SEA TURTLES - TOKELAU IS. FILE

G. H. BALAZS

1 of 2

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20-822 20-823

P.O. BOX 865 APIA
WESTERN SAMOA

Western Union -
INTERNATIONAL 37-6311

18/2/4

9-18
Pedro will accompany
Balazs on turtle investigation

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

16 June 1981

Balazs
UNIHMW

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

Dear Dr Balazs,

Further to my letter of 10 March, I can now confirm that we would welcome a visit by you and your colleague to Tokelau later in the year. You note in your letter of 27 February, that you would prefer to travel to Tokelau in October and we do have a vessel tentatively scheduled to leave Apia on 17 October.

I cannot, however, confirm at this stage that this will definitely be the departure date; indeed, it is unlikely that I can confirm the date until at best, some two to three weeks before the scheduled date. I would suggest, therefore, that you tentatively plan on the basis of a 17 October departure but that you check with us around the beginning of that month before committing yourself irrevocably. I regret the uncertainty of this advice, but such are the problems of travelling to Tokelau!

For your information, the tentative schedule for the October sailing is:

Saturday, 17 October	early a.m.	Depart Apia
Sunday, 18 October	0900	Arrive Nukunonu
	1900	Depart Nukunonu
Monday, 19 October	0600	Arrive Atafu
	1900	Depart Atafu
Tuesday, 20 October	0600	Arrive Fakaofo
Wednesday, 21 October		At Fakaofo
Thursday, 22 October	1300	Depart Fakaofo
	1630	Arrive Nukunonu
	1900	Depart Nukunonu
Friday, 23 October	0600	Arrive Atafu
	1000	Depart Atafu
Saturday, 24 October	late afternoon	Arrive Apia

I look forward to receiving in due course, more details about your planned travel and work programmes.

Yours sincerely,

(J P Larkindale)
Official Secretary

955-1155 Continental - SUN. WED. FRIDAY

PAGO #498 - pay within 3 days

#440 - 30-day advance - 85% penalty

586-0844 SPIA -

PAGO - SAME

APIA - #558

#510 - 30-day advance - 15% penalty

University of Hawaii at Manoa

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

21 August 1981

Mr. J.P. Larkindale
Official Secretary
Office for Tokelau Affairs
P.O. Box 865 APIA
Western Samoa

Dear Mr. Larkindale:

Thank you for your letter of 16 June 1981. I regret that it has not been possible for me to write to you at an earlier date, however, I want to assure you that I am indeed pleased to learn of your favorable response. The vessel dates for an October visit to Tokelau are well-suited to my schedule. Furthermore, changes that may arise 2-3 weeks prior to the departure date can be accomodated on my part.

There is now a question as to whether or not William Pedro of the Office of Marine Resources in American Samoa will be able to participate in this visit. An expedition to Rose Atoll is being undertaken by his agency during October which may require Mr. Pedro's involvement. I will obtain clarification on this point and contact you again within the next two weeks.

The basic study plan for my visit will be to exchange as much information as possible relating to sea turtles with the residents of each island. If sufficient time is available, I would also like to personally visit some of the sites where turtles nest or reside in nearshore waters.

I appreciate your support of this project and feel confident that it will be of benefit to all parties involved.

Sincerely,

George H. Balazs
Assistant Marine Biologist
and Deputy Chairman
IUCN/SSC Marine Turtle Specialist Group

GHB:lb

University of Hawaii at Manoa

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

September 16, 1981

Mr. J.P. Larkindale
Official Secretary
Office for Tokelau Affairs
PO Box 865 Apia, Western Samoa

Dear Mr. Larkindale:

I am pleased to tell you that it will be possible for Mr. William Pedro of the American Samoa Office of Marine Resources to accompany me on the study visit to Tokelau. I plan to arrive in Apia on October 15th, and will contact you shortly thereafter. William will arrive on the afternoon of the 16th. If there are any changes in the vessel's departure date, please contact me by telegram as soon as possible.

I would like to know if your office and each of the islands of Tokelau have a copy of the publication "Ethnology of Tokelau" by Gordon Macgregor. This was issued some years ago by the Bishop Museum here in Honolulu. If you do not have copies, I will bring several with me to give to the proper authorities.

Sincerely,

George H. Balazs
Assistant Marine Biologist &
Deputy Chairman
IUCN/SSC Marine Turtle Specialist Group

University of Hawaii at Manoa

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

September 16, 1981

Dr. Dick Wass
Office of Marine Resources
Government of American Samoa
Pago Pago, American Samoa 96799

Dear Dick:

I was very pleased to learn that William has approval to join with me on the sea turtle expedition to Tokelau. From the last word I received, the vessel is still scheduled to depart from Apia on October 17th in the early am hours. I plan to arrive in Apia a few days in advance, but right now do not have firm dates. I may not be able to stop over in Pago on the way down because of the costs involved.

I did not include William's air fare between Pago and Apia in my World Wildlife Fund grant application because it would have pushed the total funding request over $1000. I know that this would have placed me at a disadvantage in the evaluation process. I hope that the cost of William's fare will not be a hardship on your office. I am confident that it will represent money well spent.

Best regards,

George H. Balazs

cc William Pedro

University of Hawaii at Manoa

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

August 28, 1981

Dr. Thomas E. Lovejoy
Program Director
World Wildlife Fund-U.S.
1601 Connecticut Avenue, N.W.
Washington, D.C. 20009

Dear Dr. Lovejoy:

My enclosed proposal entitled "Cooperative Marine Turtle Conservation and Assessment in the Tokelau Islands" is being submitted for funding consideration as the result of encouragement received during a recent telephone inquiry to Program Administrator Nancy Hammond.

