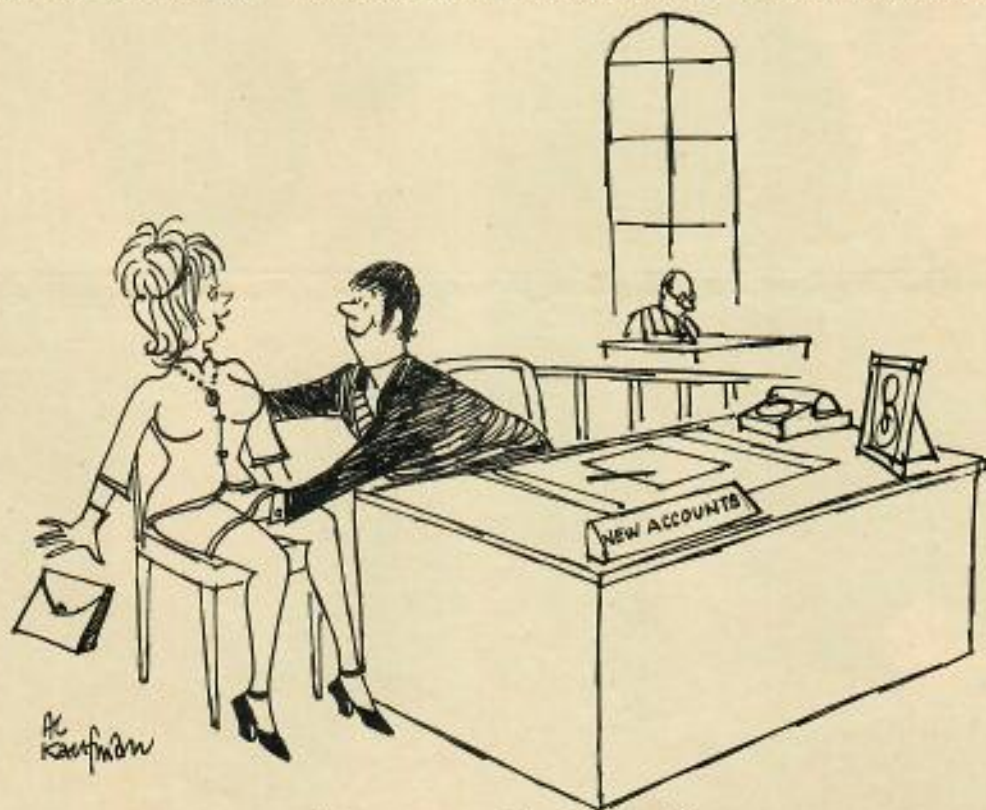
With the obvious shortage of women, the thirty or so dogs on the island get more attention than they deserve, and all two-hundred percent of them (counting the spare tire) are overweight, lazy, and pampered to the point of limp intensive care. For all I know, their ancestors bobbed across the Pacific in a papyrus doghouse, and I understand they can catch their own fish in the lagoon, but that must have been many generations ago. During a typically warm South Pacific evening, any scrap of shade around the dining hall looks like its been inundated by an avalanche of pregnant black and white sandbags with legs, ready to open their mouths, but certainly not move their heads, to smack away at any nourishing morsel that might come their way. At night they'll congregate outside the barracks and generally make a nuisance of themselves howling at the moon or padding around the building trying to locate

their most generous mealtime benefactor.

There are also about fifteen or twenty cats on the island, but they stay pretty much to themselves, mainly because the dogs are bigger than they are. Once a year a vet visits the island to roll up his sleeves and perform a series of quick operations to stop any bumper crop of squealing puppies and kittens that would otherwise threaten to make Canton the mecca for homeless dogs and cats the world over.

Despite the obvious quaintness of the whole affair, the biggest problem facing a new arrival on Canton is overcoming the shock of being confined on an isolated coral atoll. During my first six months here not a day went by that I didn't think about quitting and returning to the States, but somehow, without conscious awareness of the fact, the mind adapts. I now see Canton as a small group of people all on a first name basis, caught up in an environment of no TV, good food, a few vehicles, and surrounded by a sweeping world of water and coral linked by one plane a week.

Some employees have worked on Canton since the island was re-opened four years ago, but to others, it's an agonizing environment of endless boredom. Alan ran the post office for six weeks. Wade made it to eight months. I've completed my first year, and have signed up for another. But, I sure do look forward to those vacations. □



"My, you are a friendly bank!"

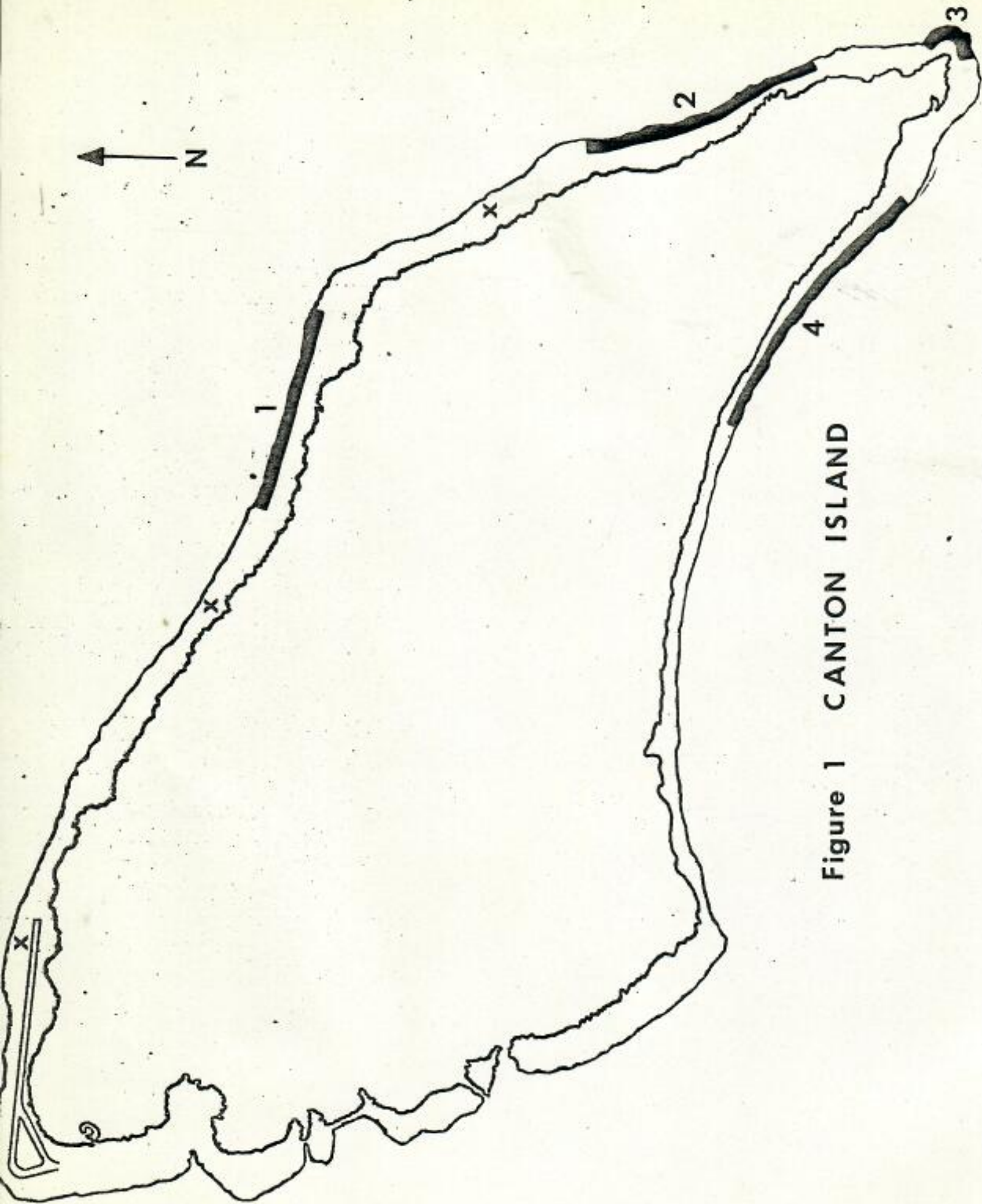


Figure 1 CANTON ISLAND



KENTRON HAWAII LTD

EXPECTED ARRIVALS TUESDAY, 13 FEBRUARY 1973

FROM HICKAM AFB, HAWAII - KENTRON HAWAII LTD

Brandlin, Mark E., Deckhand/Diver PCS 567N1
 Holt, K. C., Work Control Spec PCS 567N1
 Harvey, Albert F, Marine Fmn/Nav PCS 565N2 #3
 Hentacutan, Sergio C, Plumber PCS 567N2
 Young, Thomas W.H., Elect, TDY2wk 588
 Menard, Clifton, Ret fm Vaca

FROM PAGO PAGO, AM SAMOA

TAVAI, L., Ret fm Medical
 CURRY, P.B., Ret fm Vaca
 SIAOLOA, L., Ret fm Vaca
 TUIPELEHAKE, A., Ret fm LOA
 TATAIPU, SS, Ret fm LOA
 IZUKA, Karl T, Ret fm Dental
 MAIAVA, J.S. Ret fm Vaca
 PALATA, V. Ret fm LOA
 DANIELSON, L.R. Ret fm LOA

FEDERAL ELECTRIC CORPORATION

Hartley, S. F., TDY 2wks Trlr 7

DET 1, GSSQ - 7 days

Thornton, Ernest, T/SGT
 MAKLE, Eugene H. S/SGT
 WILL, James R. SGT
 TEMPLE, Jeffery D A1C

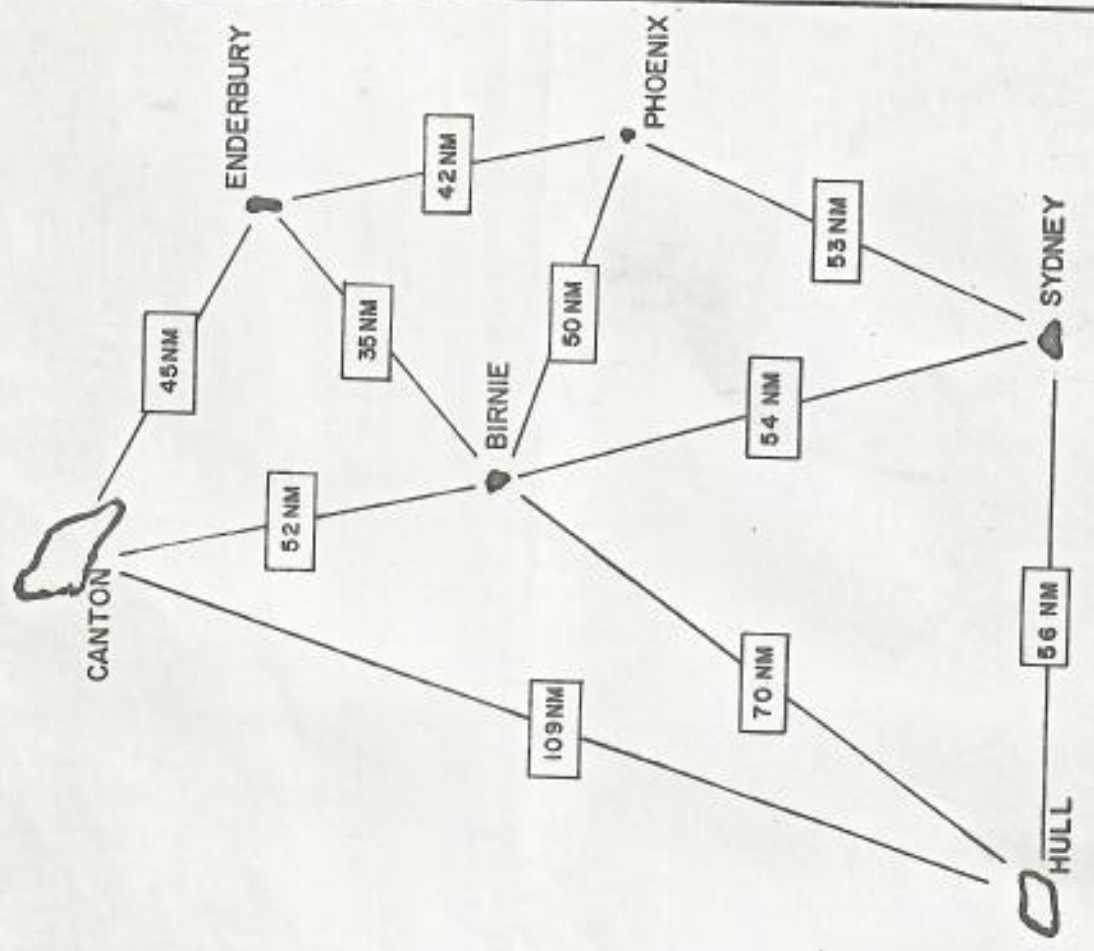
UNIVERSITY OF HAWAII

Balazs, George, TDY 1 wk 588



595

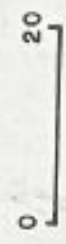
PHOENIX ISLAND GROUP



Mc KEAN



GARDNER



APPROX SCALE: 1" = 20 NM

BASE INFORMATION SUMMARY

SAMTEC OPERATING LOCATION NO. 1 - CANTON ISLAND

HOURS OF OPERATION

SICK CALL: MONDAY - SATURDAY 0700-1000

OUT PATIENT HOURS: MONDAY - SATURDAY 0700-1130, 1230-1700

MESS HALL: BREAKFAST - MONDAY - SATURDAY 0530-0645, SUNDAY 0800-1200 BRUNCH
LUNCH - MONDAY - SATURDAY 1130-1215, SUNDAY 0800-1200 BRUNCH
DINNER - EVERY DAY 1700-1900

SUNDAY SCHEDULE WILL APPLY ON HOLIDAYS

SNACK BAR & CLUB: MONDAY - FRIDAY 1700-2200, SATURDAY 1700-2300
SUNDAY & HOLIDAYS 1300-2100

RETAIL STORE: MONDAY - SATURDAY 1200-1300 & 1700-1830, SUNDAY 1100-1400
CLOSED HOLIDAYS

MOVIE: EVERY NIGHT 1900 AND 2100 (DOUBLE FEATURE)

POST OFFICE: MONDAY - SATURDAY 1100-1300
TUES, WED, THURS, SAT 1700-1800
MONDAY & FRIDAY 1700-1900

BARBER SHOP: MONDAY - FRIDAY 1130-1300, 1730-1930
SUNDAY 0800-1130, 1200-1730
CLOSED SATURDAYS AND HOLIDAYS

HAM SHACK: MONDAY - SATURDAY 0700-1130, 1230-1700
SUNDAY - ALL DAY IF OPERATOR AVAILABLE

CASHIER SERVICE: MONDAY - SATURDAY 1100-1200

RECREATION ACTIVITIES - SCHEDULE POSTED WEEKLY

DEEP SEA FISHING - MOUNTAIN BALL - VOLLEY BALL - HORSESHOES - GOLF - TENNIS

SHUFFLE BOARD - SWIMMING - BASKETBALL

EQUIPMENT MAY BE CHECKED OUT AT THE RECREATION OFFICE

PRIME CONTRACTORS ON SITE

KENTRON HAWAII, LTD. - BASE OPERATIONS & MAINTENANCE
FEDERAL ELECTRIC CORPORATION - TECHNICAL SUPPORT
GLOBAL ASSOCIATES - HELICOPTER SUPPORT

GENERAL REFERENCE NOTES

1. **CURFEW:** Sunday night through Friday night, 2230. Saturday night and nights preceeding holidays, 0030. Personnel need not turn out all the lights and retire at these times, however, overhead and porch lights should be out, noise held to a minimum and all personal bars closed. Of primary importance, consideration shall be shown to those who may desire to sleep.
2. **WATER:** Fresh water at Canton must be distilled from sea water. Water production facilities are presently marginal and storage capacities limited. Everyone is requested to take every opportunity to conserve water.
3. **LAUNDRY:** Personal laundry and bed linens are laundered once each week. A schedule is posted in each residence indicating the day of the week laundry will be picked up from that particular house and dorm. Beds should be stripped and the soiled linen placed with personal laundry outside the front door for pick up.
4. **HOUSEKEEPING:** Janitorial service is provided daily for all dorms and houses. Janitors will clean latrines and showers daily and sweep quarters. Personnel are requested to adhere to general good housing practices in regards to personal areas and belongings.
5. **VEHICLES:** Vehicles are to be used for official business and only during working hours. With the exception of emergency and a few other designated vehicles, all vehicles are turned in to the Motor Pool at the end of the working day. All vehicle operators must possess a valid U.S. Government Vehicle Operator's Permit. Individual requirements for after duty hours are accomplished by the use of the Base bus, which runs from 0600 to 2300 Monday thru Saturday. On Sunday the bus runs from 0600 to 1800. Bus route is posted throughout island facilities.
6. **SWIMMING:** Swimming for recreation purposes is limited to the salt water Swimming Pool south of the main cantonment. The "Buddy System" is in force at the pool - no one is to be in the pool unless at least one other person is in attendance.
7. **LOCAL SEA LIFE:** The lagoon is infested with sharks and eels, and personnel are cautioned to be very careful even when wading in the shallows of the lagoon or on the ocean reef. For such recreational activities the "Buddy System" will also be employed. Personnel are also cautioned against eating fresh fish caught in the lagoon or surrounding ocean since many of them are poisonous when ingested.
8. **ALCOHOLIC BEVERAGES:** Alcoholic beverages are available for sale at the Club and the Retail Store. Personnel are expected to exercise good judgement in their consumption of such beverages.
9. **OFF LIMITS AREAS:** The Flight Line and the POL Farm are "Off Limits" to all personnel and vehicles not engaged in official functional duties.
10. **SMOKING:** Smoking in bed is prohibited. Smoking elsewhere is restricted when so posted.

11. **NOTES OF CAUTION:** (a) The sun's rays are very intense at Canton. All personnel are encouraged to use a protective lotion and to avoid long exposure. (b) Canton is a coral island. Coral can be quite poisonous; any coral cuts or abrasions should be treated quickly. (c) Live ordnance, left over from World War II, has been discovered or unearthed during excavation operations on occasion. Personnel discovering any ordnance will assume it is live, will leave it untouched, and will report its whereabouts immediately to the Fire/Security Department.

12. **PROTOCOL:** SAMTEC Operating Location No. 1 is a military facility, and SAMTEC requests that military personnel wear appropriate uniforms, and exchange normal military courtesies on first meeting each day. Both military and civil service personnel are requested to present themselves at the Base Commander's office the day of their arrival to program their activities during their tour at Canton.

13. **ELECTRICAL POWER:** Like water, electrical power is at a premium at Canton. All personnel are requested to be conservative in their use of lights and equipment requiring electrical power.

14. **WILDLIFE CONSERVATION:** Sea birds and sea turtles are protected at Canton, Enderbury, Birnie and Hull Islands. All personnel are prohibited from molesting these birds and sea turtles, and from disturbing their nesting areas. In its context, this prohibition is directed toward minimizing the impact of the Air Force Phoenix Island operation on the ecology of the island chain, both in terms of the animal and bird life of the area, and indigenous vegetation. For example, visits to Birnie must be used only for scientific purpose or emergencies, and activity on Enderbury and Hull will be confined to the immediate area of instrumentation sites. No pets or other animals will be introduced to the three islands outside of Canton. Waste material will be collected in containers provided so that it may be removed from the outer islands and disposed of elsewhere.

15. **FIGHTING:** It is a local policy that anyone that provokes a fight will be sent back to his home of record on the first available aircraft that departs the island.

16. **CONDUCT OF PERSONNEL:** Violations of laws, policies, regulations, etc. governing personnel conduct at SAMTEC OL-1 may be prosecuted/adjudicated in the following manner:

- a. Trial by a court of law (for civilians)
- b. Trial by a court martial (for military)
- c. Non-Judicial punishment under Article 15 of the Uniform Code of Military Justice (for military)
- d. Denial of the privilege of entry to OL-1.
- e. Involuntary termination of employment and banishment from OL-1 for a specified cause by the individual's employer.
- f. Involuntary termination and banishment from OL-1 for a specified cause at the request of the Base Commander.

OCEAN

6000 FT RUNWAY

AIR TERMINAL

CHAPEL/RECREATION OFFICE

CLUB/BAR
THEATER

RETAIL STORE
DISPENSARY

HOUSING
COMMANDER'S OFFICE

POST OFFICE

SHOPS, WIVES
& ADMIN
OFFICES

MESS HALL

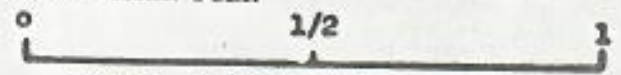
SWIMMING POOL

LAGOON

NW PORTION

CANTON ISLAND

DEEP WATER PIER



APPROX. SCALE: 3" = 1 MILE



AIRLINE PASSENGER TICKET, BAGGAGE CHECK AND MAC BOARDING PASS

MISSION NUMBER	BOARDING TIME DATE	BOARDING NUMBER	ORIGIN/DESTINATION VIA	BAGGAGE PIECES POUNDS
C-017	TIME 0715	1	HICKAM CIS	No. 1
	DAY MO YEAR FEB. 13 1973			Lb. 30

The Following Constitutes A Statement By the Carrier Which Is Hereby Delivered To the Passenger At the Carrier's Request

CONDITIONS OF CARRIAGE AND ADVICE TO INTERNATIONAL PASSENGER ON LIMITATION OF LIABILITY

Passengers on a journey involving an ultimate destination or a stop in a country other than the country of origin are advised that the provisions of a treaty known as the Warsaw Convention may be applicable to the entire journey, including any portion entirely within the country of origin or destination, that in most cases limits the liability of the carrier for death or personal injury and in respect of loss of or damage to baggage. For such passengers, the convention and special contracts of carriage embodied in applicable tariffs provide that the limit of liability for each passenger for death, wounding, or other bodily injury shall be the sum of U.S. \$75,000 inclusive of legal fees and costs, except that, in case of a claim brought in a state where provision is made for separate award of legal fees and costs, the limit shall be the sum of

U.S. \$58,000 exclusive of legal fees and costs. The carrier shall not, with respect to any claim arising out of the death, wounding, or other bodily injury of a passenger, avail itself of any defense under Article 20(1) of said Convention as amended by the Hague Protocol signed September 28, 1955. The names of carriers parties to such special contracts are available at all ticket offices of such carriers and may be examined on request. Additional protection can usually be obtained by purchasing insurance from a private company. Such insurance is not affected by any limitation of the carrier's liability under the Warsaw Convention or such special contracts of carriage. For further information please consult your airline or insurance company representative.

FOR THE PURPOSES OF ARTICLE 3 AND 4 OF THE WARSAW CONVENTION, THE FOLLOWING CONSTITUTES PARTICULARS GIVEN BY THE CARRIER TO THE PASSENGER

A. The place of issue of the passenger ticket and the baggage check is that place designated as "origin" in the "Origin/Destination" block on the front page of this document; the date of said issue is set forth in the "Boarding Time and Date" block on the front page of this document.

B. The place of departure is the place of "origin" as set forth in the "Origin/Destination" block on the front page of this document; the place of destination is in the same block. The agreed stopping places are also in the same block.

C. The letter symbol which is the prefix of the mission number shown in the "Mission Number" block on the front page of this document is the symbol of the carrier for this flight. The name and address of this carrier

is shown opposite the same letters symbol set forth below under the heading "Mission Number Prefix Code".

D. The number of the passenger ticket is set forth in the "Boarding Number" block on the front page of this document. Your name is on the flight manifest for this flight opposite this same number on said manifest.

E. The number and weight of the packages or baggage are shown in the "Baggage/Pounds" block on the front page of this document.

F. Delivery of said baggage will be made to the bearer of the baggage check.

G. This transportation of the passenger and the baggage is subject to the rules relating to liability established by the Convention, but the higher limits of liability as set forth elsewhere on this document apply.

MISSION NUMBER PREFIX CODE

Flight Code

- A** Alaska Airlines, Inc. Seattle-Tacoma Intl Arpt Seattle, Washington
- B** Braniff Airways, Inc. P.C. Box 35001 Dallas, Texas
- C** Capitol International Airways, Inc. Nashville Metropolitan Airport Nashville, Tennessee
- D** Other
- E** Eastern Air Lines, Inc. EAL Bldg 10 Rockefeller Plaza New York, New York
- F** The Flying Tiger Line, Inc. 7401 World Way West Los Angeles Intl Airport Los Angeles, California
- G** Seaboard World Airlines, Inc. SBW Bldg John F. Kennedy Intl Arpt Jamaica, New York
- H** Continental Air Lines, Inc. Los Angeles Intl Airport Los Angeles, California
- J** Trans International Airlines, Inc. P.O. Box 2504, Airport Station, Oakland, California 94614
- K** Trans Caribbean Airways Hangar No. 1, JFK Intl Airport Jamaica, New York
- L** Other
- M** American Airlines, Inc. 633 Third Avenue New York, New York
- N** Northwest Orient Airlines, Inc. Minneapolis/St. Paul Intl Arpt St. Paul, Minnesota
- P** Pan American World Airways, Inc. Pan Am Building New York, New York
- Q** Overseas National Airways John F. Kennedy Intl Arpt Jamaica, New York
- R** Airlift International, Inc. P.O. Box 535 Miami Intl Arpt Miami, Florida
- S** American Flyers Airline, 208 Airport Drive, Middletown, Pa
- T** Trans World Airlines, Inc. 605 Third Avenue New York, New York
- U** United Air Lines, Inc. P. O. Box 66100, O'Hare Intl Airport, Chicago, Illinois
- V** Southern Air Transport, Inc. P.O. Box 19067 Washington, D. C.
- W** World Airways, Inc. Oakland International Airport Oakland, California
- X** Saturn Airways, Inc. P. O. Box 2426, Oakland International Airport, Oakland, California 94614
- Y** Other
- Z** Universal Airlines, Inc. Hangar No. 2, Willow Run Airport, Ypsilanti, Michigan, 48187

**MAC NOTICE TO INTERNATIONAL PASSENGERS TRAVELING ON
COMMERCIAL AIRLIFT CATEGORY "B" CONTRACT FLIGHTS**

This transportation is being furnished you pursuant to a contract between the carrier and the Government. This contract includes language which provides in part that if a court of competent jurisdiction determines that the Warsaw Convention (49 Stat. 3000) entitles the carrier to limit its liability, then the carrier agrees, in accordance with Article 22(1) of said convention, that the limit of liability for each passenger for death, wounding, or other bodily injury shall be U.S. \$75,000, inclusive of legal fees and costs, except that, in case of a claim brought in a state where provision is made for separate award of legal fees and costs, the limit shall be the sum of U.S. \$58,000, exclusive of legal fees and costs; and that the carrier shall not, with respect to any claim arising out of the death, wounding, or other bodily injury of a passenger, avail itself of any defense under Article 20(1) thereof. Said contract provision applies regardless of places of origin, destination, or stopping. Under this contract, the carrier's liability for checked baggage is limited to the actual value of the item or items lost, damaged, or destroyed, not to exceed \$8.00 per pound times

the weight of the packed outermost carrying case (such as bag or suitcase) containing such item or items. The carrier's liability for unchecked baggage and items of personal property is for the actual value not to exceed \$340.00 per passenger. The carrier's liability for unchecked baggage and items of personal property exists only when the loss or damage was caused by the carrier. The Warsaw Convention requires that a passenger ticket be issued, and that certain matters be stated thereon. This language is set forth above on this ticket. Whether the Warsaw Convention is applicable and whether the carrier can limit its liability to the amounts specified above are matters for resolution by a court of competent jurisdiction. The issuance of this ticket is not to be construed as constituting any opinion of the Government with respect to these questions. Nothing herein shall be deemed to affect the rights and liabilities of the carrier with regard to any claim brought by, on behalf of, or in respect of any person who has willfully caused damage which resulted in death, wounding, or other bodily injury of a passenger.