Please note that the modest amount being requested from World Wildlife Fund-U.S. ($785) will be matched by approximately $500 in travel costs and other forms of assistance contributed by the Office for Tokelau Affairs. This is admittedly a small project, but nevertheless one of potentially longterm significance to the isolated and resource-limited native inhabitants of Tokelau. I should also point out that this cooperative work responds directly to Action Projects 66, 110, 114, 132 and 135 of the Sea Turtle Conservation Strategy that resulted from the World Conference on Sea Turtle Conservation.

As requested, by copy of this letter I am informing Bob Scott at IUCN/SSC of my proposal for financial aid from World Wildlife Fund-U.S.

Thank you for your consideration. I look forward to hearing from you on this matter at your earliest convenience.

Sincerely,

George H. Balazs

George H. Balazs
Assistant Marine Biologist

GHB:lb

enclosure

WORLD WILDLIFE FUND

DATE	ACCOUNT	DESCRIPTION	AMOUNT
09-17-81	32960186	000000 ~~Abundance, distr. & movements of olive ridley sea turtles~~ Cooperative Marine Turtle Conservation and Assessment in the Tokelau Islands	$785.00

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED ABOVE
IF NOT CORRECT PLEASE NOTIFY US PROMPTLY. NO RECEIPT DESIRED

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED ABOVE
IF NOT CORRECT PLEASE NOTIFY US PROMPTLY. NO RECEIPT DESIRED

WORLD WILDLIFE FUND
1601 CONNECTICUT AVENUE, NW.
SUITE 800
WASHINGTON, DC, 20009
PHONE: 202-387-0800

CONNECTICUT AVENUE OFFICE
NATIONAL SAVINGS & TRUST CO.-10
1225 CONNECTICUT AVENUE, N.W.
WASHINGTON, D. C. 20036

No 1529

15-52/540

September 17 1981

PAY W.W.F. INC. $785 AND 00 CTS. DOLLARS $ 785.00

TO THE ORDER OF George H. Balazs

WORLD WILDLIFE FUND

R C

E.U. Curtis Bohlen

⑈0000 1529⑈ ⑆054000522⑆ 104⑈ 16 18 776⑈

WORLD WILDLIFE FUND

DATE	ACCOUNT	DESCRIPTION	AMOUNT
09-17-81	32960186	000000 ~~Abundance, diets, & movements of olive ridley sea turtles~~ Cooperative Marine Turtle Conservation and Assessment in the Tokelau Islands	$785.00

DETACH AND RETAIN THIS STATEMENT
THE ATTACHED CHECK IS IN PAYMENT OF ITEMS DESCRIBED ABOVE
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1601 CONNECTICUT AVENUE, NW.
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⑈0000 1529⑈ ⑆054000522⑆ 104⑈ 16 18 776⑈

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20 822 20 823

P.O. BOX 865 APIA
WESTERN SAMOA

18/2/4

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

8 September 1981

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

Dear Dr Balazs,

Thank you for your letter of 21 August confirming that you will be able to travel to Tokelau on the October charter.

The actual timing of the charter is, however, still somewhat uncertain. Since I last wrote to you, we have succeeded in negotiating a four year charter of a vessel to service Tokelau. The ship is currently undergoing a number of modifications and alterations to suit her better to our needs and it is too early to be able to state just when it can return to Apia to undertake the October voyage. I will let you know of a confirmed schedule just as soon as possible, but in the meantime we are still working on the assumption that a 17 October departure from Apia is possible.

We have also had to revise the schedule for this sailing, to take into account the vessel's speed and our various commitments in Tokelau. The schedule now is:

Saturday, 17 October	2000	Depart Apia
Monday, 19 October	0600	Arrive Nukunonu
	1200	Depart Nukunonu
	1630	Arrive Fakaofo
	1900	Depart Fakaofo
Tuesday, 20 October	0600	Arrive Atafu
	1900	Depart Atafu
Wednesday, 21 October	0600	Arrive Fakaofo
Thursday, 22 October	At Fakaofo	
Friday, 23 October	1900	Depart Fakaofo
Saturday, 24 October	0600	Arrive Nukunonu
	1200	Depart Nukunonu
	1630	Arrive Fakaofo
	1900	Depart Fakaofo
Sunday, 25 October	0600	Arrive Atafu
	1200	Depart Atafu
Tuesday, 27 October	0600	Arrive Apia

There is a possibility, if the volume of cargo justifies it, that the vessel will return to Nukunonu for the day of 22 October.

I hope that these schedule changes will not inconvenience you too much and I look forward to meeting you in October.

Yours sincerely,

(J P Larkindale)
Official Secretary

JPL:mnc

University of Hawaii at Manoa

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

September 22, 1981

Mr. J. P. Larkindale
Office for Tokelau Affairs
P.O. Box 865 Apia
Western Samoa

Dear Mr. Larkindale:

Concerning the revised schedule information contained in your letter of 8 September 1981, I would be interested to learn of the size and source (nationality) of the vessel that has recently been obtained for charter to Tokelau. It is desirable that I provide this information to the University of Hawaii Administration and contracting officials of my affiliate agency, the National Marine Fisheries Service.

All plans still remain firm for William Pedro and me to undertake the October visit to Tokelau.

Best regards.

Sincerely,

George H. Balazs
Assistant Marine Biologist

GHB:le

University of Hawaii at Manoa

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

September 21, 1981

Nancy Hammond
Program Administrator
World Wildlife Fund- U.S.
1601 Connecticut Avenue, N.W.
Washington, D.C. 20009

Dear Nancy:

Thank you for your letter of September 18th and the check that arrived this morning. I am most appreciative for your prompt action in this matter.

The form for financial reports and the Cornelius/Robinson proposal were not enclosed with your letter, as indicated. This has probably already come to your attention and they are now in the mail to me.

Peter Pritchard recently wrote to me and mentioned that WWF-US would probably be providing funds to the Cayman Turtle Farm for the rearing of Kemp's ridleys. If possible, I would really like to know the details of this grant.

Best regards- warm aloha,

George H. Balazs
Assistant Marine Biologist

enclosure

GHB:le

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

Geo Balazs
c:DO/Ad

September 24, 1981 F/SWC2:RSS

Dr. Philip Helfrich
Director, Hawaii Institute
of Marine Biology
P. O. Box 1346
Kaneohe, HI 96744

Dear Phil,

This is to confirm our discussion on the proposed trip by George Balazs to survey the turtle resources of the Tokelau Islands. I believe it would be to the best interest of the University of Hawaii and the Federal Government if George did take advantage of this unique opportunity to obtain data on the turtle resources of the area. I'm glad that you fully agree with me on this point.

In discussing details of the Tokelau trip with George, he indicated that he would like to spend several days in Western Samoa in order to follow up on a study he is undertaking with researchers from Western Samoa on the hawksbill headstart project. The National Marine Fisheries Service is keenly interested in the hawksbill population in Western Samoa since we believe that the hawksbill showing up in American Samoa probably comes from one single intermingling population. Since the per diem costs to cover George's stay in Western Samoa will not run more than several hundred dollars we would be willing to cover the cost of this portion of George's trip. I would like to suggest that you send us a bill after George's return from this trip to cover the Western Samoa portion.

Sincerely,

Richard S. Shomura
Director, Honolulu Laboratory

cc: G. Balazs

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NNNN RW

1981 SEP 23 PM 7 04

ZCZC WHH261 NZ0339 WSA233

HWHU CO SXAP 049

APIA 49 23 1505

BALAZS UNIHAW
P.O. BOX 1346
XXXXXXXXX KANEOHE, HI 96744

111 THANKS YOUR TELEGRAM OF 18 SEPTEMBER WILL ADVISE DATE
OF SAILING FROM APIA AS SOON AS POSSIBLE FOR YOUR INFO
IT IS LIKELY THAT THERE WILL BE 10 TO 14 DAYS DELAY
TO NEXT TRIP.
ORIGINALLY SCHEDULED FOR DEPARTURE APIA 17 OCTOBER
REGARDS

LARKINDALE TOKALANI

1981 SEP 24 AM 8 29

TELEPHONED:
TO: Mary
BY:
REPLY-WUI
PHONE-537-631

COLL 111 18 10 14 17

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9-24

D
HJ SVC POS 1+
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ZCZC HUA344 VIA ITT ZUI159 WSA233
HARU CO SXAP 049
APIA 49 23 1505

X 247-6631
G. BALAZ - SECRETARY

BALAZS
UNIHAW
HONOLULU

III THANKS YOUR TELEGRAM OF 13 SEPTEMBER. WILL ADVISE DATE OF SAILING FROM APIA AS SOON AS POSSIBLE. FOR YOUR INFO, IT IS LIKELY THAT THERE WILL BE 10 TO 14 DAYS DELAY TO NEXT TRIP, ORIGINALLY SCHEDULED FOR DEPARTURE APIA 17 OCTOBER.
REGARDS, LARKINDALE TOKALANI

COL 111 13 10 14 17

BARRY D. SIMMONS D.D.S. P.C.
GENERAL DENTISTRY
847 SOUTH MILLEDGE AVENUE
ATHENS, GEORGIA 30601
TELEPHONE (404) 546-1716

9-29-81

Dear George.

Thank you for your letter 18 September.

In any government (if the opportunity presents itself) there is a Minister and/or Secretary of Health. This person(s) would be my contact.

Explain that Dental Health International begins dental projects in developing countries. We are responsible for personnel (dentists) and equipment.

Again, I understand the relatively small chance of your meeting with these people, but perhaps sea turtle/nutrition and oral health and the Ministry of Health?

I am planning the Solomon Islands for next year! I could fly via Tokelau. Thank you very much sincerely, Barry

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ELIZABETH

BALA ZS UNIHAW
HONOLULU HAWAII

113 REGRET TO ADVISE THAT TOKELAU CHARTER IS VIRTUALLY CERTAIN TO BE DELAYED AND IS UNLIKELY TO DEPART APIA BEFORE 31 OCTOBER AT THE EARLIEST WILL ADVISE SOONEST ONCE EXACT DEPARTURE DATE IS KNOWN APOLOGISE FOR INCONVENIENCE REGARDS
LARKINDALE TOKALANI

COL 113
31

RCA Global Telegram
Reply via RCA: call 212-248-7000

AMERICAN SAMOA GOVERNMENT
PAGO PAGO, AMERICAN SAMOA 96799
OFFICE OF MARINE RESOURCES

In reply refer to:

August 31, 1981

Dr. George H. Balazs
Hawaii Institute of Marine Biology
P. O. Box 1346
Kaneohe, Hawaii 96744

Dear George:

Henry has asked me to reply to your letter of August 21 regarding William's participation in your visit to the Tokelau Islands October 17-24, 1981.

We would be pleased to have William accompany you. It will be a valuable experience for William and serve as in indication of the American Samoa Government's commitment toward sea turtle conservation and increased understanding of the resource.

In your letter you mentioned the possibility of a few days in Apia prior to and following the boat trip to theTokelaus. Because William has spent a lot of time away from the office lately, we would prefer that he spend no extra days in Apia unless necessitated by the departure and/or arrival times of the vessel.