MEAL RECEIPT <i>(Applicable Only To Flights By Military Aircraft)</i>					
	NUMBER ORDERED	NUMBER PAID	NUMBER RATION	AMOUNT PAID	REFUND FTS CERTIFICATION
FIRST MEAL					
SECOND MEAL					
THIRD MEAL					
OTHER					
<p>NOTE: To secure refund, FTS must annotate applicable space above, indicating the number of meals not furnished.</p> <p>SIGNATURE OF PASSENGER FOR REFUND</p>					

U.S. ATOMIC ENERGY COMMISSION/JTG 8.5
HOLMES & NARVER, INC./TU 8.5.1
P. O. BOX 9186
HONOLULU, HAWAII 96820

ORDER NO. 940

DATE 6 FEBRUARY 1973

ORIGINAL

TO: INDIVIDUAL(S) LISTED

SUBJECT: TRAVEL ORDERS

1. THE FOLLOWING LISTED PERSONNEL WILL PROCEED ON OR ABOUT 13 FEBRUARY 1973, FROM HONOLULU, HAWAII TO CANTON ISLAND, TO ACCOMPLISH TASK OF MUTUAL INTEREST TO THE DOD/AEC ON TEMPORARY DUTY FOR APPROXIMATELY ONE (1) WEEK AND UPON COMPLETION THEREOF, WILL RETURN TO HONOLULU, HAWAII.
2. INDIVIDUAL(S) LISTED BELOW HAVE CLEARANCE(S) AS INDICATED:

NAME	S.S. NO.	CLEARANCE	AEC NO.	DATE GRANTED
BALAZS, GEORGE	UNIV. HAWAII	XXXXXXXXXX	GSR	2-12-73

3. ACCOUNT CLASSIFICATION: TRAVEL IS PROPERLY CHARGEABLE TO CIC T116-31.
4. AUTHORIZATION: TRANSPORTATION VIA MAC AIRCRAFT IS AUTHORIZED UNDER THE PROVISIONS OF AFR 76-15 AND FOLLOWING REFERENCES: (a) LTR DTD 6/23/70, DEPT. OF THE AIR FORCE, HQ 6486TH ABW (PACAF), TO DIR., PASO/JTG 8.5, SUBJ: CUSTOMER IDENTIFICATION CODES IN SUPPORT OF JOHNSTON ATOLL AND OTHER LOCATIONS; (b) MSG, 6486 ABW (BCPTB), 040608Z JUN 70, SUBJ: REQUEST FOR CONTRACTOR CIC's; (c) LTR, HQ MAC (MABIFA), 6/9/70, SUBJ: REQUEST FOR CONTRACTOR CIC's; (d) LTR, HQ MAC (MABIF), 9/20/66, SUBJ: MAC TRANSPORTATION CHARGES (AEC LTR, HOA:NSR-1915, 8/12/66).
5. SPECIAL INSTRUCTIONS: MR. BALAZS IS AUTHORIZED 50 LBS. EXCESS BAGGAGE WEIGHT.

ORIGINAL

F. L. Van Rensselaer

AUTHORIZED SIGNATURE

DISTRIBUTION:

- 5 EACH - INDIVIDUAL(S) LISTED (AEC)
- 2 EACH - INDIVIDUAL(S) LISTED (H&N)
- 3 EACH - H&N PERSONNEL DEPT. (HONO)
- 3 EACH - H&N PERSONNEL DEPT. (J.A.)
- 1 COPY - H&N DIVISION CONTROLLER (HONO)

03

PRIORITY

FEB - 8 '73 2841

PRIORITY

PT-02366

PTTUZYUW RUWJSLC0199 0391700-UUUU--RUHHABA.

ZNR UUUUU

P R 081630Z FEB 73

FM SANTEC VANDENBERG AFB CALIF

TO RUHHABA/USAEC/PASO/HONOLULU HAWAII

ZEN1/SAMSO/DEC/VAFB CALIF

FECH/SANTEC/SUDH/HICKAM AFB HI

RUWJEBH/SAMSO/DE/SG/LAAPS CALIF

WTC/CANTON OL-AE/CANTON ISLAND PHOENIX ISLANDS

RUHHABA/619MASSG/CCZ/HICKAM AFB HI

ZEN1/KENTRON HAWAII LTD/VAFB CALIF

BT

UNCLAS SU/SUAS

SUBJ: USAEC MSG 020100Z FEB 73 QUOTED FOR BENEFIT OF OL-AE FILES. THIS MSG IN THREE PARTS.

PART I.

W.B. HILLS SENDS. REQUEST ENTRY APPROVAL TO CANTON ISLAND FOR GEORGE BALAZS, ~~SECRET~~ US CITIZEN, POB DETROIT, MICH, DOB 26 JAN 43, CONSIDERED GOOD SECURITY RISK AS OF 30 JAN 73, ASSOCIATED WITH HAWAII INSTITUTE OF MARINE BIOLOGY, UNIV. OF HAWAII. PURPOSE OF TRIP: TO CONFER WITH L/COL DEEM AND OTHER APPROPRIATE ADMINISTRATIVE PERSONNEL ON THE PRESERVATION OF TURTLE

FEB 8 1973

Action Info File

A	I	ROUTING
		DIRECTOR
		ADM. ENGR.
		PROJ. ENGR.
		SECRETARY
SEND COPY TO:		
		NV
		HAN
		JA
		Other

U of H. Ho
Signature

PAGE 2 RUWJSLC0199 UNCLAS BREEDING POPULATIONS ON CANTON ISLAND. DURATION OF STAY: 13 FEB 73 THRU 20 FEB 73. TRIP REQUESTED BY THE ISLAND COMMANDER.

PART II.

FOR USAEC: REQUEST FOR ENTRY APPROVED WITH FOLLOWING STIPULATIONS/UNDERSTANDING:

1. SUBJECT STUDY IS AN INDEPENDENT STUDY WITHOUT AIR FORCE FUNDING.
2. MR BALAZS WILL REIMBURSE KENTRON HAWAII LTD AT THE ESTABLISHED DAILY RATE FOR HOUSING, MESSING, AND LAUNDRY.
3. THE STUDY IS CONFINED TO CANTON ISLAND.
4. ANY PHOTOGRAPHIC COVERAGE TO BE PROVIDED BY MR. BALAZS.
5. ANY STUDY REVIEWS DEVELOPED BE FORWARDED TO HQS SANTEC/SUD FOR REVIEW AND APPROVAL WITH A COPY PROVIDED THE CANTON COMMANDER PRIOR TO PUBLICATION.

PART THREE.

FOR 619MASSG/CCZ. REQUEST MR. BALAZS BE BOOKED VIA AEC FUNDED TRAVEL ORDERS ON THE 13 FEB FLIGHT

PAGE 3 RUWJSLC0199 UNCLAS TO CANTON AND THE 20 FEB FLIGHT FROM CANTON TO HICKAM.

BT

#0199

NNNN#

OPR				
CC	DO	IO	IP	IN
DP	AG	DE	DC	DA
SG	IG	JA	MC	OI
CSH	CSP	BOL		DC
BASE/TENANT UNITS				
OPR		INFO		
619				
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09

Canton

Sharon

Jan 7 1973 advertise Home

Jan 3 73 SB IS ~~issue~~ issue

March 4 72 Advert. Home

Dec 16 71

SB IS

July 13 71

SB IS

March 15 71

SB Home

Aug 31 69

Ad Home

Jan 19 68

Ad Home

July 7 1965

SB IS

UNIVERSITY OF HAWAII

INTER ISLAND OUT-OF-STATE TRAVEL REQUEST

SOC. SEC. NO. (35-43) 564-54-0156		LAST NAME, FIRST NAME, MIDDLE INITIAL (44-49) BALAZS, GEORGE, H.		DOCUMENT NO. (1-6) T
TRAVELER'S HOME ADDRESS, ZIP CODE P.O. Box 8195, HONOLULU 96815		DEPARTMENT, PROGRAM, ETC. HIMB		MONTH, DAY, YEAR (7-12) 1/27/78
INSTRUCTIONS TO TREASURY OFFICE: <input type="checkbox"/> FORWARD CHECK TO <input type="checkbox"/> CALL _____		TRAVELER'S TITLE Assistant Marine Biologist		TELEPHONE NO. 247-6631

ESTIMATED OUT-OF-STATE TRAVEL COST		TRAVEL ADVANCE (13-34)		AMOUNT (70-79)	
PER DIEM RATE	NO. OF DAYS	ACCOUNT CODE		REQUESTED	
_____	X _____	25	61 4151		
AIR FARE—P.O. NO. _____					
MILEAGE/TAXI, ETC. _____					
CONFERENCE FEE _____					
OTHER _____					
TOTAL \$ _____					

SOURCE OF FUNDS (CONTRACT/GRANT NO., ACCOUNT NO. (S) AND AMOUNTS) NO COSTS INVOLVED - travel courtesy of the U.S. Air Force	CASH ADV. ISSUED: <input type="checkbox"/> F222 <input type="checkbox"/> Above A/C Check/SWV No. _____
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PROP. DEP. DATE 1/29/78	PROP. RET. DATE 1/31/78	PROPOSED ITINERARY Honolulu-Phoenix Islands and return
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PURPOSE/JUSTIFICATION FOR TRAVEL OR INTER-ISLAND TRAVEL ADVANCE
aerial surveys for nesting sea turtles

George H. Balazs 1/27/78
Traveler's Signature and Date

APPROVAL RECOMMENDED (Signature and Dates)

Principal Investigator

Department Chairman

WR

Dean/Director

Director of Organized Research Activities

Robert P. Dahl

Fiscal Officer

Vice-President for Business Affairs

COMMENTS/REASONS FOR DISAPPROVAL

APPROVED:
Philip Helfrich FEB 7 1978

Director of Research Date

President Date



University of Hawaii at Manoa

Hawaii Institute of Marine Biology
P.O.Box 1346 • Coconut Island • Kaneohe, Hawaii 96744
Cable Address: UNIHAW

December 13, 1974

Lt. Col. R. E. Holley
Director of Support
Department of the Air Force
Headquarters Space & Missile Test
Center (AFSC)
Vandenberg Air Force Base
California 93437

Dear Col. Holley:

This letter is in reference to your correspondence of December 2nd concerning my inquiries to Mr. Ewen (SAMTEC) about additional marine turtle surveys in the Phoenix Islands. It is indeed regrettable that the Air Force does not see fit to approve and support a small program designed to periodically monitor turtle populations throughout the year. As you may be aware, the funds required for such work would be minimal, amounting to less than \$300.00 for each visit. Surveys of this nature could provide both reliable and useful baseline data on the status of the colony, certainly a more desirable and realistic manner of assessment than merely responding to emergency situations after they have already arisen.

The majority of the world's green turtle populations are presently rapidly declining due to overexploitation and habitat destruction. Both the International Union for the Conservation of Nature (IUCN) and the U. S. Department of the Interior are aware of these survival problems and list the species and various sub-species in the "threatened" category. At a recent task force meeting of marine turtle specialists which I attended, recommendations were made which will undoubtedly result in reclassifying the green turtle as "endangered." Full protection afforded by the "endangered" status is deemed essential if biologists are to have sufficient time to gain knowledge on the population dynamics and migratory patterns of each remaining intact colony. Only with this information as a basis can sound long range conservation programs be developed. The aspect of migration is particularly relevant for the animals under your jurisdiction in the Phoenix Islands as nothing is known about their movements and schedules.

Lt. Col. R. E. Holley
Director of Support

December 13, 1974
Page 2.

The next issue of Atoll Research Bulletin will contain the results of my February, 1973 survey of Canton Island, the only work of scientific quality that has thus far been conducted on marine turtles in the area. Rather than regarding this investigation as an end, I would hope that your organization will view it in its proper perspective as a preliminary evaluation of what needs to be accomplished with respect to defining the characteristics of the colony. Only through on site visits by an experienced researcher can such information be obtained.

Sincerely,

GEORGE H. BALAZS
Jr. Marine Biologist

GHB:ec

cc: Mr. Ewen
Dr. Helfrich
Dr. Fosberg
Dr. Carr
Dr. King

July 12, 1974

Major Philip J. Stack
Commander
Department of the Air Force
Hq, Space and Missile Test Center (AFSC)
Operating Location APO S. F. 96401

Dear Major Stack:

Reference is made to your letter of June 18, 1974 requesting information about the biological characteristics and habits of the Tridacna clam. I am enclosing a xerox copy of a scientific publication which is probably the most authoritative publication on the matter.

I am director of the Mid-Pacific Marine Laboratory located on Enewetak Atoll and we have similar concerns about the clam populations on that island. Very little is known about the growth rate of Tridacna, although we are presently conducting growth studies on one species at Enewetak. Early indications are that these animals are rather slow growing.

There has been indiscriminate collecting and massive poaching of Tridacna in the western Pacific. A case in point is the Japanese poaching on Helen's reef for Tridacna shell and muscle that apparently almost completely wiped out a dense population on that reef.

As is too often the case, we have insufficient evidence to properly manage this resource, but in view of the lack of better evidence to the contrary, biologists strongly advocate taking the conservative stance, that is, to restrict indiscriminate collecting of the giant clam.

It has been my experience that, with the exception of a few Pacific island peoples where they had a strong system of chiefs and taboos, the natives of the Pacific generally demonstrate very poor conservation practices. It probably relates to some built-in limiting factors that existed before modern man arrived on the scene that kept them in balance with their environment. With our refinements, we have apparently allowed them to increase survival rate to a point that the earlier controlling mechanisms are no

Major Philip J. Stack
July 12, 1974

Page 2

longer in effect and, therefore, they exploit the natural resources in an uncontrolled manner.

Several weeks ago your office called regarding a fish kill on one of the islands. We received the samples that had been misssent and had thawed, and also a roll of colored film which we had developed. I am returning most of the photographs herewith, as some were obviously of a personal nature and did not relate to the fill. We kept copies of those that were of special interest to us.

We are at a loss to determine what may have caused the kill, although a radio message at the time indicated a low tide and extremely heavy rains. This would suggest a combination of stresses that could have caused such a kill. I asked the person I spoke with at that time to supply me in writing data on water temperature, salinity, rainfall, wind velocity and direction, etc. This information did not arrive and, therefore, it is not possible to come to any further conclusions on the matter. If such information was sent and misplaced, I would appreciate receiving it, as I think this is of considerable scientific interest and, obviously, of some general interest to you. Incidentally, the turtle pictured appeared to be starved; perhaps this was due to some disease it had.

I trust this information will be useful to you. I look forward to our continued cooperation on matters of mutual interest.

Yours sincerely,

Philip Helfrich
Acting Director

PH:md

Encls.

bcc: ✓ George Balazs

October 23, 1973

Major General Jessup D. Lowe
Commander, Headquarters Space and
Missile Test Center (AFSC)
Vandenberg Air Force Base, California 93437

Dear General Lowe:

I learned with regret that the Air Force would be unable to honor my request for lodging and transportation support in order to conduct more comprehensive studies of marine turtle breeding populations in the Phoenix Islands. Dr. Albert Banner and the co-investigators, including myself, were also disappointed to learn of the non-acceptance of our major proposal entitled "Marine Environmental Reconnaissance Studies, Phoenix Islands" which was submitted to the Air Force some time ago. It is my understanding that the Navy will now conduct an Ecological Base Line Survey within the next few months. Several coral reef specialists who were among the original co-investigators of our proposal are being included in this survey in order to provide essential expertise. It is unfortunate that no specific effort from any one member of the team will be directed at marine turtles. The sea birds and turtles are undoubtedly the most important species of the area because many are now threatened with depletion in other areas of the world.

I greatly appreciate your offer to share with me any data collected pertaining to marine turtles as I continue to be very much interested in this colony. I also appreciate the granting of permission to conduct further surveys which are consistent with Air Force support capabilities and resources. In this respect, I have approached several independent research foundations concerning the possibility of obtaining funding for a small intensive study in the area. This would, of course, be subject to your approval.

Major General Jessup D. Lowe
October 23, 1973

Page 2

You may be interested to learn that my paper entitled "Marine Turtles in the Phoenix Islands" was accepted for publication in the Atoll Research Bulletin, a Smithsonian Institution publication edited by Dr. F. R. Fosberg. Dr. Fosberg has visited Canton many times and has published much information on the flora of the area. As in our original agreement, Captain E. A. Howell first cleared my manuscript for publication.

Sincerely,

George H. Balazs
Jr. Marine Biologist

GHB:ah

November 16, 1972

Director of Plans
SAMTEC
Vandenberg Air Force Base
XPP Santa Maria, California 93437

Attention: Col. Bray

Dear Col. Bray:

Through communications over the past few months with Col. Robert Hines of the SAMTEC facility on Canton Island I have been made aware of a nesting sea turtle population which exists in that area. To my knowledge, no published material presently exists describing or defining this population. As a biologist working on the nutrition, growth and feeding behavior of these marine reptiles, I am aware of the loss to the scientific community that the lack of such data represents. Of special significance is the fact that all marine turtles, on a world-wide basis, have experienced a drastic reduction in number over the past 100 years. This has mainly been due to the destruction of highly productive nesting and over fishing.

I would like to propose a pilot ecological field project dealing solely with marine turtles in the Canton Island area. The objects of my initial study would be as follows:

1. To identify which of the five types of marine turtles exist in this area and in what proportions.
2. To make estimates of the total size of the existing populations.
3. To locate, identify and describe active nesting sites.
4. To make preliminary recommendations on how best to conserve marine turtles in this area.

Director of Plans, SAMTEC

Page Two

November 16, 1972

I would like to conduct this study over a seven day period during the second week of either December or January. In addition to myself as project leader, I would like to take my associate, Ernest Ross of the University of Hawaii Animal Science Department and my Biological Assistant, John Wheeler.

All equipment and instrumentation for data collection (including camping gear) will be supplied by the Hawaii Institute of Marine Biology. I would request that SAMTEC supply the per diem visitor charge (\$5.50 per day per person) and the cost of round trip air fare between Honolulu and Canton Island.

Your assistance on this project request will be greatly appreciated.

Sincerely,

George H. Balazs
Jr. Marine Biologist

mk

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE TEST CENTER (AFSC)
VANDENBERG AIR FORCE BASE, CALIFORNIA 93437




1 DEC 1972

REPLY TO
ATTN OF: XPP

SUBJECT: Canton Island Marine Research Project

TO: Mr. George H. Balazs, Jr.
Hawaii Institute of Marine Biology
University of Hawaii

1. Your request for entry to Canton Island to study the nesting sea turtle population is approved. The SAMTEC contact at Canton Island will be Lt Col Paul Deem, the new island Commander. Lt Col Deem will be taking over command from Lt Col Hines in December.
2. Your request for financial aid from SAMTEC is outside the scope of our authority and, therefore, cannot be provided. If military air travel is required, arrangements should be made with the Traffic Management Office, Hickam Air Force Base, HI, telephone 44-2133. [REDACTED]
3. If additional information should be required, your contact at HQ SAMTEC, Vandenberg Air Force Base, will be Mr. Richard W. Laren, telephone 866-7875/6.


LAWRENCE L. EPPLERY, JR., Colonel, USAF
Director of Plans

Bob Lusk

TITLE

An Investigation of the Marine Turtle Populations in the Canton Island Area.

PRINCIPAL INVESTIGATOR

George H. Balazs

INSTITUTION

University of Hawaii, Hawaii Institute of Marine Biology

DURATION

One Year (1973-74)

MOTIVATION

Personal communications with the military commander (Col. Robert Hines) of the SAMTEC facility on Canton Island has revealed that marine turtles inhabit surrounding areas of that island in addition to those of Enderbury and McKlean. Indication has been given that adult females actively nest in relatively large numbers on several sand beaches throughout the year. Hatchling turtles have been observed on occasion around installations, apparently attracted to lights.

All pertinent information obtained on marine turtles present in these areas strongly suggests a healthy, viable population of grazing, breeding and nesting animals. However, no published material presently exists either describing or defining this population. To date no studies have been carried out on these animals.

An investigation of this colony would have special significance at this time due to the fact that all marine turtles, on a world-wide basis, have experienced a drastic reduction in numbers over the past 100 years. This decline has mainly been due to the destruction of highly productive nesting sites and overfishing. Beaches in Bermuda, Cayman Island, and Mauritius, which were at one time sites for large numbers of nesting turtles, no longer function as such due to the encroachment of civilization. Concern by Pacific island nations for the decline in numbers of turtles inhabiting their waters has led to the enactment in recent years of extensive restrictions on the taking of these animals both in the water and on the beaches. In addition, several countries have initiated conservation and education programs dealing with these animals.

Because of the remoteness and lack of habitation in the Canton area, it is critical that this population of marine reptiles be examined, described and defined at the present time. In this way it will be best understood how to protect and perpetuate these animals.

SUPPORT REQUESTED

Initial Reconnaissance Visit

Travel:

Honolulu to Canton Island and return.	\$ 94.00
Seven days per diem cost	42.00
Total.	\$136.00

SUPPORT REQUESTED

Salaries and Wages.....None

Expendable supplies and equipment:
turtle tags, pliers, scale, calipers.....\$ 125.00

Travel:

Three trips - Honolulu to Canton and return for
Principal Investigator and two support personnel...\$ 846.00

Per diem while at Canton.....\$ 378.00

TOTAL COSTS.....\$1,349.00

PHOENIX IS.

file the same notes

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON, D. C. 20560

AIRMAIL

April 14, 1965

Dr. Archie Carr
Department of Biology
University of Florida
Gainesville, Florida

Dear Sir:

I regret taking so long to write you but I have been in the Pacific for the last two months and I had misplaced my journal abstractions about the turtles.

While on Erikub Atoll on 26 October 1964, I collected two sets of turtles, one set of four eggs and one of approximately 25 live young.

I kept the eggs in a pan of sand under a light. They were kept warm and moist until the 12th of November when the first one hatched. The rest hatched on 14 November. The last three weighed 27 gms, 27 gms, and 28 gms. (weight to the nearest gram) upon absorbing the last of the egg yolk and coming out of the egg. I noticed that when they hatched that much yolk was still left and they would stay half in and half out of their eggs for as long as 12 hours before coming completely out. These young ones didn't eat much and the last one died on the way to Gainesville. I had put them in fresh water after they hatched in hopes that they would survive in it. The fresh water may have been the reason for their death.

The young were caught off the ship at night. We were anchored about $3/4$ of a mile from the nearest land. There was a bright light on each side of the ship that was used for fishing and the turtles seemed attracted to the light. At about 10:00 PM the first ones started coming by and they kept going by for about 20 minutes. I caught about twenty-five out of probably seventy-five that came by. I do not know if any came by on the other (windward) side of the ship. They were definitely in a scattered group that was traveling in a definite direction. Sometimes as many as six were within sight at one time. I put half in salt water and the rest in fresh water on 26 October. On 14 November the salt water turtles averaged ten grams more than the fresh water ones caught on the same night. On 20 November the salt water ones were twice as large as the fresh water ones and the first fresh water ones started to die. Within a week all the fresh water ones (not the ones that were hatched by me) had died.

This is all the information I have. I am sorry I wasn't more scientific about the weights.

April 14, 1965

During my latest trip to the Pacific Islands I collected some grass from the bottom of the reef on Enderbury Island, February 14, 1965. The grass grew very commonly on the bottom in about a quarter mile stretch of windward Enderbury Reef. Turtles were commonly seen in the spot feeding on this grass.

While on Birnie Island on 11 February 1965, I collected barnacles from a dead sea turtle. The turtle looked as if it died while digging a hole on the island. The barnacles and the grass are enclosed.

Sincerely yours,

Lawrence N. Huber
Technical Assistant
Pacific Project
Division of Birds

Enc.

Bala ZS

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE TEST CENTER (AFSC)
VANDENBERG AIR FORCE BASE, CALIFORNIA 93437



REPLY TO
ATTN OF: CA

12 OCT 1973

SUBJECT: Unsolicited Proposal, "Marine Environmental Reconnaissance
Studies"

TO: Mr. Howard P. McKaughan
University of Hawaii
Office of Research Administration
Honolulu, Hawaii 96825

1. Reference our letter of 12 June 1973. Your unsolicited proposal was evaluated by the Air Force Office of Scientific Research and the USAF Environmental Health Laboratory. In view of the considerations provided by these two agencies and as a result of our internal review, it is necessary to reject your unsolicited proposal. Ecological studies of the Phoenix Islands are presently scheduled to be conducted during November and December, 1973. These studies, to be conducted by the U. S. Naval Underseas Center, will satisfy existing needs, including requirements of Air Force Manual 126-1.

2. We wish to express our appreciation for your interest in our programs and the efforts you have expended in the preparation and submission of this proposal.

3. In accordance with Air Force regulations, we have retained the copy of your proposal, which will be filed at the Space and Missile Test Center (SAMTEC) for permanent record.

Stanley R. Radom

STANLEY R. RADOM
Unsolicited Proposal Control Officer

VH cys:
DR. BANNER
DR. S. SMITH
CGAD

OFFICE OF
RESEARCH
ADMINISTRATION

73 OCT 17 PM 2:43

Beaufort force 2 3 4 5 6 7 8 9

OCEAN AREA EAST OF THE PHILIPPINES

January	5	23	31	21	13	5	0
February	13	21	37	17	7	2	0
March	13	29	26	19	12	1	0
April	18	37	22	8	3	0	0
May	29	36	22	3	1	0	0
June	27	31	25	3	2	2	0
July	26	30	17	9	4	2	1
August	20	27	21	14	3	2	1
September	27	26	14	7	4	5	3
October	23	27	26	10	2	2	1
November	11	21	33	19	8	4	0
December	9	17	31	17	14	5	2

APPENDIX B

RAINFALL RECORDS

ISLANDS	AVERAGE ANNUAL RAINFALL, INCHES	YEARS OF RECORD	SOURCE
Marshall Islands:			
Eniwetok	53	5	1
Ujelang	77	16	1
Wotje	78.2	4	2
Kwajalein	107	8	1
Arno	120(?)		3
Jaluit	157	25	2
Caroline Islands:			
Mokil	100(?)		4
Kapingamarangi	80-100(?)		5
Lamotrek	104		6
Kayangel	150(?)		7
Ulithi	114.21	2	8
Line Islands:			
Palmyra	149.72	1	8
Johnston	32.90	2	8
Washington	122.00	7	9
Fanning	81.00	41	9
Christmas	58.00	12	9
Malden	28.00	33	9
Flint	(56.00)	3	9
Penryhn	70.98	14	10
Northern Cook Islands:			
Manihiki	94.74	14	10
Pukapuka (Danger)	109.42	14	10
Palmerston	82.82	11	9
Tokelau Islands:			
Atafu	114.70	24	11
Phoenix Islands:			
Canton	17.32	14	8
Sydney	41.41	3	12
Gardner	46.06	4	12
Hull	32.63	3	12
Raised atoll:			
Ocean	82.34	2	12
	471		

Pacific Discovery
V. XXX NS
Sept-Oct 1977



Academically Speaking: DOG FISH VS. FISH DOG

Lester C. Gunther, Jr.

THE HIGHEST elevation on Canton Island is nine feet, hardly enough to cause a small burp in the trades which almost constantly rush in from the southeast.

A member of the mid-Pacific Phoenix group, 2 degrees south of the equator, Canton is 12 miles long by three miles wide. It is made up of a shallow oval lagoon surrounded by a narrow circle of coral atoll interrupted by a channel at the western end through which the tides completely exchange the lagoon water every three days.

Late in January of this year, as guests of the U.S. Air Force, Dave Powell, Curator of Steinhart Aquarium; Leighton Taylor, Director of Waikiki Aquarium and his wife Linda; Ralph Alexander, an aquarist at Waikiki; and I traveled to Canton to collect live sharks for display at Steinhart.

As the result of transportation and cost factors we were in pursuit of small specimens. Canton possesses a large population of sharks. While diving we counted seven species: black-tip, reef white tip, oceanic white-tip, grey reef, whale shark, hammerhead, and lemon. Most of these are found outside the lagoon on the outer reefs, and their size and freedom of movement make collecting difficult. We found, however, that baby black-tips and lemons, most of them under three feet in length, inhabit the shallows along

the shores of the lagoon. We could stand on the beach and watch them as they meandered close to shore in calf-deep water, and we felt that their capture would be simple.

Our theory was that we would extend a 125-foot net out from the shore to form a barrier into which we could drive the sharks. By entering the water in a skirmish line some 200 yards up-beach, we would encourage the animals into the net from which we would extricate them.

So much for theory.

Rather than reacting as any normal biomass and fleeing directly away from potential danger, the sharks split in every direction except toward the distant, invisible net. Our line of five screaming, splashing, stumbling beaters ended up tangled in the net suffering from exhaustion and coral cuts while our prey resumed their meandering elsewhere.

Next time we decided to use finesse rather than force, and we coaxed the sharks into the net by advancing upon them slowly, thus not bringing them to a state of frantic activity. Their first intimation of real danger would be when they hit the net—but it would be too late to escape as we would be there to capture them.

We re-entered the water and slowly drove the fishes to the net. This worked rather well, except that

Above, Tonga John with his shark-hunting dog Blackie and captive shark.
Right, the lagoon at Canton Island, where fish dogs hunt dog fish.

upon bumping the net the sharks immediately took off at full power in every other direction; and only one shark became entangled in the net and was captured.

As this second method had resulted in a 100% improvement, we continued to use it for the balance of that day as well as the next. We wanted to capture a minimum of 14 sharks—but after two days we had been able to secure only eight.

As other work had to be done, it was decided that the third day would be spent diving beyond the reef. However, as my involvement was not necessary, I was persuaded to ask for the help of some of the local inhabitants and to continue the great shark hunt.

Ed Ewen, a U.S. Air Force representative, had to go to the far end of the island to do some work, so after enlisting Tonga John, one of the Canton permanent staff, as a fishing companion, I loaded our net and keeping box aboard the truck and we headed out. An unanticipated but not unwelcome passenger on the truck was Blackie, Tonga John's dog.

Blackie is a rather interesting animal; a descendant of the original dogs which were brought to Canton in 1937. Few if any other dogs have been introduced since the original canine presence, and there has been much inbreeding. Blackie looks, as do his brother and his sisters and his cousins and his aunts, like a black labrador who was hit on a dark night by a cross between a bulldog and a hyena.

After Ed had finished his tasks we proceeded to some tidal flats where we could see at least ten small sharks. We stopped the truck and the first one out was Blackie, closely followed by Tonga John.

After Ed Ewen and I had unloaded the net we started to stagger into the water—but we were brought up short by the sight of Blackie, tail wagging, standing near us on the shore with a very surprised and uncomfortable shark lying by his side. Tonga John advised me that catching sharks was Blackie's favorite game, but offered to keep him out of the way while

we went about our netting.

I inspected the shark and noted that there wasn't a mark on him. The Labrador ancestor had bequeathed Blackie a soft mouth and he had retrieved the fish as though it were delicate spun glass.

Vividly recalling the previous 2 days' activities and results, I solemnly returned the net to the truck, got out my camera, and returned to the water's edge. The only thing which was required of me was that I wade about until I saw an individual fish which was the right size. I would then point to it, triggering Blackie into motion. With flapping ears, whipping tail and waving tongue, Blackie, like a cutting horse, would take off after the designated victim. The pursued shark, using all its instinctive tactics, would shoot off, dodging and making square corners faster than I could visually follow. But Blackie always seemed to be one jump ahead, and in not more than 10 seconds the chase would be over and the dog, a very human expression of glee on his face, held the shark down with his front paws until Tonga John came over to pick up the catch and transfer it to the holding tank.

Within 15 minutes Blackie had duplicated our efforts of many hours and I had six confused but healthy sharks in the box. It occurred to me that if Blackie ever learned to use SCUBA I could be completely replaced.

Now we almost had to tie Blackie to the truck to keep him from continuing his performance. I found, however, that he liked ice cubes even better than chasing sharks, so by giving him free access to the beer cooler we were able to keep his activities contained until we could get everything prepared for return to our home base.

I had expected to spend all the day on our venture, but was back in our quarters by early afternoon, and by the time that my co-expeditioners returned, exhausted and shriveled from their diving, I had showered, put on clean clothes and consumed a quantity of refreshments. The divers were delighted and



the recent United States charts showed serious discrepancy, and the basis of these estimates is not now known. . . . Apart from the reliability of the charts the method of producing the estimated area is liable to up to 10 per cent error due to the most irregular nature of the land and the small scale of several of the insets. In all but the recent United States charts, it is considered that this error is small compared to the probable error in the charts themselves.

Changes in atoll population densities

Population figures for the various Pacific atolls are improving in reliability and completeness but also suffer from many deficiencies and uncertainties. The U. S. Navy handbook (1948, p. 52) pointed these out in the following comment:

It must be understood, however, that population changes for any given island are affected not only by vital trends, but also by the extensive inter-island migrations and displacements of modern times. The earlier statistics, too, are often of even more dubious accuracy than those of the Japanese and American periods. Those made before 1900 are usually counts or estimates made by voyagers, missionaries, or early scientific visitors, while the later ones are official censuses or estimates. A number of small islands have been devastated by storms, and their populations moved partly or wholly elsewhere; this explains some of the extreme shifts.

According to the 1958 report, "The first thorough census of the Trust Territory using uniform census schedules and trained census teams was conducted in the year under review . . . Much of the statistical data come from municipal officials. The data furnished by local authorities are checked against previous reports, but there are sources of error which cannot be controlled."

TABLE 30
Total Populations of Atolls Groups in Various Periods

	1935	1945	1948	1958
Marshall atolls	10,383	9,593	10,553	13,728
Caroline atolls	9,954		9,496	8,157
Ellice atolls	3,994 (1931)		4,487 (1947)	
Tokelau atolls	1,102 (1931)		1,416 (1947)	1,571 (1958)
Phoenix atolls	31 (1931)		984 (1947)	(Migrants from Gilberts)
Gilbert atolls	26,416 (1931)		27,824 (1947)	28,675 (1958)
Tuamotu atolls	4,668 (1936)	6,143 (1946)	6,733 (1951)	7,615 (1958)

The following discussion is limited to population changes in the major atoll groups for which statistics were obtained (Table 30). On the basis of the data, it is seen that the total population in each of the Marshall, Ellice, Gilbert, Tokelau, and Tuamotu atoll groups have increased between 1930 and 1958, whereas that in the Caroline atolls has shown a steady decline. The decline in the Carolines appears to be a continuing one from the 19th century, although it doesn't apply to all parts of the archipelago. This decline is the result of many factors, among them epidemics, poor sanitation, and poor nutrition (especially the lack of vitamin E, which led to low fertility as well as to low survival rates) (Burrows and Spiro, 1953, pp. 4-6). Other influences leading to the declines on the atolls are natural calamities, shifting about of groups of people by the Germans and Japanese, and migration to and resettlement on the high volcanic islands, such as Ponape, Mak, and the Palaus. The net results in terms of effect upon the atoll ecology of most atolls has been a reduction in the population pressure upon the atoll resources. Only the populations of Nama, Ifalik, Pulusuk, Mokil, Ngatik, Kuoro, and Kapingamarangi show an increase in 1958 over the 1935 figures and thus an increasing pressure upon the atoll food plants and animals.

Though estimates of the population in the Marshalls before the German occupation of the islands were between 15,000 and 16,000, but these may have been far from reliable. At the time of the German occupation, the population had fallen to between 12,000 and 13,000. The official German figure for 1909 was 9,567 and in 1913, 9,546 (Yanaihara, 1939). By 1939 it was clearly clear that the decline in population in the Marshalls had come to an end. In 1958 the only reef islands and atolls in the Marshalls not showing a larger population than in 1935 were Lib, Jaluit, Aur, Wotje, Mili, and two atolls involved in the nuclear bomb tests, Bikini and Eniwetok. In the latter two the population has been removed permanently or for an indefinite period. The total increase in the Marshalls population over that of 1935 was over 32 per cent, or an average of about 1.4 per cent per

yearly figures for the population of the Gilberts may have been exaggerated, but Gulick (1862, p. 410) cited Captain Randall's estimate of over 30,000 people for the different atolls here. Twenty years later Finsch (1882) estimated the group to have some 37,000 people. If these estimates are reliable, the Gilberts, with only 28,675 people in 1958, had a much-decreased population pressure, although the concentration in villages localized the pressure on the land and marine resources much more than in the pre-European times. The 1931 census showed that the population of seven northern Gilbert atolls had changed little in three decades but that the

northern(?) ones and the Ellice atolls had increased substantially (Maude, 1952). The 1947 census gave an average annual increase of 8.28 per thousand, or 0.8 per cent per year, for the Micronesians and Polynesians in the two groups over the 16 years since the 1931 census (Turbutt, 1949, p. 37). The much smaller Micronesian rate of only 5 per thousand per year, or only one-third with the Polynesian rate of 15.5 per thousand per year, is related to the greater population density and demand on food in the Micronesian Gilberts. In the more-isolated Tokelau atolls, the increase between 1931 and 1951 amounted to 2.8 per cent per year. Because of drought conditions in the Gilberts, the British in 1938-1939 encouraged the resettlement of over 1,000 Gilbertese on Sydney, Hull, and Gardner Atolls in the Phoenix group to relieve the pressure on food resources (Laxton, 1951). This would seem to belie the large estimates for the early populations.

According to available statistics (Danielsson, 1955, p. 113), the Tuamotu population dropped from 6,588 in 1863 to a low of 4,294 in 1902. The earlier figure was not surpassed until 1951. In 1958 the population of this group had reached 7,615, or over 1,000 more than that of the 1863 figure, according to a letter to the writer from the Secretary General of French Polynesia (November 6, 1959). The atoll totals probably would have been a good deal larger were it not for emigration of atoll dwellers to Tahiti and especially to the capital, Papeete. Thus the atoll population figures do not show the real natural increase in the Tuamotu group, which actually is larger than the figure showing the resident population.

Conclusion

In general, the conclusion is inescapable that with the improved medical supplies, education, and sanitation in recent decades, the population pressure upon the atoll food resources gradually is increasing—in some atolls at rapid rates. Man's effects upon atoll land and marine ecology will further increase as rising population numbers compel an intensified effort to extract more food from the land, the reef, and the waters around them. Conservation practices to prevent destructive exploitation and to preserve a maximum sustained yield becomes all the more essential and must command the vigilant attention of local and higher authorities alike.

PERCENTAGE FREQUENCY OF WINDS OF EACH BEAUFORT FORCE IN THE TROPICAL NORTH PACIFIC

Beaufort force	2	3	4	5	6	7	8	9
JOHNSTON ISLAND								
January	5	17	35	23	14	2	0	0
February	5	15	38	29	11	1	0	0
March	2	11	31	36	17	1	0	0
April	1	11	37	36	13	1	0	0
May	2	8	43	37	9	0	0	0
June	1	6	48	39	6	0	0	0
July	1	8	47	38	5	0	0	0
August		6	53	35	5	0	0	0
September	2	13	51	28	5	0	0	0
October	3	11	41	34	10	0	0	0
November	2	8	36	38	13	1	0	0
December	2	13	32	31	17	3	0	0
WAKE ISLAND								
January	9	18	25	20	14	7	2	0
February	12	17	26	19	12	6	1	0
March	9	26	38	18	4	1	0	0
April	8	29	38	18	4	1	0	0
May	14	27	33	16	4	0	0	0
June	15	38	34	6	1	0	0	0
July	12	36	38	9	1	0	0	0
August	10	36	39	10	1	0	0	0
September	14	30	37	0	0	0	0	0
October	9	29	37	16	4	1	0	0
November	9	24	41	17	4	0	0	0
December	9	26	38	16	5	1	0	0

ATOLL ENVIRONMENT AND ECOLOGY

BY HEROLD J. WIENS

NEW HAVEN AND LONDON, YALE UNIVERSITY PRESS, 1962

A. WIENS
1962

20 JUNE 1974

DEAR MR. BALAZS,

RECENTLY, DUE TO OPERATIONAL REQUIREMENTS, I HAVE HAD THE OPPORTUNITY TO TRAVEL AND TO PAY EXTENDED VISITS TO SDR 2 & 3, LOCATED ON ENDENBERRY AND HULL ISLANDS RESPECTIVELY. WHILE AT BOTH OF THESE PLACES I WAS ABLE TO WALK COMPLETELY AROUND THE SEAWARD SIDE OF BOTH ISLANDS. THOUGHT YOU MIGHT BE INTERESTED ON THE LOCATION AND AMOUNT OF TURTLE ACTIVITY I NOTED DURING THESE WALKS.

SOUTH ON ENDENBERRY (SEE MAP) THE NESTING AREAS SEEM TO BE LOCATED EAST OF THE RADAR SITE, BETWEEN THE RADAR AND THE OLD LIGHTHOUSE. I SAW ONLY 2 NEW NESTS (THE TURTLES HAD OBVIOUSLY LAID THE NIGHT BEFORE AS THE TRACKS WERE VERY FRESH), BUT AROUND 50 TO 100 OLD ONES. THE BEACH IS SANDY AND LOCATED TO THE LEEWARD SIDE OF THE ISLAND. TO ME, THIS IS STRANGE AS THE WINDWARD SIDE (LOCATED BY THE SHIPWRECKS) HAS VERY FINE SAND BUT NO EVIDENCE OF TURTLE NESTING. THIS IS UNLIKE CANTON OR HULL, WHERE THE MAJORITY OF NESTS ARE LOCATED ON THE WINDWARD SIDE.

I SAW MUCH EVIDENCE OF NESTING ON HULL ISLAND, MORE IN FACT, THEN I'VE SEEN ON EITHER ENDENBERRY OR CANTON. THE ISLAND ITSELF IS ABOUT 2/3 RDS AS LARGE AS CANTON (TOOK ABOUT TWO DAYS TO WALK AROUND IT) BUT THE BEACH AREA IS ABOUT THE SAME. OF THE TWO BEACH AREAS IN WHICH NESTING WAS SIGHTED, BY FAR THE MOST ACTIVITY WAS NOTED ON THE NORTH EAST SIDE (SEE MAP). AROUND 30 FRESH SETS OF TRACKS WERE NOTED IN THIS AREA. ONE OF THE CHIEF CHARACTERISTICS OF THIS BEACH IS THE LARGE AMOUNT OF BRUSH GROWING NEAR THE BEACH. BECAUSE OF THIS THE TURTLES DIG THEIR NESTS IN THE SHRUBBERY AND ARE HIDDEN FROM SIGHT FROM THE BEACH. NO ATTEMPT WAS MADE TO LOCATE OLD NESTS AS THIS AREA ALSO HAPPENS TO BE A GRAY BACKED TERN NESTING AREA AND WE DIDN'T WANT TO DISTURB THEM. FROM ALL THE FRESH TURTLE TRACKS WE SAW, THERE MUST BE AT LEAST 5 TO 10 TIMES AS MANY OLD ONES. THIS, AT LEAST, SEEMS TO BE THE PERCENTAGE ON CANTON AND ENDENBERRY.

THE SOUTHERN BEACH AREA HAD FEW NESTS, WE SAW ONE FRESH ONE AND FOUR OLD ONES. AGAIN, THERE MIGHT BE MORE, BUT TERNS NEST HERE ALSO AND FOR THE SAME REASONS AS ABOVE WE DIDN'T EXPLORE. THE REST OF THE ISLAND IS COMPOSED OF REEF AND CHANNELS AND LITTLE, IF ANY, TURTLE ACTIVITY WAS NOTED.

I DON'T KNOW WHETHER YOU ARE AWARE OF IT, BUT ON HULL THERE ARE TWO DOGS. THESE WERE LEFT OVER FROM THE OLD COPRA PLANTATION THAT WAS ACTIVE UNTIL AROUND 6 YEARS AGO. THESE DOGS ARE NEVER SEEN BY SITE PERSONNEL, THEY ARE TOO WILD, BUT THEIR TRACKS ARE SEEN REGULARLY. ALL ATTEMPTS TO CATCH THEM HAVE COME TO NO AVAIL.

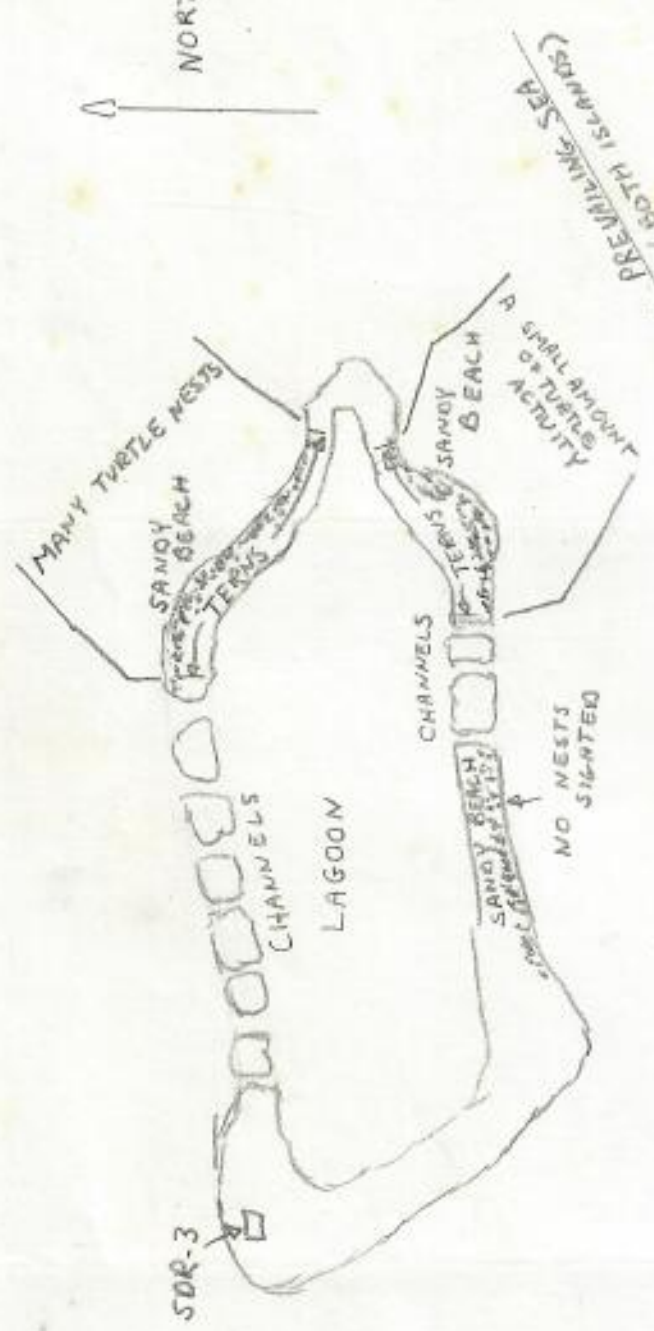
SORRY ABOUT THE MAPS. YOU CAN SEE WHY I'M AN ELECTRONICS TECHNICIAN INSTEAD OF A DRAFTSMAN (OR TYPIST FOR THAT MATTER).

HOPE THIS IS OF SOME HELP,

John L. Keys

P.S. BY THE WAY, THE READING MATERIAL YOU'RE SENT IS VERY INTERESTING AND APPRECIATED. I FIND MYSELF GETTING MORE & MORE INTRIGUED WITH TURTLES. HAD NO IDEA SO LITTLE IS KNOWN ABOUT THEM. I USED TO HANG AROUND SCRIPPS INSTITUTE OF OCEANOGRAPHY AT SAN DIEGO (MY MOTHER WAS HEAD RESEARCH LIBRARIAN FOR TEN YEARS) ^{THERE} AND I NEVER NOTICED ANY TURTLE ACTIVITY, AND/OR RESEARCH GOING ON.

NORTH

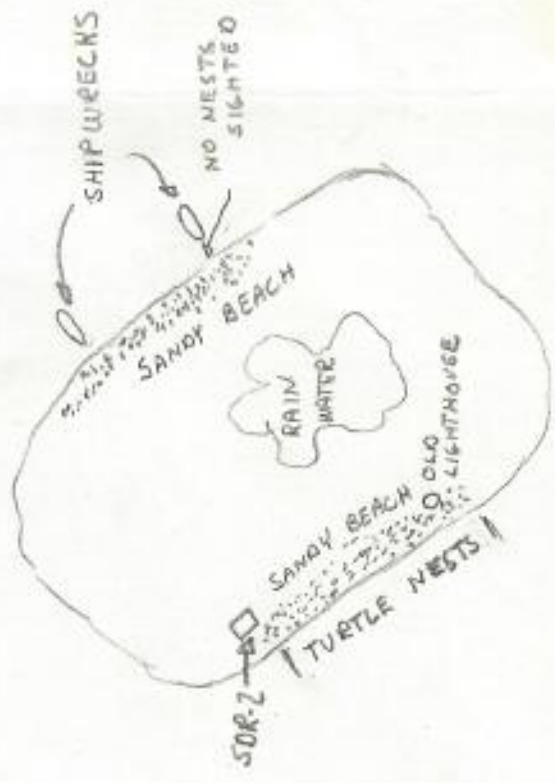


PREVAILING WIND (BOTH ISLANDS)

HULL ISLAND

PREVAILING WIND (BOTH ISLANDS)

NOT TO SCALE AND VERY BADLY DRAWN



ENDENBERRY ISLAND





*Dear Hawk - For your reference per
discussion with
Phil 3/13
Bob Lusk*

SUBJECT: ENVIRONMENTAL BASE LINE SURVEY

DATE: 6 March 1973

TO: MEMO FOR RECORD

MEMO NO.: KH-4-B-159/73

On Tuesday, March 6, 1973, a conference was held at SAMTEC for the purpose of defining the objectives of an Environmental Health Laboratory Base Line Survey of islands utilized by SAMTEC in the Phoenix group. The following personnel attended this discussion:

LtCol. A. Elliott, Environmental Health Laboratory
Capt. D. Davis, SAMSO
Capt. (Dr.) B. Clegren, Environmental Health Laboratory
LtCol. Wendt, SAMSO
LtCol. Lannin, SAMTEC Plans
Capt. J. Cady, SAMTEC Procurement
Mr. G. Ninnenman, SAMTEC Civil Engineering
Mr. E. Ewen, SAMTEC Logistics
Mr. J. Jauncey, SAMTEC ACO
Mr. D. Tharp, Kentron

The requirement for this conference resulted from a letter written to SAMSO from SAMTEC Logistics requesting that this survey be conducted. This survey has been endorsed by General Lowe. The purpose of the meeting was to discuss the recommendations of personnel from the Environmental Health Laboratory. LtCol. Elliott is primarily concerned with the water aspects of ecology (not including marine life), and Capt. Clegren is concerned about the wildlife and the marine biology aspects of the survey.

LtCol. Elliott stated that he would be looking into the design of the sewage treatment plant, the location of the salt water inlet, the currents surrounding the Phoenix Islands, and the oil spill contingency plant. His team will consist of one engineer, one chemist, and one technician. They will require a small boat to collect samples and to be utilized as a platform for current studies. Capt. Clegren proposed three methods for completing the Base Line Survey.

1. Between the years of 1961 and 1969, the Air Force funded and spent approximately \$2 million dollars on ecological studies for potential chemical and biological warfare testing. This project was dropped rather suddenly in the late 1960's prior to collecting and finalizing the data that was collected. He has recommended that the Air Force contact Mr. Clapp at the Smithsonian Institute or Dr. Humphreys of the University of Kansas for the collection and finalization of the data that is presently available. He anticipates a minimum expenditure of funds for the purpose of gathering all existing data.

6 March 1973

Page 2

2. Capt. Clegren recommended the establishment of a marine biological station on Canton similar to the station presently on Eniwetok. This station would be established in cooperation with the Institute of Marine Biology at the University of Hawaii. The establishment of this station would satisfy the requirements of the base line study and could be utilized to coordinate all scientific groups that have an interest in the Phoenix Islands and could provide a regular and periodic data gathering source.
3. He also recommends a two week survey to Canton Island for the purpose of conducting a partial survey of plant and wildlife. This study would not include the protection effects on marine life. This team would investigate the following specific questions that have been raised:
 - a. Is there presently adequate protection for the ecology of the Phoenix Islands?
 - b. Does inter-island transportation have any effect on the bird population?
 - c. Has the fly, rodent, and termite population increased to a point where it has upset the ecological environment of the Phoenix Islands?
 - d. What is the long-term effect on the growth of the coral?
 - e. What is the quality of the lagoon water?
 - f. Is the present method of trash disposal satisfactory?
 - g. What is the effect of domestic animals on the wildlife?

He also proposes to provide specific instruction on the control of pests and rodents.

The following specific action items resulted from this conference. LtCol. Elliott and his staff will contact Mr. Clapp and Mr. Humphreys to determine the costs involved in gathering all existing information into one final report. LtCol. Wendt will forward SAMTEC letters through proper channels to officially task the Environmental Health Laboratory to conduct an Environmental Base Line Survey of the Phoenix Islands. This study will take place the first two weeks in July and will consist of five officers and two enlisted personnel. No action will be taken at this time to develop a marine biology station due to the potential costs involved. Additional information on the proposed survey will be available in April or May. At this time, firm support requirements will be established and forwarded to Kentron via the ACO.


D. B. Tharp
Program Manager

cc M. W. Elliott ✓
D. O. Webb
L. C. Butler

TIDE TABLE - CANTON ISLAND - SAMTEC OL/AE

FEBRUARY 1973

(04)	(05)	(06)	(07)	(08)	(09)	(10)
0047 0.6	0123 0.6	0204 0.7	0249 0.8	0342 1.0	0448 1.1	0017 2.9
0723 3.4	0805 3.4	0846 3.4	0937 3.4	1036 3.3	1141 3.3	0607 1.1
1257 0.7	1338 0.8	1423 0.9	1521 1.0	1632 1.1	1753 1.1	1257 3.4
1937 3.7	2020 3.5	2107 3.4	2202 3.2	2304 3.0	----	1911 1.0
(11)	(12)	(13)	(14)	(15)	(16)	(17)
0137 2.9	0247 3.1	0346 3.3	0441 3.4	0527 3.6	0612 3.7	0019 0.3
0721 1.0	0825 0.9	0922 0.7	1015 0.5	1100 0.4	1149 0.4	0654 3.7
1407 3.5	1511 3.7	1606 3.9	1657 4.0	1744 4.0	1827 4.0	1232 0.5
2019 0.8	2116 0.6	2208 0.4	2253 0.3	2336 0.2	----	1910 3.8
(18)	(19)	(20)	(21)	(22)	(23)	(24)
0057 0.4	0141 0.6	0220 0.8	0305 1.1	0356 1.3	0455 1.4	0007 2.5
0735 3.6	0814 3.5	0859 3.4	0944 3.2	1036 3.0	1135 2.9	0601 1.5
1316 0.6	1401 0.8	1452 1.0	1544 1.2	1647 1.4	1800 1.4	1241 2.9
1952 3.6	2034 3.4	2115 3.1	2203 2.9	2259 2.7	----	1907 1.4
(25)	(26)	(27)	(28)			
0118 2.5	0226 2.6	0311 2.8	0352 2.9			
0711 1.5	0802 1.4	0851 1.3	0929 1.1			
1344 3.0	1438 3.1	1521 3.2	1602 3.4			
2003 1.3	2048 1.1	2129 1.0	2202 0.8			

Paul Butler

Paul C. Butler, Site Manager
 Kentron Hawaii, Ltd.
 Base Support Services

ON HER MAJESTY'S SERVICE.

SF. 121/1/4



Mr. George H. Balass,
Hawaii Institute of Marine Biology,
University of Hawaii,
Coconut Island,
P.O. Box 1346,
Kaneohe,
Hawaii 96744.

ON HER MAJESTY'S SERVICE.

SP. 121/1/4

Mr. George H. Balazs,
Hawaii Institute of Marine Biology,
University of Hawaii,
Coconut Island,
P.O. Box 1346,
Kaneohe,
Hawaii 96744.



CENTRAL GOVERNMENT OFFICES,
~~OFFICE OF THE RESIDENT COMMISSIONER,~~
GILBERT AND ELLICE ISLANDS COLONY,
Tarawa, Gilbert Islands,
Western Pacific

SF. 121/1/4

14 March 1973

(In reply please quote)

SF 121/1/4

Dear Sir,

Please refer to your letter of 22nd February.

2. The Phoenix Islands are administered by the Governor of the Gilbert and Ellice Islands Colony whose headquarters are here on Tarawa. In the case of Canton and Enderbury Islands, there is an Agreement of 6th April 1939 which placed them under joint UK/US control for a period of 50 years.
3. The US Government in agreement with the UK Government has set up a missile monitoring facility on Canton Island. The project also involves the use of Enderbury, Hull and Birnie Islands and provides for Gardner and Sydney Islands to be used if need be.
4. Apart from the possible establishment of a commercial fishing operation, the Colony Government has no immediate plans for the Phoenix Islands which, apart from US personnel, are uninhabited.
5. Birnie, Canton, Enderbury and Hull Islands were declared to be prohibited areas in 1972 under the Prohibited Areas Ordinance 1957. This makes it an offence to enter or attempt to enter any of these islands, or their territorial waters, without the Governor's written authority. This could not be given without the agreement of the US authorities on Canton Island.
6. I hope that this will give you sufficient information for your purposes.

Yours faithfully,



(A.J. HUNTER)
Chief Secretary.