It was also our understanding that your grant would cover William's round trip airfare to Apia. Do the conditions of the grant from IUCN/World Wildlife Fund preclude this possibility?

Our new vessel, the Sausauimoana, has just returned from its maiden voyage to Swains Island. Ernie Kosaka has already inquired about the possibility of taking her to Rose Island some time this year.

Tofa,

Dick

RICHARD C. WASS
Fishery Biologist

cc: William Pedro
Henry Sesepasara

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

October 8, 1981

Mr. A.L. Phillip
Chief Fisheries Officer
Economic Development Department
PO Box 832; Fisheries Department
Apia, Western Samoa

Dear Mr. Phillip:

I am writing to tell you that I will be arriving in Apia on the evening of October 15 to visit the Tokelau Islands for 10 days departing Apia on the evening of October 17. I hope to be able to visit with Viliamu at the turtle hatchery for a few days when I return to Apia from Tokelau.

I understand from Dr. Helfrich of my affiliate research agency, the Hawaii Institute of Marine Biology, that Mr. Harry Sperling will be in Apia at the time of my arrival. I would very much like to have the opportunity to meet with him for a short time on Friday October 16. If you know where he is staying, would you please give him this message. I have reservations at the Tiafau Hotel.

I look forward to seeing you again.

Sincerely,

George H. Balazs
Fishery Biologist

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

OCTOBER 6, 1981

MR. WILLIAM PEDRO
OFFICE OF MARINE RESOURCES
PAGO PAGO, AMERICAN SAMOA

DEAR WILLIAM:

I HAVE JUST NOW RECEIVED ANOTHER TELEGRAM FROM THE OFFICE FOR TOKELAU AFFAIRS WHICH STATES THAT THE VESSEL PROBLEMS HAVE BEEN SOLVED AND IT WILL DEPART FROM APIA ON OCTOBER 17 AS ORIGINALLY PLANNED. ACCORDING TO THE TELEGRAM, THIS IS A VERY FIRM DATE. I FEEL THAT IT IS VERY IMPORTANT FOR YOU TO GO ON THIS TRIP AS WE HAD PLANNED, SO HOPEFULLY ALL OF THE NECESSARY ARRANGEMENTS CAN BE MADE ON YOUR PART.

I WILL BE IN APIA BY THE EVENING OF THE 15th OF OCTEBER AND WILL BE AT THE TIAFAU HOTEL.

BEST REGARDS,

GEORGE BALAZS

Copy to Dick Wass

Head Teacher, Fakaofo (Hosea Kirifi)

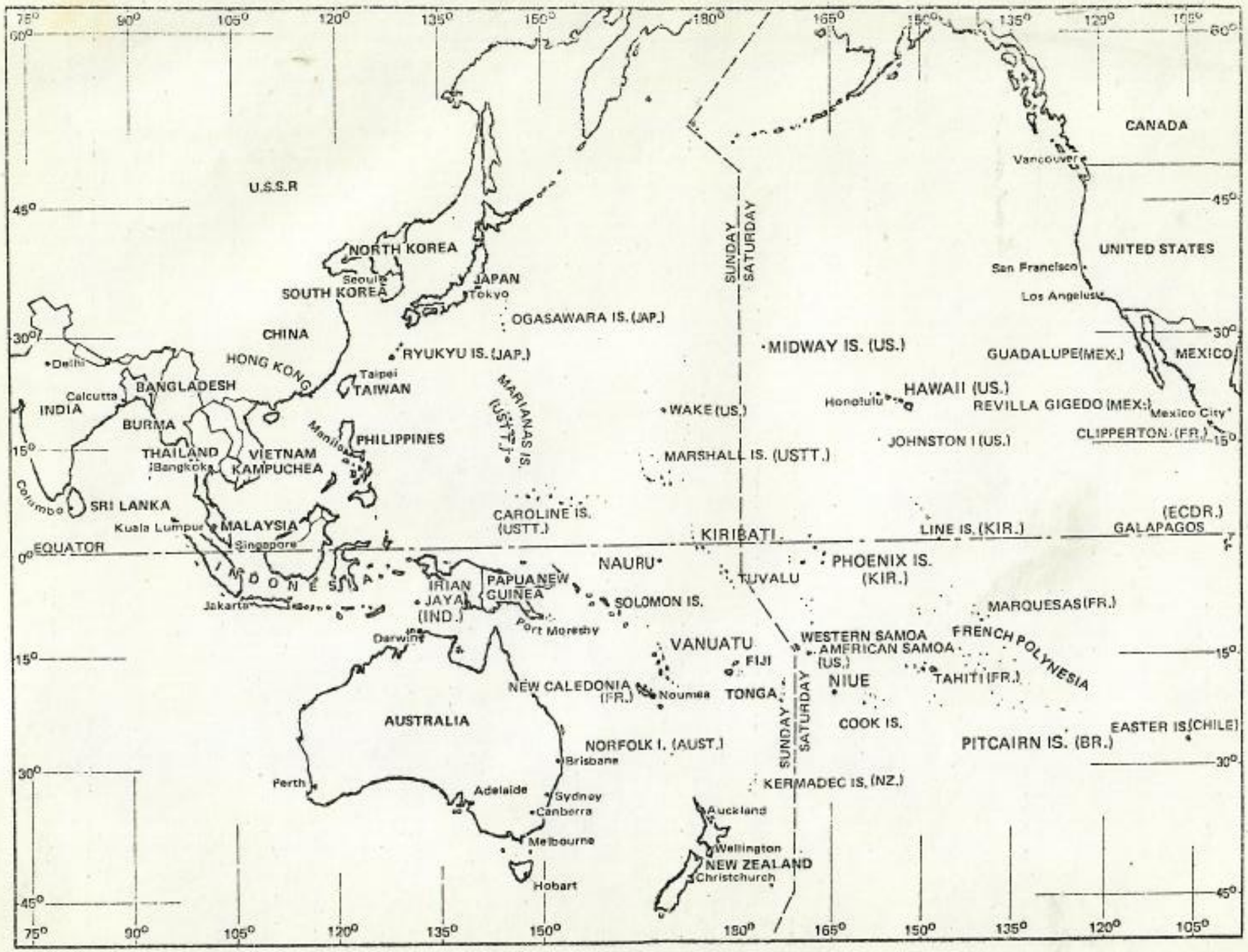
Nukunonu (Luciano Perez)