Mr. George H. Balass,
Hawaii Institute of Marine Biology,
University of Hawaii,
Coconut Island,
P.O. Box 1346,
Kaneohe,
Hawaii 96744.

Will Be Part of Kiribati

Americans Are Leaving

By Stu Glauberman
Star-Bulletin Writer

A representative of the American government whose job is to raise and lower the American flag on Canton Island will be leaving his post soon.

It is not known how long the man will remain there but his departure will bring an end to the American presence on the island.

The caretaker's boss is the governor of American Samoa, Peter T. Coleman, who is civil administrator of Canton Island in behalf of the U.S. Department of the Interior.

Coleman said yesterday his man will remain on Canton until the U.S. Senate ratifies its treaty of friendship with the new nation of Kiribati, formerly known as the Gilbert Islands.

At that time, Canton, once under joint British-American administration, will become part of Kiribati, which became independent in July.

Canton Island is a circular sandbank of coral 1,600 miles southwest of Honolulu. The airstrip there, once vital to trans-Pacific aviation, was used by the Navy in World War II

and later converted for use by the Air Force. A missile tracking station there has been abandoned.

APART FROM the flag raiser and a group of Gilbertese who represent the government of Kiribati, the island is uninhabited.

Coleman says the cession of Canton and other islands in the Phoenix and Line groups—700 miles north of Pago Pago—will be a boon to the economy of American Samoa.

An optimist with respect to the region, Coleman disagrees with critics who claim that by abandoning Canton Island, America is allowing the Soviet Union another foothold in the Pacific and threatening the future of the tuna industry centered in Pago Pago.

One such critic is Mark J. Seidenberg, a Los Angeles travel agent, who opposes the government's plans to give away Canton and a number of other islands.

Seidenberg, who is in Honolulu seeking permission from Coleman to visit the Phoenix group, has raised objections to the treaty with Kiribati in letters to congressmen, diplomats and military officials.

Fascinated by the sketchy histo-

ries of these tiny coral reefs, Seidenberg also opposes a similar friendship treaty which cedes other islands to Tuvalu, Kiribati's neighbor.

The California businessman regards the two treaties as a Central Pacific encore to America's relinquishing of the Panama Canal.

He is concerned about three consequences he feels will almost certainly follow the lowering of the American flag at Canton:

—Americans will lose sovereignty over hundreds of thousands of square miles of rich fishing waters.

—Americans will lose the historical, cultural and archaeological treasures which attach to its century-long involvement in the islands. He has a special interest in the preservation of prehistoric Polynesian sites in the Tuvalu.

—America's loss will be the Soviet Union's gain. Seidenberg characterizes Kiribati and Tuvalu as two left-leaning emerging nations which may choose to aid the Soviets gain naval and economic clout in the region.

"AS FAR AS I can see, it's a case of they (Kiribati and Tuvalu) get everything and we get nothing ex-

Canton Island

cept a little good will," Seidenberg said. "I don't see why we're giving away valuable U.S. property."

The treaty with Kiribati, signed in September and still in Senate committee, relinquishes American claims to several of the Line and Phoenix Islands including Canton, Christmas and Enderbury.

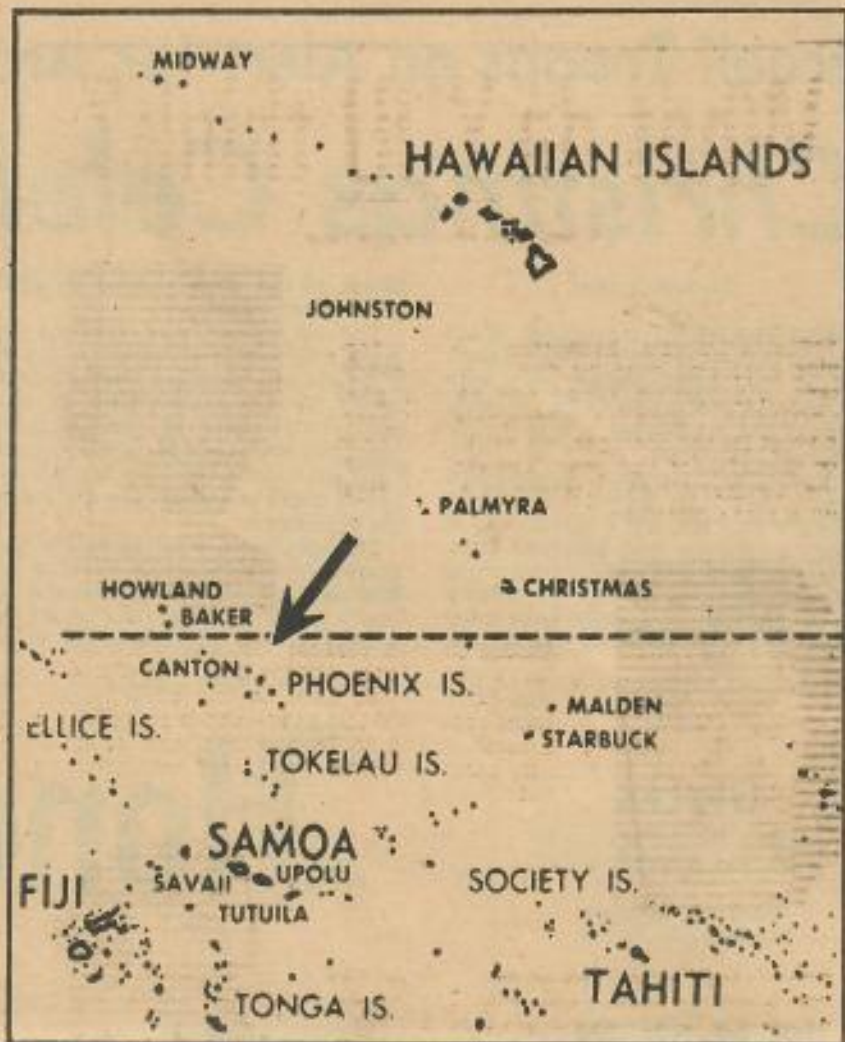
The Tuvalu treaty, signed in February and now pending Senate action, gives up America's claim to Funafuti, Nukufetau, Nukunono and Nukunono.

Coleman said the treaty contains adequate safeguards against agreement with foreign powers.

He said he plans to meet next year with Kiribati leaders to establish stronger ties.

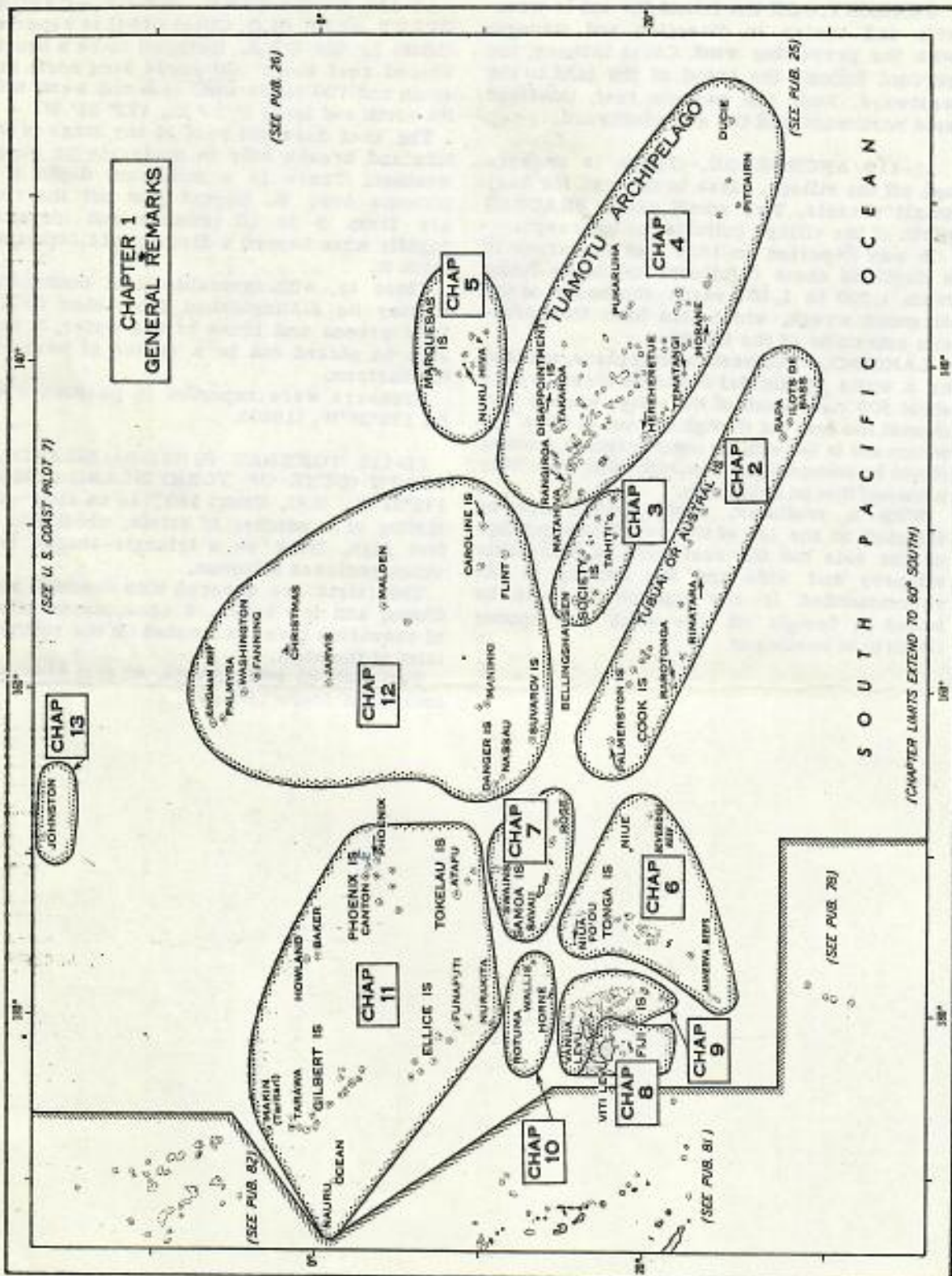
"I think the important thing will be a strong friendship with the new government of Kiribati. Together we will be looking into the feasibility of what kind of development can take place."

Coleman said he hopes talks with Ieremia Tabai, president of Kiribati, will bring cooperation in fisheries development and increased opportunity for Pago Pago to transship goods to and from Kiribati.



Enderbury
Sidney
Hull

CHAPTER LIMITS



CHAPTER LIMITS—PUB. NO. 80

CHANGE VII
8

H. O. 80

CURRENT.—Off the island the set is westerly and varies in direction and strength with the prevailing wind. Close inshore, the current follows the trend of the land to the westward. Near the western reef, the flood sets northward and the ebb southward.

11-113 ANCHORAGE.—There is anchorage off the village, close to the reef, for very small vessels. Two small range BEACONS north of the village indicate the approach.

It was reported in 1938 that anchorage in a depth of about 9 fathoms might be found from 1,000 to 1,400 yards southward of the stranded wreck, which lies near the northern extremity of the island.

LANDING.—The best landing place, marked by a white pyramidal concrete structure, is about 500 yards south of the village where a boat channel has been cut through the reef in a 054° direction and in line with the concrete beacon. Landing should be attempted just after high water when there is less surf than on a rising tide.

With a southeast wind, landing can be effected in the lee of the wreck at any stage of the tide but the reef here is extremely slippery and wide and the landing is not recommended if any equipment is to be landed or brought off. The wreck was reported (1966) to be breaking up.

11-114 OUTLYING REEF.—CARON-DELET REEF (H.O. Chart 0124) is reported (1939) by the U.S.S. Bushnell to be a heart-shaped reef about 800 yards long north and south and 700 yards wide east and west, with its north end lying 5° 34' S., 173° 51' W.

The reef does not bare at any stage of the tide and breaks only in moderate or rough weather. There is a minimum depth of 2 fathoms over it. Depths just off the reef are from 5 to 10 fathoms and increase rapidly when beyond a distance of 1,000 yards from it.

Close to, with favorable light conditions, it may be distinguished from aloft by the light greens and blues of the water. It may also be picked out by a series of waves on the horizon.

Breakers were reported in position 8° 47' S., 176° 26' W. (1966).

11-115 TOKELAU (UNION) ISLANDS.—ATAFU (DUKE OF YORK) ISLAND (8° 32' S., 172° 31' W., H.O. Chart 1993) is an atoll consisting of a number of islets, about 8 to 10 feet high, lying on a triangle-shaped reef which encloses a lagoon.

The islets are covered with coconut, pandanus, and low trees. A conspicuous clump of casuarina trees is located on the southern islet of the atoll.

Two wooden radio masts, 40 feet high, are located at Atafu Village.

Chart 781.

southerly direction and one cable wide, was reported, in 1915, to be in lat. $17^{\circ} 16' N.$ and long. $177^{\circ} 16' E.$ It was unsuccessfully searched for in 1924.

5 Chart 2867, plan of Wake island.

Wake island.—Light.—Wake island, discovered in 1706, lies 304 miles north-north-westward of Taongi, the northernmost of the Marshall islands. It consists of three islets, Wake, Wilkes and Peale, which attain an elevation of 21 feet (6m4), and with the reef on the north-western side enclose a lagoon, with depths of from one to $1\frac{1}{2}$ fathoms (1m8 to 2m7) in its north-western part. There is foul ground in the passages between the islets.

Wake island is a possession of the United States. The waters within a 3-mile limit constitute a prohibited area, known as a "naval defensive 16 area".

No vessel or aircraft, except those authorised by the Secretary of the United States Navy, shall be navigated in or above this area.

A light, for the use of aircraft, is occasionally exhibited, at an elevation of 100 feet (30m5), on Peale islet.

20 A signal tower on a framework structure is situated close to the south-eastern extremity of Wilkes islet.

The higher parts of the island are covered with trees and scrub; the coast consists of sandy beaches interspersed with coral rocks. The only break in the fringing reef is at the boat landing at the south-eastern end of Wilkes islet, where the beach is steep-to and consists of loose coral rocks; in its approach there are large coral rocks, which dry, and on which the sea breaks heavily at times, but there is less surf during the out-going tidal stream than during the in-going stream. There is no entrance into the lagoon, even for boats.

30 A south-south-westerly current, with a rate of from half a knot to nearly one knot, has been observed in the vicinity of the island.

The waters in the vicinity abound with fish, and sharks are numerous.

Chart 1830.

PHOENIX ISLANDS.—This group, composed of eight scattered islands, lies with Gardner island, the south-westernmost of the group, about 440 miles north-eastward of Funafuti of the Ellice group. They are all low coral islands fringed by reefs, which, in most cases, are steep-to. There is not much vegetation on any of them, except on Hull and Sydney islands, so that at night it is dangerous to navigate in their vicinity. There is a European Administrator who resides on Hull island.

In 1940, there were 625 inhabitants.

Current.—The current in the vicinity of this group sets almost constantly westward, at the rate of from one to $1\frac{1}{2}$ knots.

45 Chart 184, plan of Gardner island.

Gardner island.—Gardner island (Lat. $4^{\circ} 40' S.$, Long. $174^{\circ} 31' W.$), about 80 feet (24m4) high to the tops of the trees, encloses a lagoon, in which there is no navigable passage. It is fringed by a reef extending about 2 cables offshore, and steep-to, except at N.W. point and S.E. point, where it appears to be extending. The island was being cleared in 1938, and coconuts planted. In 1940, there were 58 inhabitants.

A British protectorate was proclaimed over the island in 1892.

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Chart 184, plan of Gardner island.

When approaching from westward, the land on each side of the north-western opening into the lagoon is first seen, appearing as two hummocks.

The stranded wreck of a steamer, on the north-western side of the reef, was very conspicuous in 1937.

There is a settlement at Keresoma, on the western side of the island, off which temporary anchorage may be obtained by small vessels on a ledge of sand and coral, which shelves steeply. The passages into the lagoon on the western and southern sides of the island are accessible to canoes, but local knowledge is necessary.

The lagoon is encumbered with coral heads, except in the middle, where there are narrow strips of coral.

Fish and turtle are plentiful.

A landing was made from H.M.S. *Leith*, in 1937, over the reef, in a small bay, between Reef and South-west points, on the western side of the island. Landing may also be effected under the lee of the stranded wreck, but it entails crossing a reef by foot, which is dangerous.

It was reported, in 1938, that anchorage, in a depth of about 9 fathoms (16m5), might be found from 5 to 7 cables southward of the 20 stranded wreck. (Lat. $4^{\circ} 39' S.$, Long. $174^{\circ} 33' W.$)

Current.—Off the island there is a westerly set, which varies in direction and strength with the prevailing wind.

Carondelet reef.—The master of the ship *Carondelet* reported that, when about 60 miles south-eastward of Gardner island, his vessel 25 passed about 2 miles from a dangerous reef, upon which the sea occasionally broke heavily.

It was sighted by the R.M.S. *Aorangi*, 12th May, 1903, and found to be in lat. $5^{\circ} 33' S.$, long. $173^{\circ} 50' W.$

In 1937, H.M.S. *Waldington* confirmed the position of the reef, and 30 reported its extent as slightly over half a mile in a northerly and southerly direction, the horse-shoe shape being concave westward.

Chart 184, plan of McKean island.

McKean island.—McKean island, about 69 miles north-north-eastward of Gardner island, was discovered and so named by Wilkes, 35 in 1840, and was annexed by Great Britain in 1936. It is of coral and sand, about 15 feet (4m6) high, and covered with bushes. Breakers extend about 2½ cables from the northern end and 2 cables from the southern end of the island. The island is uninhabited.

The island was reported, in 1933, to lie about 8 miles west-north-westward of its charted position.

Chart 184, plan of Hull island.

Hull island.—Hull island, about 137 miles eastward of Gardner island, was discovered and so named by Wilkes in 1840. A British protectorate was proclaimed in 1889.

It was reported, in 1940, that the island is about 7 miles long and 3 miles wide.

In 1938, the island was being worked for copra by the Administrator of the island. In 1940, there were 307 inhabitants, the settlement being situated at the western extremity of the island, where, in ordinary 40 weather, landing can be effected through a passage in the reef, by keeping a copra shed, the only one, on the beach, bearing 071° ; elsewhere it is difficult.

The island, on which there are coconut palms, the tops of which

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Chart 181, plan of Hull Island.

have an elevation of about 20 feet (15m), encloses a lagoon. A reef fringes the island. Turtles are abundant.

The best boat passage into the lagoon is situated about 1½ miles north-eastward of the western extremity of the island, and is the fifth opening from that point. It is marked by two cairns, one on each side of the seaward entrance which is about 20 yards (18m) in width; there are several coral heads, which break, close outside the entrance to the passage, but a boat should be able to avoid them; there is a depth of about one foot (0m3) in the shoaler parts of the passage.

Landing may be effected on the beach opposite the copra shed.

Anchorage.—There is anchorage for small vessels, in easterly winds only, in a depth of about 10 fathoms (18m3) about half a cable off the western extremity of the reef. There is also anchorage for a vessel of moderate draught about 1½ miles north-eastward of the western extremity of the island (*Lat. 4° 30' S., Long. 172° 31' W.*), and about 2½ cables north-westward of the entrance to the above mentioned best boat passage, in a depth of about 15 fathoms (27m4). A heavy weight should be hung over the stern to take on the edge of the reef in the event of the stern swinging towards the shore; an anchor should not be used for this purpose as it is liable to become foul in the coral heads.

A vessel is recommended to approach this anchorage with the cairn on the north-eastern side of the entrance to the boat passage bearing 25 about 155°, and with her anchor veered. She should "come to" as soon as the anchor bites.

A vessel with a draught of more than 20 feet (6m1) is recommended to lie off the western end of the island with the copra shed on the beach bearing about 063°, distant between 3 and 4 cables.

Chart 184, plan of Sydney island.

Sydney island.—Sydney island, about 53 miles eastward of Hull island, is an atoll with no opening in the enclosed lagoon. The reef which surrounds the lagoon is steep-to, except on its western side, where there is anchorage.

The island was proclaimed a British protectorate in 1889. In 1938, the island was being worked for copra under the Administrator. In 1940, there were 260 inhabitants.

The island is 20 feet (6m1) high, the tops of the trees having an elevation of 90 feet (27m4).

Wild duck is found in the lagoon. Turtle may occasionally be obtained. Fish are poisonous.

There is a west-going current, with a rate of from one to 1½ knots. *Chart 184, plan of Sydney island anchorage.*

Anchorage.—Beacons.—Vessels can moor off the western side of the island, in a depth of about 9 fathoms (16m6), about a cable from the reef, sheltered from the prevailing winds; but from November to April, north-westerly winds may be expected. There is nearly always a southerly swell at the anchorage, which causes vessels to roll heavily at times.

A conspicuous beacon, consisting of a post surmounted by a triangle, is situated on the shore above high-water mark at the western end of the island abreast the anchorage.

A white square stone cairn stands about 1½ cables southward of the beacon, and is near the site of the observation spot. A white

Chart 184, plan of Sydney island anchorage.

corrugated iron hut is situated about 1½ cables north-north-eastward of the beacon.

The best landing, found by H.M.S. *Leitch*, in 1937, was about a quarter of a cable southward of the observation spot. Landing is not advisable within one hour of high water as then the beach is very steep and the surf heavier in consequence.

Chart 184, plan of Birnie island.

Birnie island.—Beacon.—Birnie island (*Lat. 3° 35' S., Long. 171° 32' W.*), about 52 miles northward of Sydney island, consists of a coral and sand bank, 6 feet (1m8) high, on which there is a shrubby growth. The island, which is uninhabited, was proclaimed a British protectorate in 1889.

A conical beacon of corrugated iron, 30 feet (9m1) in height, stands on the eastern side of the island.

The island is fringed by a reef which extends about 6 cables from its southern side. There is a brackish lagoon, with a depth of about 6 feet (1m8), in the middle of the island.

Anchorage may be obtained off the western side of the island, in a depth of 9 fathoms (16m5), with the beacon bearing about 040°; a landing can be effected in suitable weather.

Chart 184, plan of Phoenix island.

Phoenix island.—Phoenix island, about 48 miles east-south-eastward of Birnie island, was proclaimed a British protectorate in 1899; it is uninhabited and overrun by rabbits.

The island is about 18 feet (5m5) high; there are no trees nor any distinctive elevation; it would be almost invisible on a dark night, and it is difficult of detection on a cloudy day. The island is fringed by a reef in which, on the western side, there is a break, affording good landing. Landing can also be effected in suitable weather through a small passage in the reef northward of the middle of the eastern side of the island.

Two rocks, which lie on the reef on the western side of the island, are conspicuous.

In the middle of the island there is a shallow brackish lagoon, which probably sometimes dries.

Anchorage may be obtained, in a depth of 11 fathoms (20m1), off the middle of the western side of the island.

A west-going current, with a rate of 2 knots, has been observed setting past the island.

Chart 184, plan of Enderbury island.

Enderbury island.—Beacon.—Enderbury island, a boat 41 miles north-north-westward of Phoenix island, is about 25 feet (7m6) high. The island is jointly administered by the Governments of the United Kingdom and United States of America in accordance with an agreement dated 6th April, 1939.

A white cylindrical stone beacon, 20 feet (6m1) in height, stands near the landing place on the western side of the island.

The island is fringed by a coral reef, which is steep-to, extending from half a cable to 2½ cables offshore. Two small clumps of mangrove, a few coconut palms, and scattered patches of grass are the only vegetation. There is a lagoon in the southern half of the island; quantities of decayed wood have been found on the eastern side of the island.

Chart 184, plan of Enderbury island.

Landing is difficult.

There is a west-going current, with a rate of from one to 2 knots, in the vicinity of the island.

Chart 184, plan of Canton island.

Canton island.—Lights.—Canton island, about 34 miles west-north-westward of Enderbury island, is a coral atoll about 20 feet (6m1) high, enclosing a spacious lagoon. There are coconut palms in places, and inside the high raised beach it is mostly covered with brushwood. Fish and turtle are plentiful.

The island is jointly administered by the Governments of the United Kingdom and United States of America in accordance with an agreement dated 6th April, 1939.

On the western side of the island are several openings; all of them dry, except the southernmost, which will only admit a boat; the lagoon is obstructed by coral patches.

The surf breaks very heavily on the northern extremity; and off the southern extremity, heavy tide-rips extend at least half a mile from the weather side of the island.

Chart 184, plan of Canton island anchorage.

An Administrative officer of the Phoenix group resides here; his house is situated on the shore of the lagoon inside the southernmost opening, and about 1½ cables southward of the observation spot. There is a small pier abreast the house.

A light (Lat. 2° 40' S., Long. 171° 43' W.), the position of which is approximate, is occasionally exhibited, at an elevation of 28 feet (8m5), from a white circular stone tower, 26 feet (7m9) in height, on the southern side of the entrance to the lagoon.

A light, for the use of aircraft, is exhibited, on request only, at an elevation of 51 feet (15m3), from a steel framework tower, situated about 3½ cables south-south-westward of the observation spot. Obstruction lights are exhibited.

A channel, 100 feet (30m5) wide on the bottom, dredged to a depth of 22 feet (6m7) in 1943, marked by a buoy on either side, is situated in the main entrance to the lagoon, and leads in a 037° direction to a turning basin, 1,000 feet (304m8) in diameter, in the lagoon. On the western side of this basin there is a quay, about 1,000 feet (304m8) long, with a depth of 30 feet (9m1) alongside.

The tidal streams attain a rate of 5 knots in this channel.

Anchorage may be obtained, in a depth of 10 fathoms (18m3), close southward of the southernmost opening. An anchor on about 30 fathoms (54m9) of wire, should be hung over the stern, to take on the edge of the ledge in the event of the stern swinging towards the shore. At signs of a westerly wind vessels should leave the anchorage.

A vessel approaching from northward should steer to pass about one mile westward of the north-western extremity of the island, on which there is a conspicuous palm tree; thence she should steer 180° for 3 miles until the wreck of the S.S. *President Taylor* is abeam, when she should steer for it, and anchor, in a depth of from 15 to 20 fathoms (27m4 to 36m6), about 400 feet (121m9) from it. Stern hawsers should be taken to the wreck to prevent her swinging on to the reef off the entrance to the channel.

The tidal streams in the southernmost opening in the lagoon run at a rate of from 6 to 8 knots; the in-going stream commences 2½ hours

Chart 780.

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Chart 184, plan of Canton island anchorage.

before high water and the out-going stream 3½ hours after high water; there is practically no slack water.

There is a west-going current, with a least rate of 1½ knots in the vicinity of the island.

Chart 780.

OUTLYING ISLANDS AND DANGERS.—Winslow reef, about 125 miles north-north-westward of McKean island, was reported in 1851 by Captain Winslow of the *Phoenix*, who says "it extends one mile in a north-west and south-east direction, and is three-quarters of a mile broad, with two pointed rocks awash, lat. 1° 40' S. long. 174° 50' W."

In 1942, Winslow reef was sighted in approximately its charted position and was reported to be light-coloured, about 300 yards (274m3) long and totally submerged.

The British schooner *Doris Crane* in 1926 reported passing about 3 miles northward of a coral reef or sandbank, about one mile long east and west, in lat. 0° 55' S., long. 174° 51' W. The reef, the position of which is doubtful, was clearly visible from the masthead and appeared to be awash, while broken water was visible from the deck. The weather was clear and calm.

In 1935, H.M.S. *Wellington* carried out a search under favourable conditions, but could find no indication of either reef.

A reef was reported, in 1943, to lie about 20 miles south-eastward of Winslow reef.

Chart 979, plan of Baker island.

Baker island.—Light.—Beacons.—Baker island, about 275 miles north-north-westward of McKean island, is nearly flat, but rises to an elevation of 20 feet (6m1) at its south-western extremity, where there is a steep sandy beach, which extends some distance northward; elsewhere the island is fringed by a coral reef.

A light (Lat. 0° 14' N., Long. 176° 28' W.) is occasionally exhibited, at an elevation of 49 feet (14m9), from a white circular stone tower, 26 feet (7m9) in height, on the north-western side of the island.

Two stone beacons stand on the north-western and south-western sides, respectively, of the island; landing can be effected abreast the flagstaff, situated about 1½ cables north-eastward of the south-western beacon.

An extensive shoal, with depths of 4 fathoms (7m3) in places, extends about three-quarters of a mile from the northern and eastern sides of the island. The surf breaks heavily on the eastern side and the south-western extremity of the island.

Except for some scattered patches of grass and low shrubs, the island is devoid of vegetation.

Chart 979, plan of Howland island.

Howland island.—Light.—Beacons.—Howland island, about 38 miles north-north-westward of Baker island, is devoid of vegetation except for a few stunted trees. It is fringed by a coral reef, which, on the western side, extends about a quarter of a cable offshore. On the eastern side, where the island is about 10 feet (3m0) high, the reef is steep-to.

The island is used as a landing ground for aircraft.

Shoals extend about 4 cables from the northern and southern extrem-

Chart 519, Plan of Howland island

ities of the island. A rock, the position of which is doubtful, lies about 2 cables south-westward of the southern extremity of the island.

A light is occasionally exhibited, at an elevation of 37 feet (11m3), from a white circular stone tower, 26 feet (7m9) in height, about midway along the western side of the island.

A stone beacon stands at the northern extremity, and another at the southern extremity of the island.

There is a flagstaff on the western side of the island, westward of 10 which a landing can be effected in small boats.

Chart 765.

TOKELAU ISLANDS.—This group, lying between the Phoenix and Samoa islands, comprise three atolls, namely, Fakaofu, the southernmost, Nukunono, and Atafu, the north-westernmost, with apparently deep channels between them. The islands and islets lying on the reef enclosing the lagoons are all low, but the trees on them can be seen from a considerable distance.

In 1916, the Tokelau islands were annexed to the British Empire and included in the Gilbert and Ellice islands Colony. In 1926, they were transferred to the Government of New Zealand, and are governed by the Administrator of Western Samoa, but there are no European officials.

The only export is copra.

There is occasional steamer communication with the Samoa islands.

Current.—A west-going current with a rate of one knot has been experienced in the vicinity of the Tokelau islands during September.

Chart 765, Plan of Fakaofu.

Fakaofu.—This atoll was declared a British protectorate in 1889. There is no passage into the lagoon. There are numerous islets on the reef, those on the north-eastern side and southern extremity being from 70 to 80 feet (21m3 to 24m4) high to the tops of the coconut palms, and are higher than elsewhere; the land is more continuous on the eastern side. Fonua Loa is the southernmost islet, Fonua Muli the northernmost, and Fonua Fala the westernmost.

The reef close south-eastward of Fonua Fala (*Lat. 9° 23' S., Long. 171° 17' W.*) was reported, in 1942, to have extended seaward.

Landing is dangerous except in canoes abreast Fakaofu village, about one mile south-eastward of Fonua Fala.

Chart 765, Plan of Nukunono.

Nukunono.—This atoll, about 35 miles west-north-westward of Fakaofu, was discovered, in 1791, and declared a British protectorate in 1889.

The south-eastern part of the atoll was, in 1929, reported to be incorrectly charted, and, in 1934, Nukunono island, situated on the south-western side, was reported to lie about 3½ miles eastward of its charted position.

The church, a red-roofed building, on the south-eastern end of Nukunono island, is conspicuous from westward, and on the northern side of the atoll, in 1931, there was a wreck of a schooner, which was 50 conspicuous.

The north-western side is a bare reef awash, on which the sea breaks heavily. There is no anchorage here, and landing is dangerous except

Chart 765, Plan of Nukunono.

for canoes, abreast the village on Nukunono, or about 2 miles northward, according to the direction of the wind.

There is no entrance into the enclosed lagoon.

In 1936 the population numbered 250, governed by a native magistrate and council, all Roman Catholics.

Chart 765, Plan of Atafu.

Atafu.—This atoll, 45 miles north-westward of Nukunono, was discovered in 1765, and declared a British protectorate in 1889.

The islets on this atoll are about 8 or 10 feet (2m4 or 3m0) high, 10 and covered with coconut and pandanus palms.

There is no passage into the lagoon, and the sea breaks heavily on the reef enclosing it, but at high water a boat can sometimes cross it.

The reefs forming the atoll are mostly steep-to. A reef extends about half a mile north-westward from Atafu islet, lying on the north-western extremity of the atoll. There is a village on the southern extremity of this islet. There is a hospital with a native doctor.

Atafu (*Lat. 8° 32' S., Long. 172° 31' W.*) was visited by a hurricane and two tidal waves on January 7th, 1914, which demolished the church and most of the houses.

Good anchorage, with offshore winds, in a depth of 10 fathoms (18m3), can be obtained off the north-western extremity of the atoll about 2 cables from the shore reef.

Landing can be effected at the southern end of the atoll, but it is difficult at any other time than within 2 hours of high water. A good landing may be effected on the eastern side of the atoll during westerly winds.

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PHOENIX ISLANDS

(Chg 4)

May, the prevailing winds are sometimes interrupted by westerly winds and bad weather.

Tides.—During the stay of the U. S. Coast Guard vessel *Itasca* in 1936 the rise and fall of the tide was observed to be 3 to 4 feet.

Landing.—The fringing coral reef surrounding Baker Island makes landing difficult. A relatively good landing spot is located approximately 200 yards southward along the shore from the daybeacon. It is roughly marked by a 15-foot pole set on top of the ridge immediately above the sandy beach.

Anchorage.—There is no sheltered anchorage. Vessels lie off the island and discharge to landing craft.

11-88 OUTLYING DANGERS (H. O. Chart 1993) Reef.—In 1954, a vessel reported sighting a reef about 1 mile long in an east and west direction, in 0°56' S., 174°51' W. The reef was clearly visible and the water in the general area was discolored.

A sandbar was reported in 1945 in 0°46' S., 174°43' W.

Winslow Reef, about 45 miles southward of the above-mentioned reef, was reported (1851) by Captain Winslow of the *Phoenix* to extend about 1 mile in a northwesterly and southeasterly direction and to be about three-fourths of a mile wide, with two rocks awash, in 1°40' S., 174°51' W. In 1922, the steamer *Hauraki* passed over the charted position of Winslow reef and saw no sign of shoal water. In 1928, the steamer *Nassa* passed over the charted position of this shoal and saw no sign of it. The American steamer *Golden Cross* passed over its charted position in 1932 and saw no sign of it.

In 1935 the British naval vessel *Wellington* conducted a search for these two reefs under favorable circumstances and found no trace of either in the charted positions.

In 1937, airplane search for both reefs was conducted from the U. S. S. *Colorado* and no trace of either was found in the charted positions.

Recent observations (1944) by a vessel places Winslow Reef in approximately latitude 1°36'30" S., longitude 174°57'00" W. Soundings taken from a whaleboat in what appeared to be the portion of the least depth indicated a minimum depth of 6 fathoms, pink coral and red sand, over an area about one-half of a mile in diameter. The bottom was clearly visible and showed to be light in color with brown patches of live coral.

The reef is about a mile long in an east-west direction by one-half of a mile wide in a north-south direction with the shallow area toward the west. The northwest and southeast edges of the reef come out into points. The sides of the reef drop off steeply on all sides.

In September 1944, a small patch of light breakers was observed about 3 miles eastward of Winslow Reef.

In 1943 an uncharted reef was reported lying about 30 miles southeastward of Winslow Reef in latitude 1°51' S., longitude 174°30' W.

A merchant vessel reports that during an 8-hour run in the vicinity of Winslow Reef a 7-mile set to the west was encountered.

11-89 PHOENIX ISLANDS (H. O. Chart 0124) is a group comprised of the eight islands of Canton, Enderbury, Phoenix, Birnie, Hull, Sydney, McKean, and Gardner.

The group lies about 500 miles northeastward of the Ellice Islands. The islands are low and of coral formation, surrounded by fringing reefs which in most cases are steep-to.

With the exception of Hull, Sydney, and Gardner, the islands are almost devoid of vegetation, and navigation in their vicinity at night is dangerous due to the difficulty of distinguishing them.

dangerous due to the difficulty of distinguishing them.

These islands lie in an area much frequented by American whalers, beginning with the close of the 18th century, and most of them are American discoveries.

The islands of the Phoenix Group were visited and surveyed in 1840 by Wilkes, who discovered Hull and McKean Islands. The islands were bonded under the United States Guano Act of 1856, and a number of them were occupied for the purpose of working and exporting guano. All of the islands of the group were surveyed by the U. S. S. *Bushnell* in 1939.

Supplies are not available ordinarily.

Winds.—The prevailing winds are easterly. They are most variable from January to May inclusive, which is the period of worst weather. During these months northwesterly winds, accompanied by rain squalls in which the winds may reach a force of 7 to 9, Beaufort scale, are sometimes encountered.

Currents.—The offshore currents generally set westward, their strength and direction varying with the wind. The maximum velocity does not exceed $1\frac{1}{2}$ knots, and the usual velocity is less than 1 knot.

11-90 CANTON ISLAND ($2^{\circ}50' S.$, $171^{\circ}43' W.$, *H. O. Chart 5741*) is the largest and most northerly of the Phoenix Group. It is a coral atoll, triangular in shape, enclosing a large lagoon studded with coral heads, and crossed by numerous barrier reefs. As an atoll, it is unique in that the land rim is unbroken except for two openings on the west side.

It consists of a narrow strip of land varying in width from 100 yards to 700 yards, and in height from sea level to 20 feet. The west or lee side lies in a north and south

direction, and is shortest, about 4 miles in length. The other sides trend southeasterly and meet in a point about 9 miles from the northwestern extremity.

The island is very steep-to. The coral shelf extends only about 200 yards from the shore line, except at the three corners where it extends about 400 yards. Depths outside the reef line drop off from 100 to more than 300 fathoms within a few hundred yards. The surf breaks heavily on the weather side and at the three points and heavy tide rips extend at least 500 yards off the northeastern or weather side.

The island is practically bare of vegetation except for a few scattered palm trees, kou bushes, and bunch grass.

Prominent landmarks include twin water tanks about $\frac{1}{4}$ mile southward of Musick Light, twin water tanks about $2\frac{1}{4}$ miles northward of the light near the northwestern extremity of the island, and a white rectangular concrete building about 2 miles northward of the light.

Canton Island is the port of entry for the Phoenix Island.

Approximately 324 persons reside on the island in connection with American and British functions. The U. S. Civil Aeronautics Administration, U. S. Weather Bureau and commercial airlines operate an airfield, its installations and a hotel and settlement. American government functions also include a post office and a Deputy U. S. Marshal. The hotel and settlement face the lagoon on the southern side of the main entrance; several small piers suitable for use by boats lie along the lagoon side of this area.

Lizards, rats, and several species of birds are found on the island. Fish are plentiful but those caught in the lagoon must be re-

garded with suspicion as some, notably the red snapper and rock cod, may be poisonous. Barracuda, rainbow runners, wahoo, tuna, and ulua are excellent and safe to eat. The lagoon is infested with shark, moray, eel, and ray.

The island was discovered independently by several ships including American whalers, probably before 1820, and was known by a variety of names including *Mary*, *Swallow*, and *Mary Balcourt*.

Commander R. W. Meade of the U. S. S. *Narragansett* surveyed the island and named it after the New Bedford whaleship *Canton*, which was wrecked on the island in 1854.

By agreement made April 6, 1939, Canton Island was placed under the joint administration of the United States and Great Britain for a period of 50 years.

Both American and British Governments maintain radio communications. All vessels entering the harbor should contact local authorities before entering. The American station maintains a continuous service on 500 kc. and 8364 kc. and is prepared to handle traffic as well on 2716 kc. Initial call-up should be on 500 kc. or 8,364 kc. The call letters are "KCCG." The British Government station operates intermittently on low power voice (A3) and CW (A2) on 7000 kc. with call letters "ZIT."

An airfield is located at the northwestern part of Canton Island.

Explosives dumping area.—An explosives dumping area has been established southward of Canton Island, between the parallels of 3°09' S., and 3°28' S., and between the meridians of 171°53' W., and 172°13' W.

Weather.—There are no noticeable seasons throughout the year. Temperatures range

from a night low of 75° to a daytime high of 95°. Annual rainfall varies from 8 inches to 40 inches.

Winds.—The prevailing winds 90 percent of the year are easterlies, ranging from east-northeast to east-southeast, with an average velocity of 12 to 18 knots. The winds rarely blow from the west. Hurricanes are unknown.

Visibility.—The average visibility is from 12 to 30 miles. There are no low clouds, fog, or mist, and haze is infrequent.

11-91 Currents.—The ocean current near the island sets about 255° at about 0.8 of a knot, but is much stronger at the northwest and southeast points of the island. A vessel lying off the western shore may expect to be set off at the average rate.

Tidal currents.—Close to the western shore the flood sets 325°. In the lagoon entrance the current runs 6 to 8 knots at strength of flood and ebb. Time of slack water, particularly low water slack, is of very short duration, frequently not more than 10 minutes. Ebb currents produce a marked rip when mixing with ocean currents up to a mile or more off the entrance channel.

Tides.—The mean high-water interval at Canton is 5 hrs. 00 min. The mean range is 3.3 feet and the spring range is 4 feet. Local weather conditions make both tide and current predications inaccurate, and vessels entering the harbor should contact local authorities for information regarding conditions at time of entering.

11-92 Lights.—Musick Light is shown from a cylindrical stone tower 28 feet above the water on the south side of the lagoon entrance. It is reported that the light is a good orientation point.

An aviation light is shown from a tower, 40 feet high, at the airfield near the northwestern end of Canton Island.

An aeronautical radiobeacon is located about 2 miles southward of the aviation light at the airfield.

Obstruction lights are shown from five radio towers on the southeastern end of the island.

11-93 Entrance channel.—The main entrance, a dredged channel, is entered on the west side of the stoll between Spam Island, the island close northward of Musick Light, and the island next northwestward. The channel had a controlling depth of 25 feet (1957) over a bottom width of 250 feet and has not been dredged recently. Vessels with a draft of 22 feet entered the channel in 1949. This channel leads in a 037° direction to an 1,800-by-1,600-foot turning basin northward of Spam Island, in which there is a least depth of 27 feet. The limits of the basin are marked by buoys. Black conical buoys mark the northern side and red conical buoys mark the southern and eastern sides, but they should not be relied on. Entry in the daytime and at slack water is highly recommended.

Warning.—Vessels drawing more than 23 feet, or more than 420 feet in length, shall not enter Canton Harbor except in emergency.

Channel buoy.—The main channel buoy is Canton Island Channel Entrance Buoy 1, a black can, moored on the northwestern side of the entrance channel about 600 yards west-northwestward of Musick Light.

Range.—The range leading through the entrance channel consists of two triangular daymarks, each painted red. The beacons are situated on white pipes and the rear triangle is inverted.

Tidal currents.—It is reported that tidal

currents within the channel attain a rate of 6 to 8 knots.

Pilotage.—No pilots are available, but upon request persons with local knowledge will board the vessel off the entrance and advise the master.

11-94 Boat channel.—Between Spam Island and the northern end of that part of the main island on which Musick Light stands is a break in the reefs. This channel has charted depths of 11 to about 25 feet between the islands. It is narrow, subject to strong tidal currents, and reportedly silting up. Just inside the entrance are numerous dangerous coral heads. Rowing boats and launches with less than 10 knots of speed should only attempt this channel at slack water.

The right-hand side of the channel must be held in entering and, immediately after traversing the entrance, a sharp turn southward must be made to avoid a large coral field. The channel from that point to the landing place is clear except for scattered coral heads which can be clearly seen. Low-powered or pulling boats should wait for slack water before entering or leaving, or if necessary, proceed with favorable currents. The latter procedure is dangerous, however, because of the strength of the current (6 knots or more), and subsequent loss of control.

A light, marking the channel, is shown from a wooden house on a coral bank.

The lagoon itself is navigable only by boats of shallow draft, and numerous reefs and coral heads exist.

Seaplane landing.—Extensive seaplane runways were dredged and marked during hostilities. These runways are located eastward and northeastward of Boat Channel, and while still marked, they are no longer

lighted and their condition and controlling depth are not maintained.

11-95 Anchorage.—There is fair anchorage on the coral shelf just south of the lagoon entrance for vessels drawing less than 24 feet, in charted depths of 43 to 84 feet, white coral sand, in good holding ground.

Care must be taken to insure dropping the anchor on the shelf as the depth increases abruptly to depths of over 100 feet a short distance seaward.

At this anchorage, the ship will swing from 040° to 160° but will not swing into the beach while the trade winds are blowing. Westerly winds are practically unknown at this island.

A vessel reported on this anchorage as follows:

"Anchorage for light draft vessels on the ledge south of the entrance to the main channel is feasible with the prevailing easterly winds. However, any vessel with considerable drag and a tendency to sail up on its anchor would quickly be in difficulty, for there is insufficient room to swing with the stern to the beach."

According to a report (September 1945) there are three mooring buoys, all old and in a cramped position, in the turning basin. Mooring here is considered unsafe for any vessel over 200 feet in length, and only one vessel of that length can be accommodated, because of lack of swinging room.

Local opinion in 1949, supported by that of masters who have visited the island since the war, is that, effectively, there is no good anchorage for a vessel too large to enter the harbor, and smaller vessels waiting for slack water will be well advised to stand offshore.

Landing may be effected at the sandy beach and small pier opposite the settlement, inside the lagoon.

11-96 General navigational information.—The following information concerning Canton was reported in 1944:

The strong current, strong wind, and small space in which to maneuver a fairly large vessel make entry of this port quite hazardous. A speed of 5 to 8 knots must be

maintained to stem an ebbing tide in the channel, and to navigate the turn at the lagoon end of the channel. A 550-yard turning basin is not to be considered as ample space in which to stop or maneuver a large vessel. The current in this channel runs as high as 8 knots on both flood and ebb, and the periods of slack water are almost negligible. There is no way to determine times of slack water by computation, since the channel is on the lee side of the island, and a strong wind may prolong the period of ebb and shorten the period of flootides. The local method of determining slack water is to watch the large can buoy moored at the lagoon end of the channel on the southeast side.

The channel ranges are plainly discernible. Vessels should plan to enter at high water slack, and leave at low water slack, in order to insure that they will be stemming the current. Vessels should make the dock port side to, and the turn to the left should be started in the channel as the bow passes the above mentioned buoy. Small rudder angles should be used to avoid throwing the stern into the southeast side of the channel and into the buoy.

The importance of keeping to the middle of the channel cannot be overemphasized, because a strong bank suction is experienced if a vessel is off the range.

11-97 Port facilities.—A quay 385 feet long, with two 40-foot spurs and a depth of 27 feet alongside, fronts the western side of the turning basin. Depths are very shallow along the inner ends of the spurs. Northward of the quay there is a boat landing, and on the southern side of the lagoon there are several small boat landings.

Machine shop repairs are very limited. A small barge or launch is available for offshore cargo work on a small scale.

Limited quantities of water and food may be available in case of emergency only. Limited quantity of Diesel oil may be secured in emergency or by prearrangement with Island authorities at least two months in advance.

Medical facilities on the island are very limited. There is no hospital, but in case of emergency patients may be evacuated by commercial air facilities.

Commercial air transportation is available at frequent intervals to Honolulu and to Nadi, Fiji, thence connections are made to points beyond.

11-98 ENDERBURY ISLAND ($3^{\circ}08' S.$, $171^{\circ}05' W.$, *H. O. Chart 5739*) is a coral island, rectangular in shape, about 2.7 miles long and 1 mile wide with the longer axis north and south. It consists of a rim averaging 13 feet in height with a sunken central plain about 4 feet above sea level. In the center of the island is a small, shallow, brackish lagoon.

The island is steep-to with a very short reef which makes landing difficult because of the strong sweep of the undertow on the shelving shore. The shelf extends only about 75 yards and drops off rapidly except at the northeast and southeast corners. A shoal extends north-northeastward from the northeastern extremity of the island about 1,200 yards with depths increasing gradually to 50 fathoms at the outer extremity. At the southeastern extremity, a shoal area extends east-southeastward about 650 yards and it is advisable to give this shoal a berth of at least 100 yards, due to the strong current and heavy surf setting upon it. At all other points, the 100-fathom curve lies within 500

yards of the island. The 500-fathom curve is about 1 mile offshore.

At the southeast corner of the island there is a stranded wreck.

The most conspicuous objects on the island are several palms at the north end, a large guano heap about 20 feet high on the western side, and the buildings of the settlement at the southwest corner. Near the settlement is a large kou bush, about 50 feet in diameter and 15 feet high, fronting the buildings. The major part of the low-lying plain in the center of the island is covered with a flat, green growth giving it the appearance of a grassy meadow. There are a few withered palms in the southern part of the island.

By agreement made April 6, 1939, Enderbury Island was placed under the joint administration of the United States and Great Britain for a period of 50 years.

Lizards, hermit crabs, polynesian rats, and several species of birds are found on the island. Fish are abundant and all common species are edible. The large sea turtle is found on the beaches.

Weather.—The winds vary from northeast to southeast. There are frequent but usually brief rain squalls and they cannot be depended on as the sole water supply.

11-99 Currents.—Immediately west of the island the current sets to the southward with a strength of about 1 knot. In very strong flood tides this set may be reversed. Clear of the island to the north or south,

the average set is about 0.8 knot in a 255° direction.

Beacon.—A white cylindrical tower, 20 feet high, is located on Enderbury Island.

11-100 Anchorage.—During the season of the southeast trades there is opportunity for anchorage on the spit off the northeast point. A vessel of moderate size can anchor there in 25 to 30 fathoms, coral and sand, with the largest palm tree bearing 206°, distant 1,500 yards, about 1,150 yards from the beach. Larger vessels could anchor farther out on the same bearing in a depth of 50 fathoms. The anchorage should be approached slowly from west-northwestward, with constant use of the hand lead, as the spit is very narrow and may be overrun easily.

The observed set of the current at this anchorage is to the north of west which keeps the stern away from the shore.

Anchorage here is not recommended when the northeast trade wind is blowing.

11-101 Landing.—The landing place is on the western side of the island just north of the settlement. Ships may approach the island to within less than 500 yards at this point. Motorboats may approach within 75 yards, which is the limit of the fringing reef. Landing may be effected by a surfboat through a channel in the reef leading in on a range of two beacons erected on the beach about 100 yards southwestward of the 20-foot beacon mentioned above. The front range is a pyramidal block of concrete and the rear range a white triangular daymark; the range is in line 092°. Great care must be used in landing as the reef is short and steep and the boatmen must contend with a strong backwash and set to the southward on the reef. The best landing conditions prevail at high tide and with a strong easterly wind which flattens the swell that usually sets in from the south.

11-102 BIRNIE ISLAND (3°35' S., 171° 31' W., H. O. Chart 5739) is a barren kidney-

shaped island about 1,300 yards long and 600 yards wide, the axis running in a north-northwesterly and south-southeasterly direction.

The island is 12 feet high on the rim, sloping gradually to sea level at a small, shallow, brackish pond about 300 yards long by 50 yards wide, located about 100 yards inland from the eastern side of the island.

A flat, fringing reef, drying at low water, and extending as far as 200 yards offshore, surrounds the island.

A shoal, which breaks in heavy weather, extends 1,300 yards southward from the southern point of the island. Depths on the shoal vary from 3 to 4 fathoms. Depths of 80 fathoms were found 1,200 yards northward of the northwestern extremity. At other points, the 100-fathom curve lies about 500 yards from the island.

A stone beacon, about 16 feet high and 14 feet in diameter at the base, is located at the eastern extremity about midway of the island.

The only vegetation on the island is a wiry grass and some creeping plants.

Sea birds, hermit crabs, and polynesian rats are found on the island. Fish are plentiful and so far as is known, there are no poisonous species.

Currents.—Close in to the western shore, the current sets northward. Farther off, the set is westerly and is usually at a rate of about one-half of a knot, the strength and direction varying with the surface currents set up by the prevailing wind.

Anchorage.—It may be possible to anchor a small vessel off the northwest point, about 500 yards, with easterly winds. The southern spit is considered too dangerous for anchorage as it drops off from a depth of 2 or 3 fathoms in surf to 30 fathoms within 100 yards.

Landing may be effected with caution and by skilled oarsmen at a point about midway of the western side just north of a pipe staff.

11-103 PHOENIX ISLAND ($3^{\circ}43' S.$, $170^{\circ}43' W.$, *H. O. Chart 5739*), named after the American ship that discovered it, is a treeless, triangular coral atoll, the land portion of which is about 1,300 yards long and 800 yards wide. The island is surrounded, except for the middle third of the west or longest side, by a wide platform reef, the whole atoll being about 1,700 yards long and 1,200 yards wide.

The reef bares at low water. Off the reef, the depth increases rapidly. The 100-fathom curve is about 500 yards off in places. Depths of less than 5 fathoms, however, are found within 500 yards off the southeastern and northeastern sides, and shoals which break heavily extend about 700 yards off the northwestern end of the island.

The land rim is about 16 feet high 100 feet inshore from the reef. The first rise is covered with loose coral fragments washed in from the sea. From the rim there is a gradual slope to the dried-up lagoon in the center. This surface is of sand sparsely covered with grass about 2 feet high. The lagoon surface is a thin salt crust over guano, about 6 inches below the level of the outside reef. There are a few puddles of water, inches deep.

The island is uninhabited and there is no anchorage.

Wildlife found at Phoenix Island includes birds, rabbits, hermit crabs, rats, and lizards. Fish are plentiful and so far as is known, nonpoisonous.

Winds.—Winds are always easterly. Usually, they vary from east-northeast to east-southeast with the latter predominating.

Currents.—The current sets strongly past the northern and southern points of the is-

land converging on the west side. Close in to the shore on the west side of the island, the flood sets northward and the ebb sets southward. Offshore, the set is westerly about one-half of a knot, varying in strength and direction with the surface currents set up by the prevailing wind.

11-104 Landing.—The best landing place is on the west side about 500 yards from the northern point of the island at the narrowest part of the reef. Near this landing, on the highest point of the land rim, there is a standard Navy observation spot, a concrete truncated pyramid, 3 feet high.

In effecting landing, care must be taken to time the surf as a boat may be upset or broached by inexperienced boatmen.

11-105 SYDNEY ISLAND ($4^{\circ}27' S.$, $171^{\circ}15' W.$, *H. O. Chart 5738*) is a triangular atoll with the base lying east and west and the apex to the northward, the sides being about 2 miles long.

The island was swept by a tidal wave in 1914.

The land rim of the atoll is about 15 feet high, covered with brush and trees, entirely enclosing a circular, very salty lagoon which has a depth of less than 3 fathoms and is obstructed by numerous islets and shoal patches.

The island is surrounded by a platform reef from 50 to 200 yards wide, some of which is bare at low water. Immediately off the reef there are depths of 10 to 20 fathoms, except at the extremities of the island, where the slope is more gradual. The 500-fathom curve is about 1 mile off and the 1,000-fathom curve about 2 miles offshore.

There is a large grove of coconut palms about 60 feet high at the western extremity of the island and a smaller one at the eastern extremity, with other clumps scattered over the southern rim. The remainder of the rim is covered with brush and shrubs from 15 to 30 feet high.

Since 1938, the island has been settled with Gilbertese, of whom there were 394 in 1949; there is a village at its western end. An administrative officer of the Gilbert and Ellice Island Colony and a native magistrate live on Sydney Island.

A radio station keeps a schedule with the Colonial Administration at Ocean Island and with the other British Colonized islands of the group.

Copra is the sole export of the island.

Rainwater for drinking purposes is caught and stored in cisterns. Several wells on the island provide brackish water.

There are numerous species of insects including flies (but no mosquitoes) on the island. Hermit crabs, turtles, and birds are to be found. There are several species of fish and all except a few of those caught on the reef are edible.

Winds.—The winds at Sydney are almost always easterly, those of the southeast quadrant predominating.

Currents.—Off the island, the set is westerly at a rate of about 0.5 knot, varying in strength and direction with the prevailing wind. Close inshore, it conforms to the shore line, diverging at the eastern extremity and converging at the western extremity.

Anchorage.—There is anchorage for a very small vessel in 10 fathoms of water, about 150 yards off the reef, westward of a white stone cairn, surmounted by a triangle on a black and white post, located on the shore above the high-water mark, at the western end of the island.

11-106 Landing.—In ordinary weather with the southeast trades blowing, the best landing place is at the village. A smartly handled surf boat should have no difficulty in effecting a landing through the natural fissure in the barrier at this point. The U. S. S. *Bushnell* (1939) erected two range

marks to indicate the channel leading up to the landing at the village.

With a northwest wind blowing or at low water, it is better to land on the southern side just eastward of the western extremity of the island. At this point, there is a fissure in the reef wide enough for a boat to enter if properly handled.

11-107 HULL ISLAND ($4^{\circ}30' S.$, $172^{\circ}10' W.$, *H. O. Chart 5737*) is a coral atoll, rectangular in shape, about 6 miles long by 2 miles wide. The long axis of the atoll lies in an east-northeasterly and west-southwesterly direction.