Atafu (Tenise Atoni)

c/- Office for Tokelau Affairs,

P.O. Box 865,

Apia.


U.S.S.R
NORTH KOREA
Seoul
SOUTH KOREA
JAPAN
Tokyo
OGASAWARA IS. (JAP.)
CHINA
HONG KONG
RYUKYU IS. (JAP.)
Taipei
TAIWAN
Delhi
Calcutta
INDIA
BANGLADESH
BURMA
Manila
PHILIPPINES
MARIANAS IS. (USTT.)
THAILAND
Bangkok
VIETNAM
KAMPUCHEA
Colombo
SRI LANKA
Kuala Lumpur
MALAYSIA
Singapore
EQUATOR
INDONESIA
Jakarta
IRIAN JAYA (IND.)
PAPUA NEW GUINEA
Port Moresby
Darwin
AUSTRALIA
Perth
Adelaide
Brisbane
Sydney
Canberra
Melbourne
Hobart
NORFOLK I. (AUST.)
NEW CALEDONIA (FR.)
Noumea
VANUATU
FIJI
TONGA
NEW ZEALAND
Auckland
Wellington
Christchurch
KERMADEC IS. (NZ.)
NAURU
TUVALU
SOLOMON IS.
KIRIBATI
CAROLINE IS. (USTT.)
MARSHALL IS. (USTT.)
WAKE (US.)
MIDWAY IS. (US.)
JOHNSTON I (US.)
HAWAII (US.)
Honolulu
PHOENIX IS. (KIR.)
LINE IS. (KIR.)
WESTERN SAMOA
AMERICAN SAMOA (US.)
NIUE
COOK IS.
TAHITI (FR.)
FRENCH POLYNESIA
MARQUESAS (FR.)
PITCAIRN IS. (BR.)
EASTER IS. (CHILE)
GALAPAGOS (ECDR.)
CLIPPERTON (FR.)
REVILLA GIGEDO (MEX.)
GUADALUPE (MEX.)
MEXICO
Mexico City
CANADA
Vancouver
UNITED STATES