The island is surrounded by a flat fringing reef which dries in patches and is about 300 yards wide. The shelf drops off quickly, except at the eastern extremity where there is a least depth of 60 fathoms 800 yards offshore. At all other points, the 100 fathom curve is within 600 yards of the island. The 500 fathom curve is about $1\frac{1}{2}$ miles offshore.

The land rim of the island is about 500 yards wide and encloses a large and relatively clear lagoon. On the southeast side of the island there are some passes from the lagoon to the outer reef which are fairly deep at high water, but there is no communicating channel through the reef.

The western end of the island is planted with coconut trees, the tops of which are 40 to 60 feet high at the western extremity and of less height to the northward and southward of this point. The remainder of the island is covered with a growth of brush which stands 10 to 20 feet high and on the southeastern side are trees 25 to 40 feet high. There are several stands of trees (*Pisonia Grande*) at various parts of the island, none of them more than 40 feet high.

A large, coral slab beacon, 17 feet high, stands just northward of the western extremity of the island and marks a possible

landing place. There is a flagstaff in the village and a red copra shed on the beach, in the western part of the island. There are a number of signs about the island marking out the limits of a proposed airport for the British Pacific Airways. An observation spot, established by the U. S. S. *Bushnell* in 1939, is located near the northeastern extremity of the island.

There is a settlement in the western part of the island and the population in 1949 was 618 persons, made up of colonists from the Gilbert Islands, and governed by a British Administrative Officer and a native Magistrate.

A radio station operated by the Administrative Officer maintains a daily schedule with Canton Island and the Gilberts.

A supply steamer from the Gilbert Islands calls about every third month.

Fish, lobsters, and turtles are plentiful and easily taken. Fish caught in the lagoon may be poisonous and should be passed upon by the natives.

There are several brackish wells on the island. Rainwater is caught and stored in cisterns.

Currents.—Close in to the shore, the current sets westward along the island with an average velocity of 1 knot. Offshore, the set is westerly about 0.5 knot, varying slightly in direction and velocity with the surface currents set up by the wind.

Tidal current.—The tidal current in the blasted channel through the reef in the northeastern part of the island is very strong, ranging up to 5 knots.

Tides.—In the blasted channel, the time of high water was observed (1939) to average 20 minutes later than at Apia, British Samoa. The period of slack water is very short.

11-108 Anchorages.—There is anchorage for small vessels, in easterly winds only, in

a depth of about 10 fathoms about 200 yards off the western extremity of the reef.

In 1949 a vessel anchored in 17 fathoms close to the shore reef with the flagstaff on the western extremity of the island bearing 071° , distant 400 yards. There was no swinging room. The 17-fathom patch was easily distinguished by its color.

There is also anchorage for a vessel of moderate draft about 2 miles northeastward of the beacon at the western extremity of the island. A heavy weight should be hung over the stern to take on the edge of the reef in the event of the stern swinging toward the shore. An anchor should not be used for this purpose as it is liable to become fouled in the coral heads.

It is recommended that vessels with a draft of more than 20 feet lie off the western end of the island.

Channels.—On the northwest side, the land is broken by some twenty channels, two of which are navigable by small boats. The easternmost channel, the widest and deepest, was blasted out by the U. S. S. *Bushnell* in 1939 and carries about 3 feet of water at the spring tides.

11-109 Lagoon.—The lagoon has depths up to 8 and 9 fathoms in places, but it is foul with numerous shoal coral heads. The larger and shoaler heads have been marked with buoys made of gasoline drums.

Landings.—Landing may be made at the village through the blasted channel into the lagoon.

There is a landing at the village just south of the western extremity of the island. This landing can be used at all stages of the tide during prevailing easterly winds.

11-110 MCKEAN ISLAND ($3^{\circ}36' S.$, $174^{\circ}08' W.$, *H. O. Chart 5739*) is a treeless, coral island, nearly circular in shape, set on a heart-shaped reef.

The island was discovered by Lieut. Wilkes, of the U. S. Exploring Expedition, in 1840, and a sketch survey was made. The island was surveyed by the U. S. S. *Bushnell* in 1939. Among the ruins of what was once probably the administrative headquarters of the Phoenix Guano Co., the survey party found a brass plaque bearing an inscription that the island had been "taken possession of in the name of the United States of America for the Phoenix Guano Company by Captain T. Long" of the brig *Agate* in 1859.

The land portion of the island is 1,000 yards north and south and 900 yards east and west. The shoal area is 1,500 yards by 1,250 yards. The portion of the fringing reef which dries is about 30 yards wide.

The beach is largely coralline rock and shingle and rises steeply from the reef to the land rim which averages about 12 feet in height with a greatest height of 17 feet at the northern point of the island. Within the land rim, the land slopes gradually to an irregular depression which is partly filled with water forming a very shallow lagoon. In one place, on the northern rim, there is a deep, narrow gully lying parallel with the shore and just within the beach crest.

The most conspicuous object on the island is the ruin of a large building on the western side with a coral slab wall standing 7 feet high. Scattered about this are the ruins of several structures obviously part of the old guano works.

The island has very little vegetation except around the shallow lagoon where there are sparse patches of bunch grass.

There are no inhabitants on McKean Island. There are innumerable birds, several kinds of crabs, a few lizards, and some small insects but no flies or mosquitoes. Off the reef, there is the best fishing in the Phoenix Islands, and the larger species of fish caught during the stay of the U. S. S.

Bushnell included yellow-fin tuna, barracuda, wahoo, rainbow runner, red snapper, and ulua. Sharks are to be found in large numbers.

Winds.—The winds are nearly always easterly, varying from northeast to east-southeast with the former predominating.

Currents.—The current sets strongly past the northern and southern points, converging on the west side of the island. Close in to the shore on the western side, the flood sets northward and the ebb southward. Off-shore, the set is westerly with an average velocity of 0.5 knot but varying in strength and direction with the prevailing wind.

11-111 Landing.—There is a fair landing about the middle of the western side where the reef is narrowest, close to the coral slab wall. Landing is possible here at any stage of the tide but is best just after high water as there is less surf with more water on the reef at that time. Even under the most favorable circumstances, care must be exercised in landing because of the numerous beach rocks and the surf.

11-112 GARDNER ISLAND ($4^{\circ}40' S.$, $174^{\circ}32' W.$, *H. O. Chart 5738*) is a wooded wedge-shaped island, lying in a west-north-westerly and an east-southeasterly direction, about 3.8 miles long and 1.1 miles wide at the broad end.

The island is surrounded by an unbroken, fringing reef which dries at low water and which is about 300 yards wide, except at the northwestern and southeastern points where it appears to be extending. Depths off the island, which is steep-to, average 200 fathoms at 500 yards from the reef, drop to 500 fathoms within 1 mile and 1,000 fathoms at 2 miles off the north, east, and west sides. On the south side, after the initial drop to 180 fathoms, the depth increases less rapidly and is less than 1,000 fathoms at 4 miles off.

This is particularly marked at the southeast point where a narrow tongue or ridge, with depths less than 200 fathoms, extends almost due south for $3\frac{1}{2}$ miles.

The land rim is about 12 feet high and is roughly 500 yards wide, except at the northwest end where it broadens to one-half of a mile. With the exception of two breaks, a large one on the western side and a narrow one on the southern side, the land rim entirely surrounds the lagoon. Small boats can be hauled over the reef in the western break at high water.

The lagoon is large and relatively clear with depths of 3 to 4 fathoms. It was surveyed by the New Zealand Navy in 1938 and coral heads and channels have been buoyed with 50-gallon drums. Part of the lagoon has been marked off as a landing area for planes of the British Pacific Airway and the use of this part of the lagoon is forbidden.

The most conspicuous object on the island, as seen from the sector north through west to south, is the wreck of the steamer *Norwich City* which is stranded on the west side near the northern extremity.

Gardner Island was discovered by Captain Joshua Coffin, in the American ship *Ganges*, about 1825, and was named by him for Gideon Gardner, owner of his ship.

The island is inhabited by about 97 colonists of the Gilbert and Ellice Islands Colony who live in a village consisting of about 20 grass houses, located on the south side of the western break in the land rim.

The island is well-wooded with puka, pandanus, and about 200 coconut trees together with several varieties of low shrubs and bunch grass. Some of the trees, particularly at the northwest end, reach a height of 90 feet.

Birds, crabs, and polynesian rats are to be found in abundance at Gardner Island. The natives domesticate booby birds and

avoid the fishy flavor of flesh and eggs by tethering the birds. They also use the frigate bird as the Chinese use the cormorant in catching small fish. Fish are plentiful in the lagoon and off the reef and, so far as is known, most varieties are edible.

Rain water is caught and stored in cisterns. There are a few wells on the island but all are brackish. The food supply is precarious as there are fewer than 200 coconut palms on the island and dependence must be placed mainly on fish, shellfish, turtles, birds, and the flour and rice supplied by the government. Thousands of coconut trees have been planted but are being ruined by the polynesian rats.

Current.—Off the island the set is westerly and varies in direction and strength with the prevailing wind. Close inshore, the current follows the trend of the land to the westward. Near the western reef, the flood sets northward and the ebb southward.

11-113—Anchorage.—There is anchorage off the village, close to the reef, for very small vessels. Two small range beacons north of the village indicate the approach.

It was reported in 1938 that anchorage in a depth of about 9 fathoms might be found from 1,000 to 1,400 yards southward of the stranded wreck, which lies near the northern extremity of the island.

Landing.—The best landing place is about 500 yards south of the village, over the reef at its narrowest part. Landing should be attempted only at or just after high water, as there is less surf than on a rising tide. Experienced boatmen are necessary to make a successful landing. It is one of the worst landing places in the Phoenix Group.

With a southeast wind, landing can be effected in the lee of the wreck at any stage of the tide but the reef here is extremely slippery and wide and the landing is not

recommended if any equipment is to be landed or brought off.

A radio station, maintained by the government, is located on Gardner Island.

11-114 OUTLYING REEF.—Carondelet Reef (*H. O. Chart 0124*) is reported (1939) by the U. S. S. *Bushnell* to be a heart-shaped reef about 800 yards long north and south and 700 yards wide east and west, with its north end lying in $5^{\circ}34' S., 173^{\circ}51' W.$

The reef does not bare at any stage of the tide and breaks only in moderate or rough weather. There is a minimum depth of 2 fathoms over it. Depths just off the reef are from 5 to 10 fathoms and increase rapidly when beyond a distance of 1,000 yards from it.

Close to, with favorable light conditions, it may be distinguished from aloft by the light greens and blues of the water. It may also be picked out by a series of waves on the horizon.

11-115 TOKELAU (UNION) ISLANDS.—Atafu (Duke of York) Island ($8^{\circ}32' S., 172^{\circ}31' W., H. O. Chart 0126$) is an atoll consisting of a number of islets, about 8 to 10 feet high, lying on a triangle-shaped reef which encloses a lagoon.

The islets are covered with coconut, pandanus, and low trees. A conspicuous clump of casuarina trees is located on the southern islet of the atoll.

Two wooden radio masts, 40 feet high, are located at Atafu Village.

There is no passage into the lagoon and the sea breaks with violence on the reef enclosing it, but at high water a boat may, with proper caution, sometimes cross the reef.

The reefs surrounding the atoll are mostly steep-to. A reef extends about 700 yards northwestward from Atafu, the northwesternmost islet of the atoll. Atafu had a popu-

lation of 534 in 1958. They reside on the northwest island of the atoll. There is a hospital with a native medical officer. A radio station is located on the island and communicates daily with Apia.

The islets produce coconuts, fowl, and pigs; fish are plentiful. About 50 tons of copra are exported annually. Water is caught and stored in tanks.

Atafu was visited by a hurricane and two great sea waves in January 1914. The church and most of the houses were demolished.

Anchorage.—With offshore winds, good anchorage, in 10 fathoms of water, can be obtained off the northwest extremity of the atoll, about 400 yards from the reef.

Landing.—Landing can be effected at the south end of the northwest islet. It is difficult to land except within 2 hours of high water.

11-116 NUKUNONO (DUKE OF CLARENCE) ISLAND was reported in 1934 to lie about $3\frac{1}{2}$ miles eastward of its charted position, which, for its northeastern extremity, is $9^{\circ}06' S.$, $171^{\circ}50'30'' W.$, on *H. O. Chart 0126*. The southeastern end of the island is reported to be incorrectly charted.

The island was discovered by Captain Edwards in the British naval vessel *Pandora* in 1791.

The atoll, consisting of several islets lying on a reef through which there is no entrance to the lagoon, is about 8 miles long, north and south, and 6 miles wide.

The northern side of the atoll is a bare reef, awash, upon which the sea breaks heavily. A church on the southwestern side of the island is conspicuous from westward, and near the western extremity is a noticeable clump of bushes, 8 to 10 feet in height.

Two wooden radio masts, 40 feet high, are located at Nukunono Village.

The population of the island numbered 723 in 1958.

The island produces coconuts, fowl, pigs, breadfruit, and bananas. Fish are plentiful. About 100 tons of copra are exported annually. Rain water is caught and stored in tanks.

There is a small hospital and a radio station on the island. The station communicates daily with Apia.

During offshore winds, fair anchorage can be obtained on the shelf of the reef in 15 fathoms, coral bottom, on the western side of the atoll, about $1\frac{1}{3}$ miles northward of the conspicuous clump of bushes. Landing is dangerous, but canoes can land abreast the village on Nukunono, or about 2 miles northward, according to the direction of the wind.

11-117 FAKAOFO (BOWDITCH) ISLAND ($9^{\circ}28' S.$, $171^{\circ}15' W.$, *H. O. Chart 0126*) was discovered by Captain Hudson in the U. S. S. *Peacock* in 1841.

The atoll is shaped like an arrowhead with the point to the southward. It is about $7\frac{1}{4}$ miles long, north and south, by $5\frac{1}{2}$ miles east and west. It consists of 61 islets lying on reefs which encircle a lagoon into which there is no passage.

The reefs which form the sides of the atoll are from 400 to 800 yards wide and are awash at low tide but bare in places with coral rocks and boulders emerging from the water. The surf is heavy on the northeast or weather side but moderate on the western side.

The lagoon contains a few coral heads and reefs.

The larger islets are covered with coconut palms, 70 to 80 feet high, native trees and undergrowth. Bananas, bread-fruit, and three kinds of taro are cultivated.

Fakafo had a population of 464 in 1958. There is a Catholic and a Protestant church at the village.

Coconuts, fowls, and pigs may be obtained and fish are plentiful. Animal life includes

Landing.—The fringing coral reef surrounding Baker Island makes landing difficult. A relatively good landing spot is located approximately 200 yards southward along the shore from the daybeacon. It is roughly marked by a 15-foot pole set on top of the ridge immediately above the sandy beach. The southern point of the island can be used for landing when winds are from north-eastward.

Anchorage.—There is no sheltered anchorage. Vessels lie off the island and discharge to landing craft.

11-88 OUTLYING DANGERS (H. O. Chart 1993) Reef.—In 1954, a vessel reported sighting a reef about 1 mile long in an east and west direction, in $0^{\circ}56'S.$, $174^{\circ}51'W.$ The reef was clearly visible and the water in the general area was discolored.

Winslow Reef, about 45 miles southward of the above-mentioned reef, was reported (1851) by Captain Winslow of the *Phoenix* to extend about 1 mile in a northwesterly and southeasterly direction and to be about three-fourths of a mile wide, with two rocks awash, in $1^{\circ}40'S.$, $174^{\circ}51'W.$ In 1922, the steamer *Hauraki* passed over the charted position of Winslow reef and saw no sign of shoal water. In 1928, the steamer *Nassa* passed over the charted position of this shoal and saw no sign of it. The American steamer *Golden Cross* passed over its charted position in 1932 and saw no sign of it.

In 1935 the British naval vessel *Wellington* conducted a search for these two reefs under favorable circumstances and found no trace of either in the charted positions.

In 1937, airplane search for both reefs was conducted from the U. S. S. *Colorado* and no trace of either was found in the charted positions.

Recent observations (1944) by a vessel places Winslow Reef in approximately latitude $1^{\circ}36'30''S.$, longitude $174^{\circ}57'00''W.$ Soundings taken from a whaleboat in what appeared to be the portion of the least depth indicated a minimum depth of 6 fathoms, pink coral and red sand, over an area about one-half of a mile in diameter. The bottom

was clearly visible and showed to be light in color with brown patches of live coral.

The reef is about a mile long in an east-west direction by one-half of a mile wide in a north-south direction with the shallow area toward the west. The northwest and south-east edges of the reef come out into points. The sides of the reef drop off steeply on all sides.

In September 1944, a small patch of light breakers was observed about 3 miles eastward of Winslow Reef.

In 1943 an uncharted reef was reported lying about 30 miles southeastward of Winslow Reef in latitude $1^{\circ}51'S.$, longitude $174^{\circ}30'W.$

A merchant vessel reports that during an 8-hour run in the vicinity of Winslow Reef a 7-mile set to the west was encountered.

11-89 PHOENIX ISLANDS (H. O. Chart 0124) is a group comprised of the eight islands of Canton, Enderbury, Phoenix, Birnie, Hull, Sydney, McKean, and Gardner.

The group lies about 500 miles northeastward of the Ellice Islands. The islands are low and of coral formation, surrounded by fringing reefs which in most cases are steep-to.

With the exception of Hull, Sydney, and Gardner, the islands are almost devoid of vegetation, and navigation in their vicinity at night is dangerous due to the difficulty of distinguishing them.

These islands lie in an area much frequented by American whalers, beginning with the close of the 18th century, and most of them are American discoveries.

The islands of the Phoenix Group were visited and surveyed in 1840 by Wilkes, who discovered Hull and McKean Islands. The islands were bonded under the United States Guano Act of 1856, and a number of them were occupied for the purpose of working and exporting guano. All of the islands of the group were surveyed by the U. S. S. *Bushnell* in 1939.

Supplies are not available ordinarily.

Winds.—The prevailing winds are easterly. They are most variable from January

to May inclusive, which is the period of worst weather. During these months northwesterly winds, accompanied by rain squalls in which the winds may reach a force of 7 to 9, Beaufort scale, are sometimes encountered.

Currents.—The offshore currents generally set westward, their strength and direction varying with the wind. The maximum velocity does not exceed $1\frac{1}{2}$ knots, and the usual velocity is less than 1 knot.

Time.—The standard time kept at the Phoenix Islands is that of the meridian 165° W., or 11 hours slow of G.C.T.

11-90 CANTON ISLAND ($2^{\circ}50'S.$, $171^{\circ}43'W.$, H.O. Charts 5740 and 5741) an unincorporated territory under the joint control of the United States and the United Kingdom; is the largest and most northerly of the Phoenix Group. It is a coral atoll, triangular in shape, enclosing a large lagoon studded with coral heads, and crossed by numerous barrier reefs. As an atoll, it is unique in that the land rim is unbroken except for two openings on the west side.

It consists of a narrow strip of land varying in width from 100 yards to 700 yards, and in height from sea level to 20 feet. The west or lee side lies in a north and south direction, and is shortest, about 4 miles in length. The other sides trend southeasterly and meet in a point about 9 miles from the northwestern extremity. The island has been reported to give good radar returns up to 17 miles.

The island is very steep-to. The coral shelf extends only about 200 yards from the shore line, except at the three corners where it extends about 400 yards. Depths outside the reef line drop off from 100 to more than 300 fathoms within a few hundred yards. The surf breaks heavily on the weather side and at the three points and heavy tide rips extend at least 500 yards off the northeastern or weather side.

The island is practically bare of vegeta-

tion except for a few scattered palm trees, kou bushes, and bunch grass.

The road around the island is satisfactory with a trip time of about $\frac{1}{2}$ hour from one end to the other.

Prominent landmarks include twin water tanks about $\frac{1}{4}$ mile southward of Musick Light Structure, a white rectangular concrete building about 2 miles northward of the light structure, and twin water tanks near the northwest extremity of the island.

Five radio towers stand on the southeast part of the island.

Canton Island is the port of entry for the Gilbert and Ellice Islands. The District Commissioner, Phoenix Islands District, who is an administrative officer of the Gilbert and Ellice Islands resides here.

The population of the island was about 400 (1963). The U.S. Civil Aeronautics Administration, U.S. Weather Bureau and commercial airlines operate an airfield, its installations and a hotel and settlement. American government functions also include a post office and a Deputy U.S. Marshal. The hotel and settlement face the lagoon on the southern side of the main entrance; several small piers suitable for use by boats lie along the lagoon side of this area.

Lizards, rats, and several species of birds are found on the island. Fish are plentiful but those caught in the lagoon must be regarded with suspicion as some, notably the red snapper and rock cod, may be poisonous. Barracuda, rainbow runners, wahoo, tuna, and ulua are excellent and safe to eat. The lagoon is infested with shark, moray, eel, and ray.

The island was discovered independently by several ships including American whalers, probably before 1820, and was known by a variety of names including *Mary*, *Swallow*, and *Mary Balcourt*.

Commander R. W. Meade of the U. S. S. *Narragansett* surveyed the island and named it after the New Bedford whaleship *Canton*, which was wrecked on the island in 1854.

By agreement made April 6, 1939, Canton Island was placed under the joint adminis-

tration of the United States and Great Britain for a period of 50 years.

Both American and British Governments maintain radio communications. All vessels entering the harbor should contact local authorities before entering. See H.O. Pub. 117B.

An airfield is located at the northwestern part of Canton Island.

EXPLOSIVES DUMPING AREA.—An explosives dumping area has been established southwestward of Canton Island, between the parallels of 3° 09' S., and 3° 28' S., and between the meridians of 171° 53' W., and 172° 13' W.

WEATHER.—There are no noticeable seasons throughout the year. Temperatures range from a night low of 75° to a daytime high of 95°. Annual rainfall varies from 8 inches to 40 inches.

WINDS.—The prevailing winds 90 percent of the year are easterlies, ranging from east-northeast to east-southeast, with an average velocity of 12 to 15 knots and moderate seas. Heavy weather occurred (1958) with westerly winds of 40 to 50 knots, and heavy seas lasting for about one month. The seas washed away portions of the seawall to the north and south of the western center of the island. High winds, 25 to 30 knots, and rough seas are infrequently experienced during the months of April, May, and June. During heavy weather, vessels have been held up from entering or leaving the harbor for periods of 2 to 3 days. The normal duration of heavy weather is from 2 to 3 days, occasionally extending to 5 days. Hurricanes are unknown.

VISIBILITY.—The average visibility is from 12 to 30 miles. There are no low clouds, fog, or mist, and haze is infrequent.

11-91 CURRENTS.—The ocean current near the island sets about 255° at about 0.8 of a knot, but is much stronger at the northwest and southeast points of the island. A vessel lying off the western shore may expect to be set off at the average rate.

TIDAL CURRENTS.—Close to the western shore the flood sets 325°. In the lagoon entrance the current runs 6 to 8 knots at strength of flood and ebb. The current has been observed to run as high as 11 knots at the ebb with a strong easterly wind blowing. Time of slack water, particularly low water slack, is of very short duration, frequently not more than 10 minutes. The time of high water slack is determined by a tide gauge. Ebb currents produce a marked rip when mixing with ocean currents up to a mile or more off the entrance channel.

TIDES.—The mean high-water interval at Canton is 5 hrs. 00 min. The mean range is 3.3 feet and the spring range is 4 feet. Local weather conditions make both tide and current predications inaccurate, and vessels entering the harbor should contact local authorities for information regarding conditions at time of entering.

11-92 LIGHTS.—Musick Light Structure is a cylindrical stone tower 28 feet above the water on the south side of the lagoon entrance. It is reported that the light structure is a good orientation point. The light was discontinued (1968).

ANAERONAUTICAL RADIOBEACON is located nearly 1½ miles north-northwestward of Musick Light Structure.

11-93 ENTRANCE CHANNEL.—The main entrance, a dredged channel, is entered on the west side of the atoll between Spam Island, the island close northward of Musick Light Structure and the island next northwestward. The channel had a controlling depth of 25 feet (1962) over a bottom width of 120 feet. This channel has not been dredged recently. It was reported (1965) that a ship 460 feet long with a beam of 65 feet and a draft of 20 1/4 feet entered the lagoon. This channel leads in a 037° direction to an 1,800-by-1,600-foot turning basin northward of Spam Island, in which there is a least depth of 27 feet. Entry in the daytime and at high water slack is recommended.

WARNING.—Vessels drawing more than 23 feet, or more than 420 feet in length, shall not enter Canton Harbor except in emergency.

TIDAL CURRENTS.—It is reported that tidal currents within the channel attain a rate of 8 to 10 knots.

PILOTAGE.—Pilots are not available. Persons with local knowledge will board the vessel off the entrance and advise the master, if requested through the harbor voice communications on 2,716 kcs.

11-94 BOAT CHANNEL.—Between Spam Island and the northern end of that part of the main island on which Musick Light Structure stands is a break in the reefs. This channel has charted depths of 11 to about 25 feet between the islands. It is narrow, subject to strong tidal currents, and reportedly silting

up. Just inside the entrance are numerous dangerous coral heads. Rowing boats and launches with less than 10 knots of speed should only attempt this channel at slack water. A wreck lies stranded about 1/4 mile westward of Muick Light.

The right-hand side of the channel must be held in entering, and immediately after traversing the entrance, a sharp turn southward must be made to avoid a large coral field. The channel from that point to the landing place is clear except for scattered coral heads which can be clearly seen. Low-powered or pulling boats should wait for slack water before entering or leaving, or if necessary, proceed with favorable currents. The latter procedure is dangerous, however, because of the strength of the current (8 knots or more), and subsequent loss of control.

The lagoon itself is navigable only by boats of shallow draft, and numerous reefs and coral heads exist.

SEAPLANE LANDING.—Extensive seaplane runways were dredged and marked during hostilities. These runways are located eastward and northeastward of Boat Channel, and while still marked, they are no longer lighted and their condition and controlling depth are not maintained.

11-95 ANCHORAGE.—There is fair anchorage on the coral shelf just south of the lagoon entrance for vessels drawing less than 24 feet, in charted depths of 43 to 84 feet, white coral sand, in good holding ground.

Care must be taken to insure dropping the anchor on the shelf as the depth increases abruptly to depths of over 100 feet a short distance seaward.

At this anchorage, the ship will swing from 040° to 160° but will not swing into the beach while the trade winds are blowing. Westerly winds are practically unknown at this island.

A vessel reported on this anchorage as follows:

"Anchorage for light draft vessels on the ledge south of the entrance to the main channel is feasible with the prevailing easterly winds. However, any vessel with considerable drag and a tendency to sail up on its anchor would quickly be in difficulty, for there is insufficient room to swing with the stern to the beach."

Local opinion in 1949, supported by that of masters who have visited the island since the war, is that, effectively, there is no good anchorage for a vessel too large to enter the harbor, and smaller vessels waiting for slack water will be well advised to stand offshore.

LANDING may be effected at the sandy beach and small boat pier opposite the settlement inside the lagoon.

11-96 GENERAL NAVIGATIONAL INFORMATION.—The following information concerning Canton was reported in 1944 and includes later changes.

The strong current, strong wind, and small space in which to maneuver a fairly large vessel make entry of this port quite hazardous. A speed of 5 to 8 knots must be maintained to stem an ebbing tide in the

channel, and to navigate the turn at the lagoon end of the channel. A 550-yard turning basin is not to be considered as ample space in which to stop or maneuver a large vessel. The current in this channel runs as high as 10 knots on both flood and ebb, and the periods of slack water are almost negligible. Slack water usually occurs about 1 1/2 hours after high water and low water at Apia, plus or minus 30 minutes. The channel is on the lee side of the island, and a strong wind may prolong the period of ebb and shorten the period of flood tides. The local method of determining slack water is to watch the wood chips thrown into the water at the seaward end of the channel by persons ashore.

Vessels should plan to enter at high water slack, and leave at low water slack, in order to insure that they will be stemming the current. Also, vessels are advised if practicable, to send a boat inshore to observe the tidal streams in the channel and report when conditions are suitable for the vessel to proceed into the lagoon. Vessels should make the dock port side to, and the turn to the left should be started in the channel as the bow passes the above mentioned buoy. Small rudder angles should be used to avoid throwing the stern into the southeast side of the channel.

The anchor is sometimes used in docking. Ships depart by breasting out on the bow spring line which is secured to the south end of the dock, and using the prevailing winds to assist in bringing the vessel about.

The importance of keeping to the middle of the channel cannot be overemphasized, because a strong bank suction is experienced.