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Los Angeles
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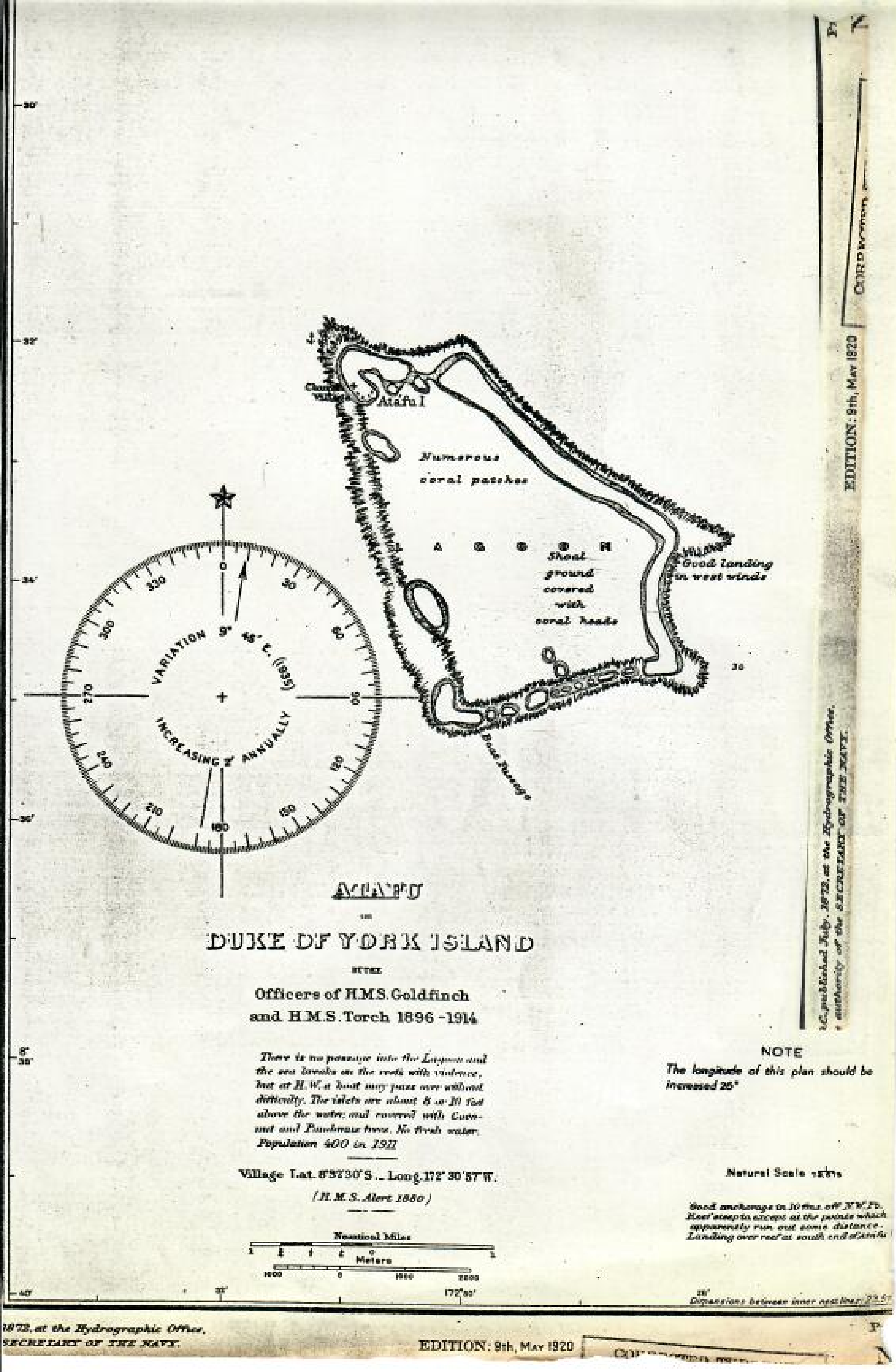
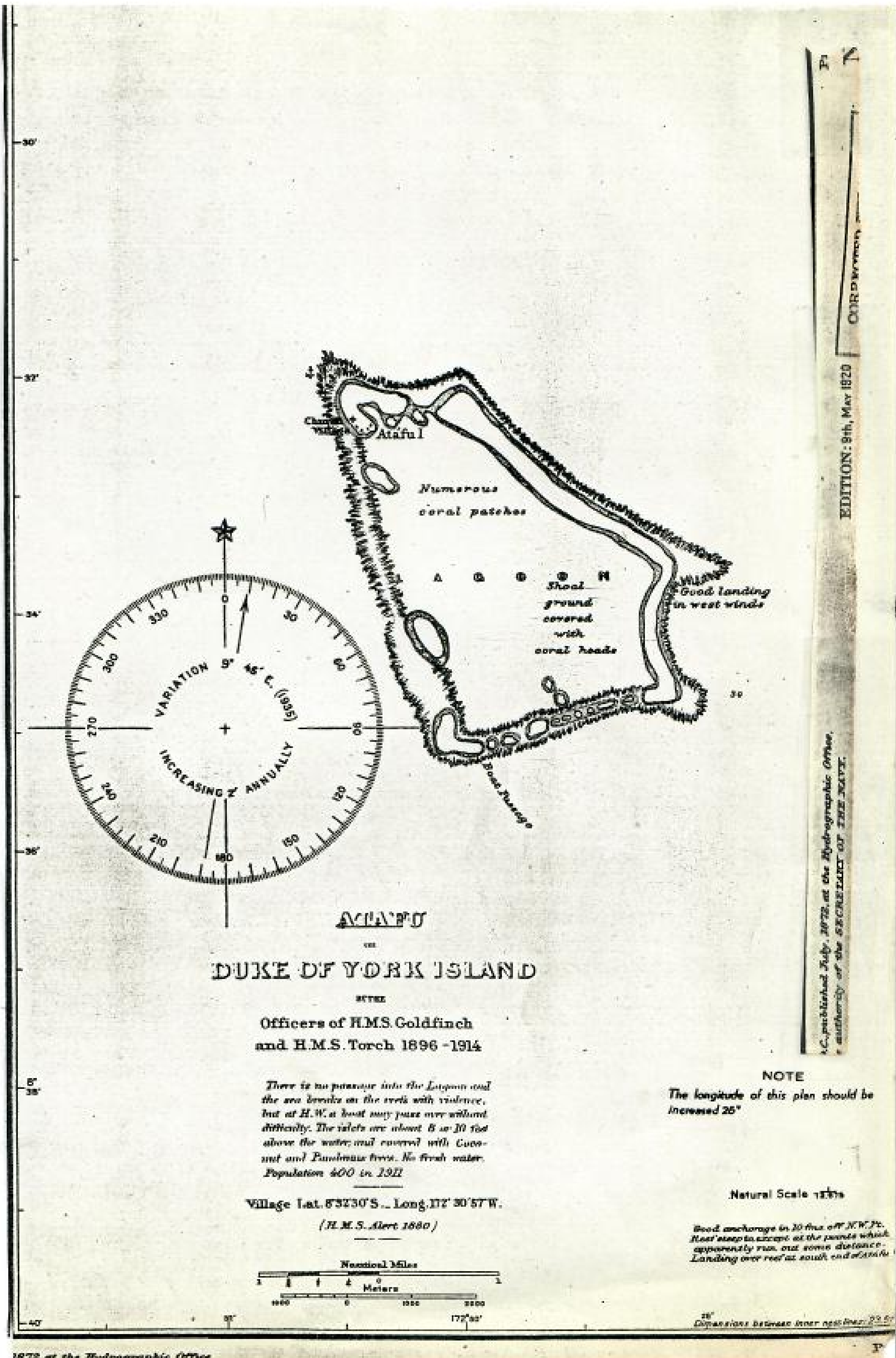


Atafu I
Numerous
coral patches
A G O O N
Shoal
ground
covered
with
coral heads
Good landing
in west winds
Boat Passage
VARIATION 9° 45' E. (1935)
INCREASING 2' ANNUALLY
DUKE OF YORK ISLAND
Officers of H.M.S. Goldfinch
and H.M.S. Torch 1896 - 1914
There is no passage into the Lagoon and
the sea breaks on the reefs with violence,
but at H.W. a boat may pass over without
difficulty. The islets are about 8 or 10 feet
above the water and covered with Cocoa-
nut and Pandanus trees. No fresh water.
Population 400 in 1911
Village Lat. 8°32'30" S. _ Long. 172° 30' 57" W.
(H.M.S. Alert 1880)
Nautical Miles
Meters
NOTE
The longitude of this plan should be
increased 25"
Natural Scale
Good anchorage in 10 fms. off N.W. Pt.
Reef steep to, except at the points which
apparently run out some distance.
Landing over reef at south end of islets
EDITION: 9th, May 1920
1872, at the Hydrographic Office,
SECRETARY OF THE NAVY.


ATAFU
OR
DUKE OF YORK ISLAND
BY THE
Officers of H.M.S. Goldfinch
and H.M.S. Torch 1896 -1914
There is no passage into the Lagoon and the sea breaks on the reefs with violence, but at H.W. a boat may pass over without difficulty. The islets are about 8 or 10 feet above the water, and covered with Cocoanut and Pandanus trees. No fresh water. Population 400 in 1911
Village Lat. 8°32'30"S. Long. 172° 30' 57"W.
(H.M.S. Alert 1880)
Nautical Miles
Meters
Atafu I
Numerous coral patches
L A G O O N
Shoal ground covered with coral heads
Good landing in west winds
Boat Passage
VARIATION 9° 45' E. (1935)
INCREASING 2' ANNUALLY
NOTE
The longitude of this plan should be increased 25"
Natural Scale
Good anchorage in 10 fms off N.W. Pt. Reef steep to except at the points which apparently run out some distance. Landing over reef at south end of Atafu
EDITION: 9th, May 1920
1872, at the Hydrographic Office, SECRETARY OF THE NAVY.
EDITION: 9th, May 1920

NOTE

The longitude of this plan should be decreased 3'13" and the latitude decreased 14"(1934)

NUKUNONO
OR
DUKE OF CLARENCE ISLAND

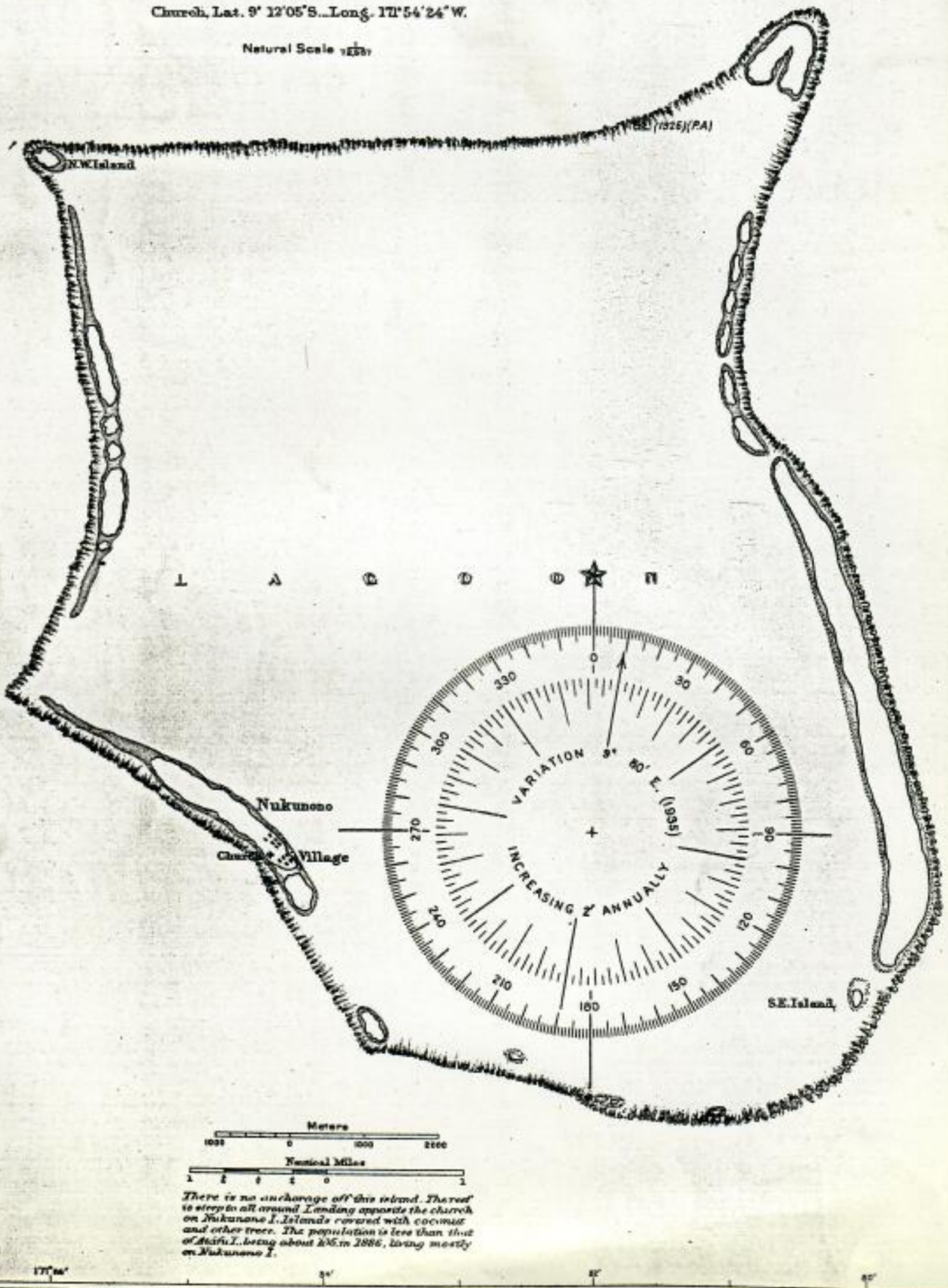
BY THE

Officers of H.M.S. Goldfinch

1896

Church, Lat. 9° 12'05"S., Long. 171°54'24"W.