A sunken tug, with a depth of 25 feet, was

reported (1963) to lie about 15 yards northward of the southern end of the quay.

11-97 BERTHS.—A concrete quay 385 feet long, with two 40-foot spurs and a depth of 27 feet alongside, fronts the western side of the turning basin. Depths are very shallow along the inner ends of the spurs. Northward of the quay there is a boat landing, and on the southern side of the lagoon there are several boat landings. A crane with a lifting capacity of 20 tons is available. Tugs are not available. A limited amount of covered storage space is available.

Machine shop repairs are very limited. A small barge or launch is available for offshore cargo work on a small scale.

Limited quantities of water and food may be available in case of emergency only. Limited quantity of diesel oil may be secured in emergency or by prearrangement with Island authorities at least two months in advance.

Commercial air transportation is available at frequent intervals to Honolulu and to Nadi, Fiji, thence connections are made to points beyond.

There is a small hospital, and a medical officer resides here.

Emergency radio frequencies for vessels and aircraft are guarded full time at the airfield control center site. Frequencies used on this circuit are: 121.5 mcs., 243.0 mcs., and 500 kcs. The following local operation circuits are also guarded full time: low frequency ship shore using 500 kcs. as call up frequency and 470 kcs. as a working frequency; and harbor voice or C.W. 2716 kcs.

11-98 ENDERBURY ISLAND (3°08'S., 171°05'W., H.O. Chart 5739) is a coral island,

rectangular in shape, about 2.7 miles long and 1 mile wide with the longer axis north and south. It consists of a rim averaging 13 feet in height with a sunken central plain about 4 feet above sea level. In the center of the island is a small, shallow, brackish lagoon. The island is uninhabited, and no fresh water is available.

The island is steep-to with a very short reef which makes landing difficult because of the strong sweep of the undertow on the shelving shore. The shelf extends only about 75 yards and drops off rapidly except at the northeast and southeast corners. A shoal extends north-northeastward from the north-eastern extremity of the island about 1,200 yards with depths increasing gradually to 50 fathoms at the outer extremity. At the south-eastern extremity, a shoal area extends east-southeastward about 650 yards and it is advisable to give this shoal a berth of at least 100 yards, due to the strong current and heavy surf setting upon it. At all other points, the 100-fathom curve lies within 500 yards of the island. The 500-fathom curve is about 1 mile offshore.

The most conspicuous objects on the island are several palms at the north end, a large guano heap about 20 feet high on the western side, and the buildings of the settlement at the southwest corner. Near the settlement is a large kou bush, about 50 feet in diameter and 15 feet high, fronting the buildings. The major part of the low-lying plain in the center of the island is covered with a flat, green growth giving it the appearance of a grassy meadow. There are a few withered palms in the southern part of the island.

Enderbury Island has been reported to give good radar returns up to 7 miles.

By agreement made April 6, 1939, Enderbury Island, an unincorporated territory, was placed under the joint administration of the United States and Great Britain for a period of 50 years.

Lizards, hermit crabs, polynesian rats, and sever species of birds are found on the island. Fish are abundant and all common species are edible. The large sea turtle is found on the beaches.

WEATHER.—The winds vary from northeast to southeast. There are frequent but usually brief rain squalls and they cannot be depended on as the sole water supply.

11-99 CURRENTS.—Immediately west of the island the current sets to the southward with a strength of about 1 knot. In very strong flood tides this set may be reversed. Clear of the island to the north or south, the average set is about 0.8 knot in a 255° direction.

A **BEACON** is located about 1/2 mile northward of the southwestern end of the island.

11-100 ANCHORAGE.—During the season of the southeast trades there is opportunity for anchorage on the spit off the northeast point. A vessel of moderate size can anchor there in 25 to 30 fathoms, coral and sand, with the largest palm tree bearing 206°, distant 1,500 yards, about 1,150 yards from the beach. Larger vessels could anchor farther out on the same bearing in a depth of 50 fathoms. The anchorage should be approached slowly from west-northwestward, with constant use of the hand lead, as the spit is very narrow and may be overrun easily.

The observed set of the current at this anchorage is to the north of west which keeps the stern away from the shore.

Anchorage here is not recommended when the northeast trade wind is blowing.

11-101 LANDING.—The landing place is on the western side of the island just north of the settlement. Ships may approach the island to within less than 500 yards at this point. Motorboats may approach within 75 yards, which is the limit of the fringing reef. Landing may be effected by a surfboat through a channel in the reef leading in on a range of two **BEACONS** erected on the beach about 100 yards southwestward of the 20-foot beacon mentioned above. The front range is a pyramidal block of concrete and the rear range a white triangular daymark; the range is in line 092°. Great care must be used in landing as the reef is short and steep and the channel is narrow with rapid shoaling toward the landing. The best landing conditions prevail at high tide and with a strong easterly wind which flattens the swell that usually sets in from the south.

11-102 BIRNIE ISLAND (3°35'S., 171°31' W., H.O. Chart 5739) is a barren kidney-shaped island about 1,300 yards long and 600 yards wide, the axis running in a north-northwesterly and south-southeasterly direction.

The island is 12 feet high on the rim, sloping gradually to sea level at a small, shallow, brackish pond about 300 yards long by 50 yards wide, located about 100 yards inland from the eastern side of the island.

A flat, fringing reef, drying at low water, and extending as far as 200 yards offshore, surrounds the island.

A shoal, which breaks in heavy weather, extends 1,300 yards southward from the southern point of the island. Depths on the shoal vary from 2 to 4 fathoms. Depths of 80 fathoms were found 1,200 yards northward of the northwestern extremity. At other points, the 100-fathom curve lies about 500 yards from the island.

A stone BEACON, about 16 feet high and 14 feet in diameter at the base, is located at the eastern extremity about midway of the island.

A small vessel reported that Birnie Island gave good radar returns up to 4 miles.

The island is uninhabited, and no fresh water is available. The only vegetation on the island is a wiry grass and some creeping plants.

Sea birds, hermit crabs, and polynesian rats are found on the island. Fish are plentiful and so far as is known, there are no poisonous species.

CURRENTS.—Close into the western shore, the current sets northward. Farther off, the set is westerly and is usually at a rate of about one-half of a knot, the strength and direction varying with the surface currents set up by the prevailing wind.

ANCHORAGE.—It may be possible to anchor a small vessel off the northwest point, about 500 yards in 9 fathoms, with easterly winds. The southern spit is considered too dangerous for anchorage as it drops off from a depth of 2 or 3 fathoms in surf to 30 fathoms within 100 yards.

LANDING may be effected with caution and by skilled carmen at a point about midway on the western side just north of a pipe staff.

11-103 PHOENIX ISLAND (3°43'S., 170°43' W., H. O. Chart 5739), named after the American ship that discovered it, is a treeless, triangular coral atoll, the land portion of which is about 1,300 yards long and 800 yards wide. The island is surrounded, except for the middle third of the west or longest

side, by a wide platform reef, the whole atoll being about 1,700 yards long and 1,200 yards wide.

Phoenix Island has been reported to give good radar returns up to 11 miles.

The reef bares at low water. Off the reef, the depth increases rapidly. The 100-fathom curve is about 500 yards off in places. Depths of less than 5 fathoms, however, are found within 500 yards off the southeastern and northeastern sides, and shoals which break heavily extend about 700 yards off the northwestern end of the island.

The land rim is about 16 feet high 100 feet inshore from the reef. The first rise is covered with loose coral fragments washed in from the sea. From the rim there is a gradual slope to the dried-up lagoon in the center. This surface is of sand sparsely covered with grass about 2 feet high. The lagoon surface is a thin salt crust over guano, about 6 inches below the level of the outside reef. There are a few puddles of water, inches deep.

The island is uninhabited and there is no fresh water.

A vessel anchored off the northeastern extremity in 16 1/2 fathoms (1965).

Wildlife found at Phoenix Island includes birds, rabbits, hermit crabs, rates, and lizards. Fish are plentiful and so far as is known, nonpoisonous.

WINDS.—Winds are always easterly. Usually, they vary from east-northeast to east-southeast with the latter predominating.

CURRENTS.—The current sets strongly past the northern and southern points of the is-

land converging on the west side. Close in to the shore on the west side of the island, the flood sets northward and the ebb sets southward. Offshore, the set is westerly about one-half of a knot, varying in strength and direction with the surface currents set up by the prevailing wind.

11-104 LANDING.—The best landing place is on the west side about 500 yards from the northern point of the island at the narrowest part of the reef. Near this landing, on the highest point of the land rim, there is a standard Navy observation spot, a concrete truncated pyramid, 3 feet high.

In effecting landing, care must be taken to time the surf as a boat may be upset or broached by inexperienced boatmen.

11-105 SYDNEY ISLAND (4°27'S., 171°15' W., H.O. Chart 5738) is a triangular atoll with the base lying east and west and the apex to the northward, the sides being about 2 miles long. It has been reported to give good radar returns up to 7 miles.

The island was swept by a tidal wave in 1914.

The land rim of the atoll is about 15 feet high, covered with brush and trees, entirely enclosing a circular, very salty lagoon which has a depth of less than 3 fathoms and is obstructed by numerous islets and shoal patches.

The island is surrounded by a platform reef from 50 to 200 yards wide, some of which is bare at low water. Immediately off the reef there are depths of 10 to 20 fathoms, except at the extremities of the island, where the slope is more gradual. The 500-fathom curve is about 1 mile off and the 1,000-fathom curve about 2 miles offshore.

There is a large grove of coconut palms about 60 feet high at the western extremity of the island and a smaller one at the eastern

extremity, with other clumps scattered over the southern rim. The remainder of the rim is covered with brush and shrubs from 15 to 30 feet high.

The island is uninhabited, however fresh water can be obtained from a cistern located in the center of the deserted village on the west tip of the island.

Copra is the sole export of the island.

Rainwater for drinking purposes is caught and stored in cisterns. Several wells on the island provide brackish water.

There are numerous species of insects including flies (but no mosquitoes) on the island. Hermit crabs, turtles, and birds are to be found. There are several species of fish and all except a few of those caught on the reef are edible.

WINDS.—The winds at Sydney are almost always easterly, those of the southeast quadrant predominating.

CURRENTS.—Off the island, the set is westerly at a rate of about 0.5 knot, varying in strength and direction with the prevailing wind. Close inshore, it conforms to the shore line, diverging at the eastern extremity and converging at the western extremity.

ANCHORAGE.—There is anchorage for a very small vessel in 10 fathoms of water, about 150 yards off the reef, westward of a white stone cairn, surmounted by a triangle on a black and white post, located on the shore above the high-water mark, at the western end of the island.

11-106 LANDING.—In ordinary weather with the southeast trades blowing, the best landing place is at the village. A smartly handled surf boat should have no difficulty in effecting a landing through the natural fissure in the barrier at this point. The U.S.S. Bushnell (1939) erected two range marks to indicate the channel leading up to the landing at the village.

With a northwest wind blowing or at low water, it is better to land on the southern side just eastward of the western extremity of the island. At this point, there is a fissure in the reef wide enough for a boat to enter if properly handled. The passages were reported improved by blasting (1964).

11-107 HULL ISLAND (4°30'S., 172°10'W., H.O. Chart 5737) is a coral atoll, rectangular in shape, about 6 miles long by 2 miles wide. The long axis of the atoll lies in an east-northeasterly and west-southwesterly direction. The island has been reported to give good radar returns up to 16 miles.

The island is surrounded by a flat fringing reef which dries in patches and is about 300 yards wide. The shelf drops off quickly, except at the eastern extremity where there is a least depth of 60 fathoms 800 yards offshore. At all other points, the 100 fathom curve is within 600 yards of the island. The 500 fathom curve is about 1 1/2 miles offshore.

The land rim of the island is about 500 yards wide and encloses a large and relatively clear lagoon. On the southeast side of the island there are some passes from the lagoon to the outer reef which are fairly deep at high water, but there is no communicating channel through the reef. It was reported that the passes in the reef were improved by blasting (1964).

The western end of the island is planted with coconut trees, the tops of which are 40 to 60 feet high at the western extremity and of less height to the northward and southward of this point. The remainder of the island is covered with a growth of brush which stands 10 to 20 feet high and on the

southeastern side are trees 25 to 40 feet high. There are several stands of trees (*Pisonia Grande*) at various parts of the island, none of them more than 40 feet high. There is a village in ruins on the western part of the island.

Rainwater is collected and kept in cisterns.

There is a radio station on the island.

A stone beacon, 16 feet high, marks the east end of the island.

An observation spot, established by the U.S.S. Bushnell in 1939, is located near the north-eastern extremity of the island.

Fish, lobsters, and turtles are plentiful and easily taken. Fish caught in the lagoon may be poisonous.

CURRENTS.—Close into the shore, the current sets westward along the island with an average velocity of 1 knot. Offshore, the set is westerly about 0.5 knot, varying slightly in direction and velocity with the surface currents set up by the wind.

TIDAL CURRENT.—The tidal current in the blasted channel through the reef in the north-eastern part of the island is very strong, ranging up to 5 knots.

TIDES.—In the blasted channel, the time of high water was observed (1939) to average 20 minutes later than at Apia, British Samoa. The period of slack water is very short.

11-108 ANCHORAGES.—There is anchorage for small vessels, in easterly winds only, in a depth of about 10 fathoms about 200 yards off the western extremity of the reef.

In 1949 a vessel anchored in 17 fathoms close to the shore reef with the flagstaff on the western extremity of the island bearing 071°, distant 400 yards. There was no swinging room.

NATURE'S MOST DRAMATIC SPECTACLE

By S. A. MITCHELL

*Scientific Leader, National Geographic Society-U. S. Navy Eclipse Expedition, 1937***With Illustrations from Photographs by Richard H. Stewart*

LIKE a hungry small boy sitting down to Thanksgiving dinner, an astronomer at a total eclipse of the sun is there to get all he can while he has the chance. The boy is determined to stuff himself with as much turkey as possible while it lasts, and the astronomer is eager to gather in all the knowledge of the sun that he can during the brief few minutes of favorable conditions created by a total eclipse.

A real "eclipse feast" on June 8, 1937, was the happy lot of the National Geographic Society-United States Navy Expedition to Canton Island, far out in the mid-Pacific (maps, pages 364, 380).

To digest this "Thanksgiving dinner of knowledge" and prepare its complete results will take many months, but I can give National Geographic Society members at least a preliminary report of what we learned and why we were anxious to travel to a place 9,500 miles from home to see the sun eclipsed for only 213 seconds.

A LITERAL "CHANCE OF A LIFETIME"

A total eclipse of the sun takes place about once every three years in some part of the earth accessible enough for astronomers to view it, and even then clouds or rain may blot out the sight and render a long journey and large expense futile.

Why not study the sun at home, where it may be seen any day? Because some of the most important features of the sun can be observed only during an eclipse, when the moon shuts off the glare of the sun's light, or can be seen best at that time.

Scientists starting out for an eclipse are truly "grasping the chance of a lifetime," because the average eclipse lasts only about three minutes. Therefore an astronomer, with the best possible luck, cannot expect more than one hour's total time for observing eclipses in his entire life!

No wonder then that astronomers are willing to gamble on the chance of bad weather and travel half around the world, risking disappointment, as has often happened, or like Father Stephen Perry, leader of a British expedition to Cayenne, French Guiana, in 1889, to carry on even when

taken suddenly ill, and knowing death is near.

With observations successfully completed the stricken scientist called for three cheers, saying, "I can't cheer myself, but I'll wave my helmet!"

Our own expedition, fortunately, was marred by neither illness nor accident, but we did defy the gods of bad luck enough to arrive at our island on May 13, and set up camp on shore with 13 scientists and officers and 13 sailor assistants!

But thirteen must have been our lucky number. The skies over the island were clear and free of haze throughout the total phase of the eclipse, and our observations were made under conditions practically ideal, which rarely have been excelled in eclipse history.

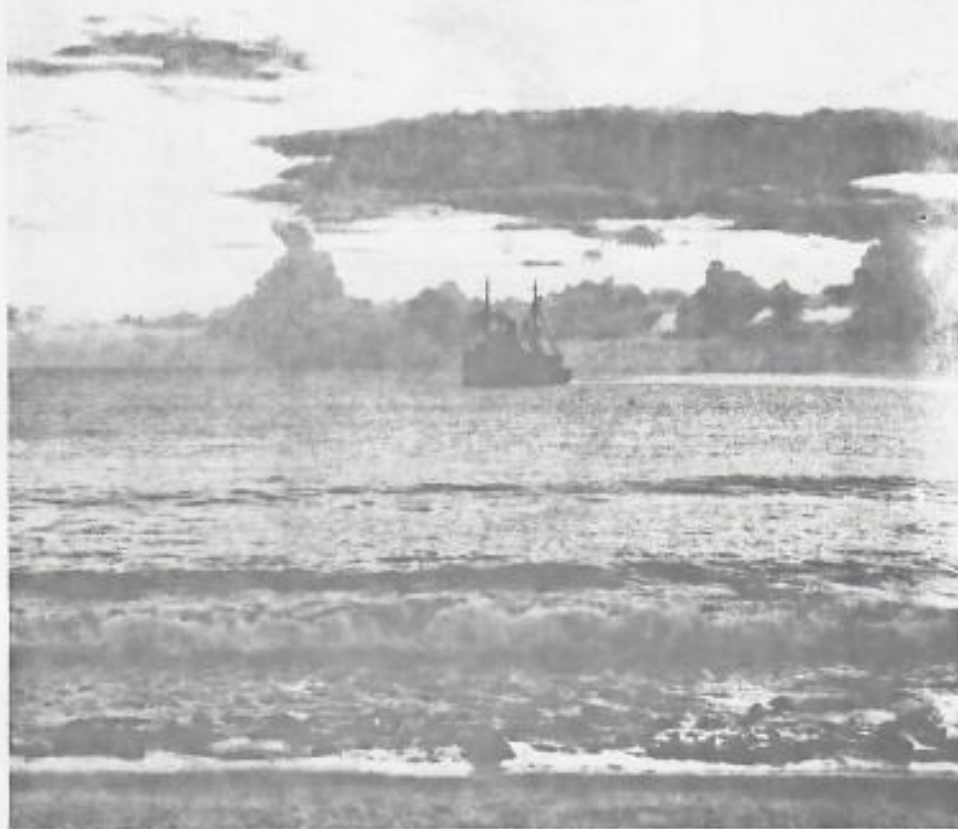
Astronomers do not travel to a desert island, as we did, or to some other remote part of the world, merely to be spectators at the gorgeous spectacle of an eclipse of the sun. More than one scientist has traversed vast distances to observe an eclipse, knowing all the time that he would not see it himself, because while it goes on he must remain shut up in a dark room to operate his apparatus.

The scientists of our own expedition, busily working their instruments most of the time, had a chance to look at the eclipse only for a few seconds of the total duration of three and one-half minutes.

Why make photographs and other observations of the eclipsed sun?

One striking answer is the fact that, as a direct result of observing eclipses, we

* Herein the National Geographic Society presents to members a preliminary report of the highly successful eclipse expedition jointly sponsored by their Society and the U. S. Navy. Dr. S. A. Mitchell, the scientific leader, is Director of the Leander McCormick Observatory, University of Virginia, and President of the Commission on Eclipses of the International Astronomical Union. Captain J. F. Hellweg, U. S. N., commanding the Navy detachment (page 377), is Superintendent of the U. S. Naval Observatory, Washington, D. C. "A brilliant success, far beyond our most extravagant expectations, has attended our venture," was Dr. Mitchell's preliminary bulletin to The Society's headquarters. It will require many months for complete study of all the expedition's findings.



TO THE "CANTONESE" CRUISES THE U. S. S. "AVOCET" WAS A SILENT SYMBOL OF GETTING BACK HOME

The Navy seaplane tender, which brought the Expedition from Honolulu to this desert isle, found a good anchorage off the mouth of the lagoon. The tidal current had piled up two humps of coral sand on the ocean bottom, which enabled the skipper to locate shallow water (page 384). Some of the crew stayed aboard the ship; others were assigned to help the scientists.

actually know more about the distribution of gases in the atmosphere of the sun, 93,000,000 miles away, than we know of the earth's atmosphere only 20 miles above our heads.

ECLIPSES HELP SET WORLD'S WATCHES

A second answer perhaps comes closer home.

The alarm clocks that awaken us in the morning are set by radio time signals from the U. S. Naval Observatory, and owe at least part of their accuracy to observations during eclipses of the sun.

Only during an eclipse can scientists make certain checkups on the movements of the sun, moon, and earth, in relation to one another and the stars, which relation forms the basis of our whole time system.

Our expedition "checked up on the solar system" again during this eclipse.

This is done by noting the exact times of the four "contacts," that is, first, when the edges of the sun and moon appear to touch, and the moon begins to move across in front of the sun; second, when the sun disappears behind the moon (beginning of totality); third, when the sun begins to emerge (end of totality); and fourth, when the sun emerges completely (page 363).

The contacts were timed visually by Captain J. F. Hellweg, Superintendent of the Naval Observatory, who was in charge of the Navy's participation in the expedition. Mr. John E. Willis, also of the Naval Observatory, timed them photographically.

These data will be extremely useful to

Observatory in its time calculations, as well as in predicting future eclipses.

THE SUN'S RADIO RECEPTION AND BALLOON FLIGHTS INTO STRATOSPHERE

The sun not only helps tell time, but makes it possible the transmission over long distances of the radio signals that bring the time to us. Scientists now believe that ultraviolet light from the sun ionizes the ionosphere, or radio-reflecting layer high in the air, which keeps radio signals from being lost in space, and enables them to travel around the earth.

Experiments were made to determine whether the transmission of radio signals would be affected by the eclipse, which data would give us additional knowledge about the different parts of the radio-reflecting layer. Results of these experiments are now being studied.

During an eclipse of 1868, astronomers found on the sun traces of a new chemical element, previously unknown. What good is it, one may ask, to discover something on the sun, 93,000,000 miles away?

This new element was helium, and 27 years later, in 1895, it was recognized on earth. Today it carries our dirigibles and balloons* safely through the skies and is used in treating divers to prevent the dread bends.

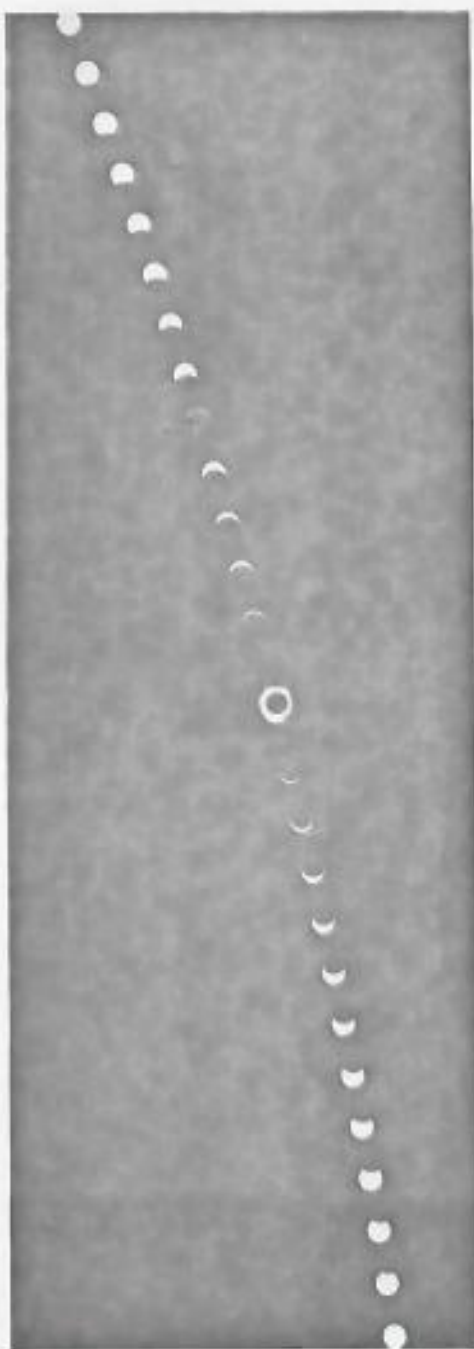
Possibilities from the study of the sun are almost limitless, even though it is really an old and not very important sample of the vast family of stars. For the sun actually is a star, and a very ancient star indeed, one of the class of stars called by astronomers "yellow dwarfs."

It enjoyed its flaming youth eons ago, passed its prime billions of years back, and now slowly cooling, heading toward inevitable death, though that time, luckily for us, is still uncounted millions of years hence.

"MOTHER SUN" AND "BABY EARTH"

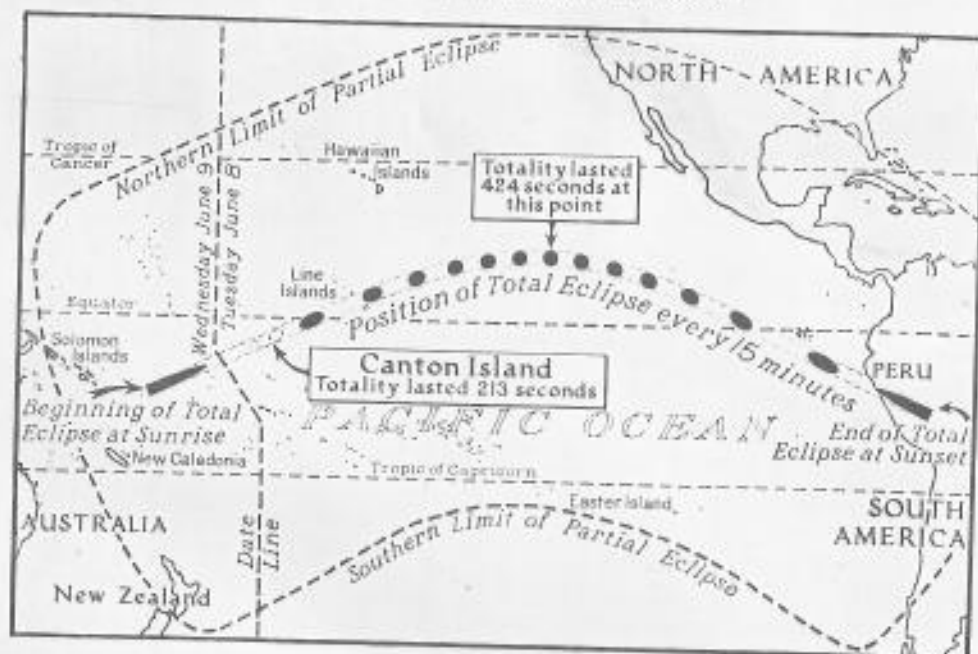
We speak of "Mother Earth," but more properly we should speak of "Mother Sun." For from her body our own earth was born, according to one widely accepted theory, long ago when the gravitational attraction

* Helium, a noninflammable gas, made it possible to carry out in complete safety the National Geographic Society-U. S. Army Air Corps stratosphere flight of November 11, 1935, which attained a new altitude record of 72,395 feet and accomplished important scientific observations.



ECLIPSE PRINTS IN THE SKIES OF TIME

Exposures made every five minutes for more than two hours show how the eclipse progressed (from bottom to top). The moon gradually moved across the sun, then covered it completely, with the corona flashing into view (center), then slowly uncovered the sun again.



Drawn by Norman Finckel

THE ECLIPSE OF 1957 WAS THE LONGEST SINCE 699 A. D. AT THE CENTER OF ITS 8,800-MILE PATH

The duration, boon to astronomers, was because the sun and moon were far apart and the moon relatively close to the earth, and also because the path lay near the Equator. Unfortunately, the maximum duration, 7 minutes, 4 seconds, was 1,200 miles from land. On Canton Island it lasted 3 minutes, 33 seconds, the precious working time which culminated months of laborious preparation. Black spots along the eclipse path show how the shape of the shadow varied as it traveled for 3 hours and 21 minutes from a point about 1,500 miles northeast of Australia to Peru. Within the large area enclosed by the heavy dotted line a partial eclipse was visible, with the moon moving part way over the sun and then retreating. The next eclipse of comparable duration will be June 20, 1955.

of another star, passing close, pulled a long streamer of matter out from the sun until it was detached, cooled, and broke up to form the planets.

Like a true mother still, the sun makes possible all life that exists on earth. It gives us light, the heat that sustains us, the wind that cools us, and long ago manufactured even the coal that today warms us in winter and runs our factories.

Without the sun there would be no flowers, no grass, no crops to feed us, no animal life, not even man himself. If the sun were blotted out for a single month we should all be frozen to death. Even the air would freeze and fall in a final mighty blizzard.

Moreover, without that invisible "apron string" of gravitation, 93,000,000 miles long, which ties us safely to Mother Sun, we would long ago have gone hurtling off into the depths of space, doomed to an end that no man knows.

Because it is the only star near enough to give us a chance to study it "close up," the sun can teach us much about the countless other stars which probably we will never see except as pin points of light.

There is every reason, then, to learn all we can about the sun. We can scarcely agree with the schoolboy's naive statement that the moon is a more important body than the sun because it gives us light at night when it is dark and we need its light, whereas the sun shines in the daytime when it is light and we could possibly get along very well without it!

CHASING AN 8,800-MILE SHADOW

Every so often, as the moon moves around the earth, it comes directly between the earth and the sun. Then its round shadow falls upon the earth, and those within the area covered by the shadow see the sun in total eclipse.

This year, on June 8, the moon came into

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THREADING A NEEDLE IS EASY COMPARED TO THE INFINITE CARE IT TAKES TO PLACE ECLIPSE INSTRUMENTS

Sighting through a surveyor's transit, to insure that his apparatus is pointed with hairbreadth precision, is Dr. S. A. Mitchell, scientific leader of the expedition. Days of exacting work were required to make perfect adjustments of his three spectrographs, mute detectives of solar atoms (369).

such a position that its shadow, about 150 miles wide, swept 8,800 miles across the Pacific Ocean, from a point northeast of Australia to the mainland of Peru (p. 364).

Because of the time of the year, relative distance of the sun and moon from the earth, and nearness of the eclipse path to the Equator, the duration of darkness at the middle of the path of this eclipse was the longest in any eclipse in 1,238 years.

SUN'S LIGHT CUT OFF MORE THAN
7 MINUTES IN MID-PACIFIC

At the middle point, about 1,800 miles southwest of Los Angeles, in the Pacific, the moon blotted out the sun's light for 7 minutes and 4 seconds, longer than it had been shut off by any eclipse since 699 A. D., the year after Carthage was utterly destroyed.

Of course all the astronomers in the world would have liked to go to that point to observe the eclipse, during the long dimming of the sun.

But unfortunately there is no land there; no land, in fact, within 1,200 miles of the place in any direction. Modern instruments with which an eclipse is observed must be

mounted on solid concrete on solid ground.

Moreover, as though Nature were playing a gigantic joke to tease the astronomers, it developed that there was almost no land at all throughout the entire 8,800 miles of the eclipse shadow's path across the Pacific.

Far toward the western end of the path were Canton and Enderbury Islands, part of the Phoenix Group,* and far to the east the shadow just before sunset would touch the mainland of Peru.

At these points the duration of the eclipse would be much shorter than at the middle of the path, but still long enough to make it well worth observing.

We chose the islands, remote and little-known as they were, because there the sun would be fairly high in the sky during the eclipse, 22 degrees, while in Peru it would be almost set at eclipse time.

The Chief of Naval Operations, Admiral William D. Leahy, arranged for us to be taken to the islands by the Navy seaplane tender, *Avocet* (page 362).

* Other islands in the Phoenix Group were in the path, but too far from its center for satisfactory observations.



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YOU SQUINT AT A STAR TO "GET THE RANGE" ON AN ECLIPSE

To avoid wasting precious seconds in adjusting their cameras after contact begins, astronomers focus on the stars night after night ahead of time. Here the Reverend Paul A. McNully, S.J., is looking through an eyepiece at a more distant star to train his cameras on our closest star, the sun. During the eclipse he spent his time exposing photographic plates. Everybody on Canton Island saw more of the eclipse than the astronomers; the latter were busy with their recording apparatus. Two members of the *Albatross*'s crew are watching how it is done.

Her commander, Lieut. T. B. Williamson, and his officers and men were most valuable members of the expedition, and the cooperation of the Navy was in every way efficient and helpful.

After finding that Enderbury Island lacked a safe anchorage, we proceeded to Canton Island, 43 miles away, which proved to be ideal for our purpose, although the eclipse there was 30 seconds shorter than on Enderbury.

THE MASSIVE SUN COULD HOLD A MILLION EARTHS

Our program for observing the eclipse was very extensive; in fact, one of the most complete ever undertaken by any one expedition.

Along the shore of the quiet lagoon we set up our delicately poised instruments, puny tools indeed for probing into the secrets of the sun's tremendous inferno (page 385).

The sun is a huge ball of superheated gases, large enough to contain a million planets the size of the earth. Its surface is hotter than the fiercest blast furnace, thousands of degrees Fahrenheit, and its interior temperature probably rises to millions of degrees. It has an atmosphere surrounding it, somewhat as the air or atmosphere surrounds our earth, but of course very different from our own atmosphere.

This atmosphere of the sun is known as the chromosphere, because of its reddish color. It is cooler than the sun, but only

as hot water is cooler than boiling water.

It is believed to be all or most of the materials of which the sun is composed, seething in the form of superheated vapor, and changed into that form by the terrific heat of the sun proper.

All elements known to exist on the sun also exist on earth.

High above the general level of the chromosphere, which is thousands of miles thick, enormous flamelike clouds of hot, rosy-red hydrogen gas, called prominences, shoot up, some moving as much as 100 miles a second.

Some of them have been seen to extend out from the sun as much as 200,000 miles, nearly as far as from the earth to the moon. Even the smaller ones could easily engulf the entire earth were they near enough.

We could see with the naked eye two enormous red prominences during this eclipse, one near the lower edge of the sun and one near its top (page 373). Many more not readily visible to the eye were recorded on our photographs. They are now being measured and studied.

Still farther out around the sun is the mysterious corona, a glorious halo of pearly white light extending millions of miles out into space, forming the most spectacular feature of a total eclipse of the sun. It surrounds the sun at all times, yet can be seen only during a total eclipse because at other times the sun's bright light blots it out.

FLAUNTING A STREAMER FIVE MILLION MILES LONG

In the first few hundred thousand miles outward in any direction from the sun the corona is of roughly equal depth, but from it, in all directions, long pointed streamers like the spines of a sea urchin extend much farther out.

The corona is like the halo that you see around a street lamp on a foggy night. The fog halo is the lamp light scattered by fog particles. The corona's light is believed to be sunlight scattered by vast numbers of inconceivably small particles floating in space around the sun.

This year we saw the corona almost circular in outline out to a distance of nearly a million miles from the sun.* Farther out beyond the sun this year's corona had many long streamers, those extending east and west being longer than those north and

south. The longest streamer recorded on our photographs so far developed was 5,000,000 miles in length.

The chromosphere, the prominences, the corona—all of them vast and awe-inspiring—are the things we study chiefly during an eclipse of the sun. But, strangely enough, it is not their vastness that interests us most, but the structure and behavior of the tiny atoms of which they are composed.

Locked up in the sun's atoms are the secrets of the sun, and though atoms are so small that several hundred million of them could be laid side by side in one inch of space, we can learn a great deal about them even from 93,000,000 miles away.

"FINGERPRINTS" OF DISTANT ATOMS

The wonderful instrument that makes this possible is the spectrograph, which searches out the secrets of atoms across vast distances, and writes them down for all to read.

Point a spectrograph at the sun. The sun's light enters, is broken up into its spectrum of different colors or wave lengths like a rainbow, and is focused on a photographic plate.

In each of the colors of the rainbow thousands of lines appear, like a ladder with rungs close together. This long ladder of light is photographed, and the lines or rungs are as good as a written message for those who can read them (pp. 365, 375).

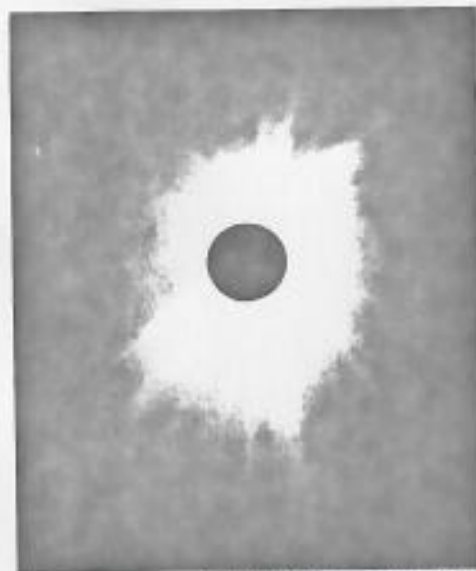
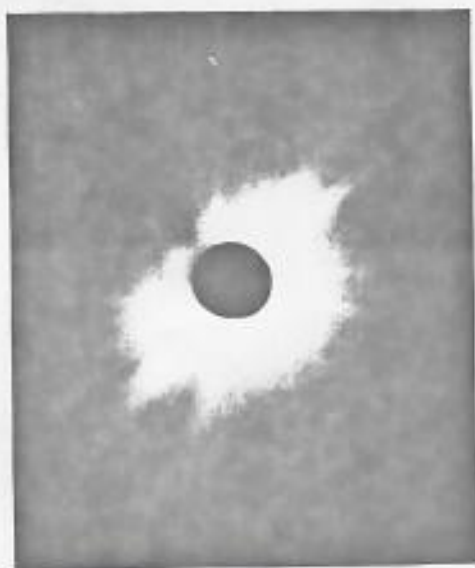
They tell what kinds of materials exist on the sun, in what quantities, how hot they are, to what pressure they are subjected, and whether they are solids or gases.

Each chemical element has an unchangeable identifying set of "finger-prints"—its spectrum lines—that can be seen with the spectrograph.

When a substance in the sun is heated to greater temperature, placed under greater or less pressure, or undergoes some other change, the tiny electrons inside its atoms are excited and rush about. This activity changes the wave length of the vibrations of light that are constantly coming from the atoms of the substance.

Then these changed wave lengths appear in the spectrograph as new lines, or old lines shifted in position or changed in other ways. They tell the astronomer exactly what has been going on.

* The diameter of the sun is about 865,000 miles.



Photographs by E. K. Kistner.

THESE PICTURES WILL HELP REVEAL THE NATURE OF THE SUN'S CORONA

They were taken through screens of "polaroid," the new material that cuts down the glare of automobile headlights. In the upper picture there is a minimum of light along a line from upper left to lower right; and below, a minimum in the horizontal direction. This results from absorption, by the polaroid screens, of the light that is polarized, or vibrating in these directions. From these photographs the percentage of polarized coronal light at various distances out from the sun can be measured; thus may be disclosed the nature of corona material. The longest streamers of the corona in the lower picture extend out 5,000,000 miles.

With the spectrograph he does not take photographs of the eclipse as a whole. Instead he allows the light from the chromosphere, the prominences, or the corona, to enter and be split up into its thousands of lines.

Then he photographs these lines, and so gains enough material to keep him busy for months, or even years afterward, decoding the messages the lines contain.

A FAR-DISTANT LABORATORY

Thanks to the spectrograph, the scientist can use the sun's vast laboratory for studying atoms almost as easily as his own workshop, and from this study has come vastly improved understanding of the structure and behavior of atoms.

But he can get much of his evidence only at eclipses, years apart, and then he can hunt only for a very short time.

He is something like a boy trying to follow a ball game by quick looks through a hole in the fence at the rare intervals when the policeman's back is turned.

Why study atoms? Because everything is made of atoms, from the human body to the most distant stars. By artificially changing atoms, one element actually can be transmuted into another (though so far on a very small scale), a partial realization of the old alchemists' dream of transmuting base metals into gold.

A very quick glance of only a few seconds is all the chance that astronomers have for one of their most important tasks during an eclipse—photographing the spectrum lines of the chromosphere, or sun's atmosphere. These lines tell what materials exist there, and their temperature, pressure, and general behavior, all important for the understanding of solar secrets.

At the time of an eclipse astronomers have an opportunity to learn what is going on in the chromosphere because then they can photograph its spectrum lines without undue complications from the light of the sun itself.

THE CHROMOSPHERE'S "BIG MOMENT"

Ordinarily, when the sun is not eclipsed, its light shines through the chromosphere, and some of it is absorbed by the chromosphere.

But during an eclipse, for a few brief seconds, the chromosphere gets a chance to shine forth with its own glory alone. Then the lines of its spectrum can truly reveal



AN ECLIPSE "GUN CREW" TRAINS FOR THE BIG BARRAGE

"Drill, drill, drill," was the day and night routine to prevent lost time and motion for the 213 seconds of the eclipse. Since an astronomer can hope for only an hour's observation time in his whole life, he can't afford to make mistakes (page 361). Dr. Richtmyer (center with hat) here rehearses putting a plate in his "polaroid camera" (page 370), while sailor assistants from the *Avocet* stand by. This camera took four pictures simultaneously through the four square black openings on its front. The awning kept off the tropical sun.

what is happening to the gases within it.

The chromosphere's "big moment" comes just after the main disk of the sun is covered by the advancing moon. For some three or four seconds then, the moon shuts off the light of the sun proper, and the light of the chromosphere shines alone as a thin, bright, red crescent along the edge of the moon.

Then the moon advances, and the chromosphere, too, is covered. It is a case of "now you see it, now you don't."

The astronomer must be ready at just the right instant to open his shutter and quickly photograph the lines of the chromosphere's spectrum. Again, at the end of the eclipse, the chromosphere shines briefly in the same way.

The lines registered by the chromo-

sphere's light are known as the flash spectrum (page 375). This is because, ordinarily, the spectrum of light from the sun has dark lines on a bright background, known as the Fraunhofer lines, for their discoverer, but at the moment when the advancing moon covers the sun during an eclipse the spectrum suddenly changes to bright lines on a dark background.

Photographing the flash spectrum is generally considered the most difficult feat, not only in observing eclipses, but in photographing all light spectra.

These lines show the kinds of materials existing in the chromosphere, but, more important still, they reveal also the heights to which these elements, all in vaporized form, are shot up above the sun's hot sur-

face, and this can be learned only during an eclipse.

These heights indicate how the different elements are affected by the great heat and pressure conditions on the sun, and this also has added to scientists' understanding of the behavior of atoms.

Our expedition had five spectrographs carefully focused to catch the fleeting flash spectrum.

The apparatus of Dr. Theodore Dunham, Jr., of Mount Wilson Observatory, specially built for this occasion, was the most elaborate ever tried at an eclipse. Assisting him was Mr. Charles G. Thompson, President of the Foundation for Astrophysical Research (page 374).

The Reverend Paul A. McNally, S.J., Director of Georgetown College Observatory, used a spectrograph that previously had been carried on the National Geographic Society-Army Air Corps stratosphere flight in 1935.

I had three spectrographs, belonging to the Mount Wilson Observatory, the U. S. Naval Observatory, and the Allegheny Observatory. During the eclipse I was assisted in operating them by Lieutenant Williamson, the commander of the *Avocet*, and Chief Quartermaster Hancock.

We were successful in catching the chromosphere's quick flash, and the code messages contained in its spectrum lines are now being studied (page 375).

The sun's corona, so thin and tenuous that the stars easily can be seen through it, and comets can pass through it undamaged, also is a target for the spectrograph.

After shooting the flash spectrum, our five spectrographs were trained on the corona during the three and one-half minutes that it was visible during the eclipse, to catch the messages of its spectrum lines.

NEW LINES DISCOVERED IN CORONA'S SPECTRUM

Dr. Dunham already has reported that he has found some new lines of unknown origin in the blue region of the corona's spectrum. Whether they come from a new element or a known element in an unfamiliar state, we do not yet know.

Also we again found the lines of our old and mysterious friend coronium still present in the corona.

Coronium probably is a familiar element so changed by heat or other conditions on the sun that it is unrecognizable. It was

first seen in the corona in 1869. The "code messages" from the corona, like those from the chromosphere, will need many more months of study.

When someone invented a new material called "polaroid," which reduces the glare of automobile headlights, he probably never expected that it would help tell us what the sun's corona is made of. Yet such is the case.

The corona's light is thought to be scattered sunlight, and all scattered light is partially polarized. Ordinary light waves vibrate in all directions as does a taut piece of string when it is plucked, but "polarized" light waves vibrate in only one direction, as would the string if it were lying in a narrow groove and therefore could move only up and down.

If you can measure the percentage of light that is polarized—the percentage that vibrates in only one direction—it will help you to understand the nature of the particles that scatter the light.

Some astronomers believe that the long, spikelike streamers of the corona may have something to do with sunspots. The streamers are most numerous when there are the most spots.

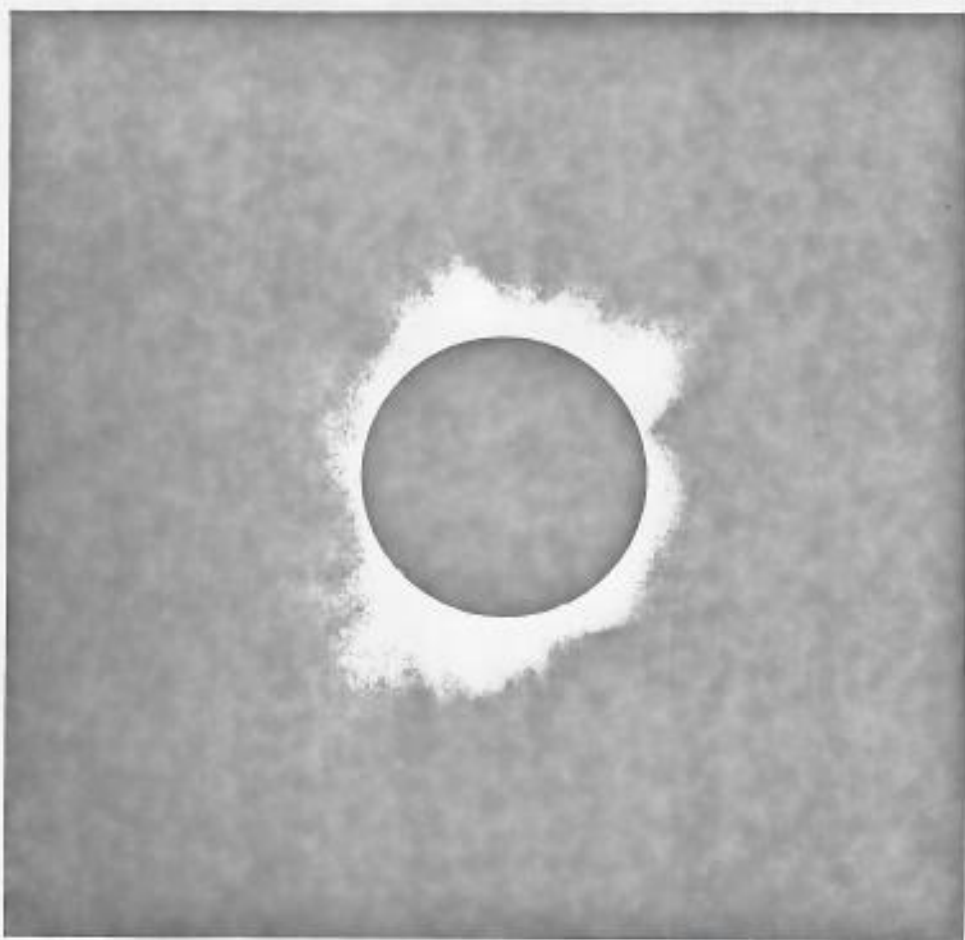
THE FIRST "POLAROID CAMERA"

Measuring the polarization of the streamers helps tell us in what direction the streamers are pointing. If we can learn their direction, we can then try to determine whether sunspots existed on the sun under the bases of the streamers at the time of the eclipse. If so, it might mean that the spots supplied the forces that extended the streamers so far outward.

The polarization measurements were made by Dr. F. K. Richtmyer, of Cornell University, with the first "polaroid camera" ever successfully used at an eclipse of the sun. He photographed the corona through disks of "polaroid," which registered the percentage of polarization of the corona's light on his plates (pages 366, 370, 371).

His photographs show for the first time that the percentage of polarization of the light of the corona and of its streamers increases outward from the sun, which is a new and important aid to better understanding of the nature of the corona.

The variation of the brightness of the corona outward from the sun is a clue to its density or thickness, and the corona's total



Photograph by Irvine C. Gardner

"MOTHER SUN" ARRAYS HERSELF IN MILLION-MILE STREAMERS, AND CHANGES THEIR STYLE EVERY YEAR

Only during a total eclipse can this pearly-white corona around the sun be seen; at other times the sun's light blots it out. On the lower left edge of the moon's black disk is a prominence, a flame-like cloud of hot hydrogen gas, rosy-red, which extends 50,000 miles or more above the surface of the sun. Here the corona appears flat; actually its streamers extend out in all directions. This year the expedition found in it traces of what may be a new chemical element, or a known element in an unfamiliar state (see page 372). This photograph was taken with ten seconds exposure. Longer exposures show the corona extending out some 5,000,000 miles (page 370).

light or candle power is a key to the amount of matter that exists in it. Dr. Richtmyer measured these with delicate, light-sensitive "targets."

First readings of his records indicate that the total light of the corona in this eclipse, as in most previous eclipses, was about equal to one-half that of the full moon or about one millionth the light of the noon-day sun.

Styles in coronas, like styles in ladies' dresses, change from year to year.

One year it may be long streamers extending out on both sides of the sun's equator, with short, stubby ones at the poles. Other years the corona may be roughly star-shaped, or almost round.

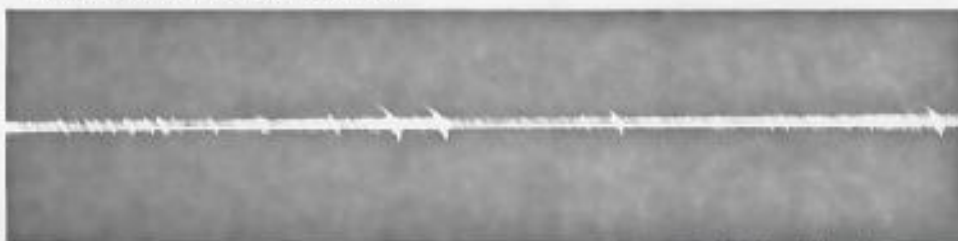
But, unlike ladies' fashions, styles in coronas repeat themselves about every 11 years, and we have reason to believe that this is because the "style arbiter" of the corona is the same mysterious power that causes the numbers of sunspots to increase and decrease over the same period.



Photograph by Theodore Dunham, Jr.

"SOMETHING NEW ON THE SUN" IS THE BULLETIN OF THESE MARKINGS

The faint white lines marked by the arrows were registered by light from the sun's corona during the eclipse in the spectrograph of Dr. Theodore Dunham, Jr. (page 374). Their origin is yet an unsolved mystery, but they represent the "signature" either of a new chemical element previously unknown or of a known element in a state unfamiliar to scientists (page 369). The new lines are in the blue region of the corona's spectrum.



Photograph from Mount Wilson Observatory

WHAT'S DOING ON THE SUN? THIS "CODE MESSAGE" TELLS YOU

The elusive flash spectrum of the sun lasts only a few seconds during an eclipse (page 371). The tiny arcs are registered on the photographic plate by light from the chromosphere, or atmosphere of the sun, just after the advancing moon has covered the main body. The arcs of light tell astronomers how high above the sun the vapors of various chemical elements are rising, some of them shooting up 8,000 miles or more. Thus the solar detectives deduce how various substances are affected by great heat and other conditions which cannot be duplicated on earth.

For this and other reasons it is important to make as many photographs as possible of the corona and also of those hot hydrogen clouds, the prominences, during an eclipse.

Our expedition made many pictures of both, in black and white and in color, with long and short exposures.

NATURAL COLOR PHOTOGRAPHS TAKEN

Mr. Willis took twelve fine pictures of the corona. Dr. McNally made six photographs to record the extent of the corona, and the variation of the intensity of its light outward from the sun. He also made natural color photographs, using three different processes, and took a series of six pictures with six different color filters and emulsions sensitive to various colors, from which he hopes to reconstruct the appearance of the corona in colors.

When photographing the sun's corona in the past, it has been next to impossible to make an exposure long enough to register the faint light of the thin outer ends of the streamers without overexposing the brighter parts of the corona nearer the sun,

and the prominences, and thus losing important details.

So this year Dr. Irvine C. Gardner, of the National Bureau of Standards, tried something new in eclipse photography, a process which was designed to equalize the amount of light reaching his plates from different parts of the corona, thus making it possible to photograph both the long, faint outer streamers and the prominences near the sun with good definition.

He also photographed the eclipse on "color separation plates," which record the red, yellow, and blue ranges of color separately. These plates carried their own filters, greatly improving their definition. Later he will try to combine the different plates to give an accurate color picture of the eclipse. He also made natural color photographs by two different processes.

AN OIL PAINTING AT ONE "SITTING"

To make an oil painting of an eclipse, with the subject giving only one "sitting," and that but three and one-half minutes long, might seem like an impossible undertaking, but it was accomplished by Mr.

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1919
1920
1921



"OLD GLORY," IN NEW STAINLESS STEEL, ADORNS THE MONUMENT UNVEILED
MEMORIAL DAY

George Hicks broadcasts a description of the ceremony as Captain Hellweg lifts a cloth American Flag from the marker which commemorates the Expedition's stay on Canton Island. The small disk in the monument, near Dr. Mitchell (left), is the seal of the National Geographic Society. Behind Captain Hellweg is Dr. McNally's battery of cameras.

Charles Bittinger, of Washington, D. C., our artist.

Motion pictures of the entire eclipse, from the time when the moon first began to cover the sun, throughout totality and until the sun was again uncovered, were made by Mr. Richard H. Stewart, staff photographer of The National Geographic Society.

No report of our expedition would be complete without mention of the three representatives of the National Broadcasting Company.

Mr. M. S. Adams and Mr. Walter Brown, radio engineers, made possible what was probably the first series of radio broadcasts from a desert island in history, and, better still, enabled us to hear on our lonely island the voices of the "folks at home" (pages 392, 393).

Mr. George Hicks, our announcer, did a splendid job of describing the eclipse to the American radio audience (page 394).

Dr. Herman A. Gross, our Navy surgeon, had few patients, but made himself

useful in many other ways. Chief Boat-swain H. S. Bogan, of the *Arcton*, in charge of loading and unloading our instruments, performed extremely valuable service.

We greatly regretted that Dr. Heber D. Curtis, of Allegheny Observatory, who was originally scheduled to be a member of the expedition, was prevented by illness from being with us.

To the following may I express the appreciation of the expedition for instruments and materials loaned, manufactured or supplied, for services rendered, and for other valuable aid:

Mount Wilson Observatory; Allegheny Observatory; the U. S. Navy and the Naval Observatory; Eastman Kodak Company; Dr. C. W. Gartlein, of Cornell University; Mr. William P. Roth, President, Matson Navigation Company; the Weston Electrical Instrument Corporation; National Bureau of Standards; Folmer Graflex Corporation; the Bausch and Lomb Optical Company; the Carrier Corporation, and the Serval Company.

review

Pac GC 861 B37

Line Islands

Barkley, Richard A.

Pac DU 615 A3

St. Britain

Colonial Office -

Gilbert and Ellice islands

colony, report for the years

Micro 3947

(reviewed ^{Hamilton} 5/29/74)

Ref. Z4737

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Line Is - Bibliography

K73

Krauss, Noel

1970

18p

Gilbert & Ellice

phosphate, Copra, shark fin -

Bees on Fanning 1924 -

Language of Gilbert entirely different from Ellice -

Ocean Is people closely related to Gilberts -

1937 - population 3 European 59 natives - ^{Hull} Canton

18th March 1937 Phoenix Is included

by an order in Council

Close of 1938 - 17 Europeans, 132 natives, 1 Asiatic

1938

Phoenix Is settlement scheme - Dec first

batch of Gilbert Is. settlers proceeded

to the P.I. -

End of 1947 - 65 scheduled landings per month Canton

^{report}
1947 - ordinance establish "Line Islands District"

Rabbits - Phoenix Is.

"By 1940 some 600 Gilbertese from overcrowded Southern G.I. had been successfully transferred to Hull, Sydney and Gardner given names Orona, Manra & Nikumara

Colonial Report 1950 and 1951 - (First mentioned)

G and F I Colony & Central & Southern Line Islands - Note on the

Central and Southern Line Islands

52 & 53 Same note

54 & 55 - Sydney no good due to salty land and poisonous fish - move them to GIZO(?) BSIP - Pan Am out same note P89 with addition

56 & 57 - note on 88

58 and 59 Resettlement began in 55 continued during 1958 with emigration of a further 215 Gilbertese from Sydney to GIZO. Now has no permanent pop., is worked as a plantation by the Phoenix Is. Co-operative Society
Note on 93 and 94

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