Natural Scale 1/25,000



There is no anchorage off this island. The reef is steep all around. Landing opposite the church on Nukunono I. Island covered with cocoanut and other trees. The population is less than that of Atafu I., being about 165 in 1886, living mostly on Nukunono I.

Small corrections from Notices to Mariners.

Printed:	Nov. '24	Nov. '29	May '34	Apr. '41	Nov. '42	Aug. '43
					'42 – 38	'43-22

Washington, D.C., published July, 19

NUKUNONO
OR
DUKE OF CLARENCE ISLAND

BY THE

Officers of H.M.S. Goldfinch

1896

Church, Lat. 9° 12'05"S...Long. 171°54'24"W.

Natural Scale 1/25,000

NOTE

The longitude of this plan should be decreased 3'13" and the latitude decreased 14"(1934)

N.W.Island

Nukunono

Village

S.E.Island

TABOOM

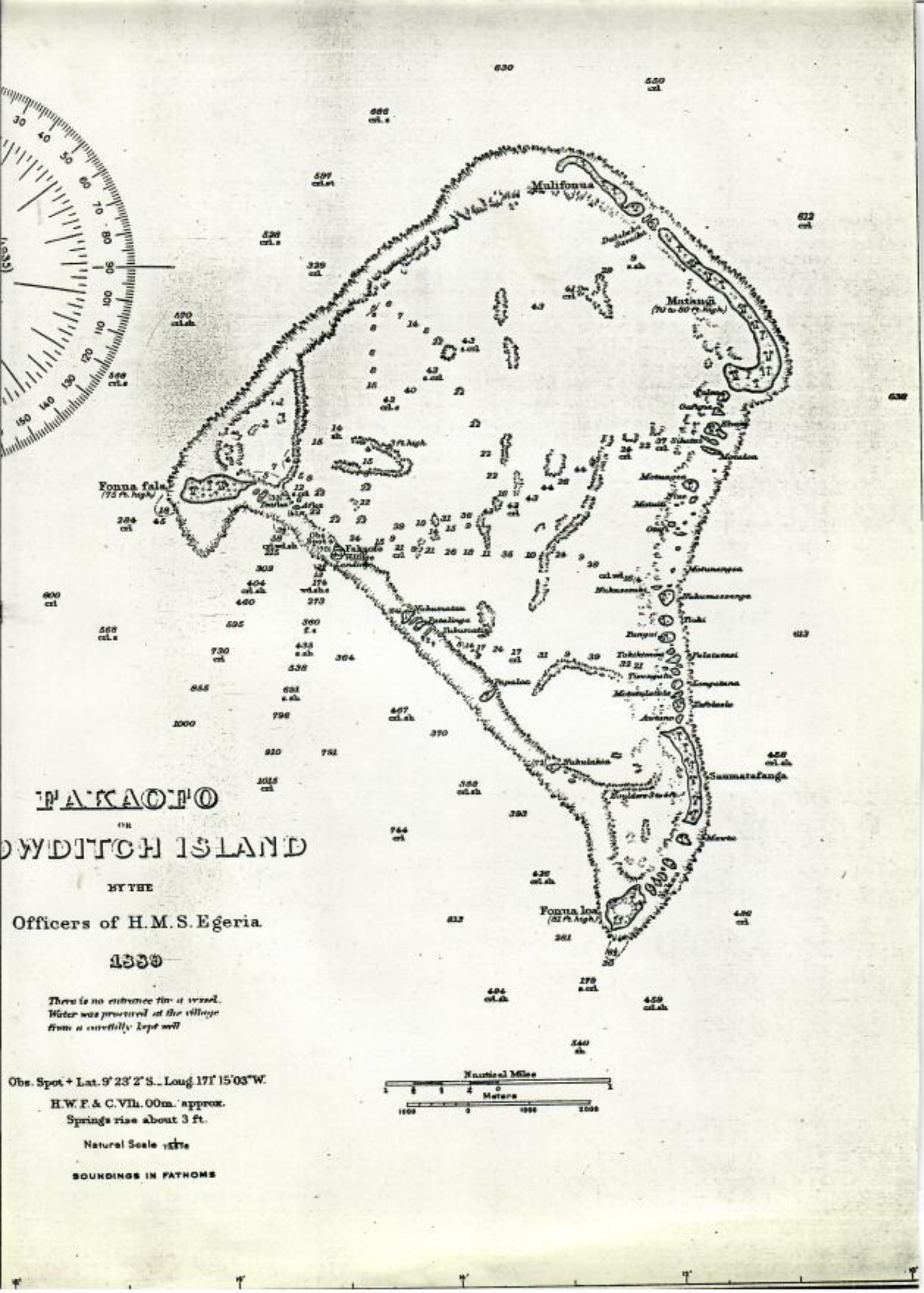
VARIATION 9° 80' E. (1935)

INCREASING 2' ANNUALLY

Meters

Nautical Miles

There is no anchorage off this island. The reef is steeps all around. Landing opposite the church.



FAKAOFO

OR

OWDITCH ISLAND

BY THE

Officers of H.M.S. Egeria.

1859

There is no entrance for a vessel. Water was procured at the village from a carefully kept well

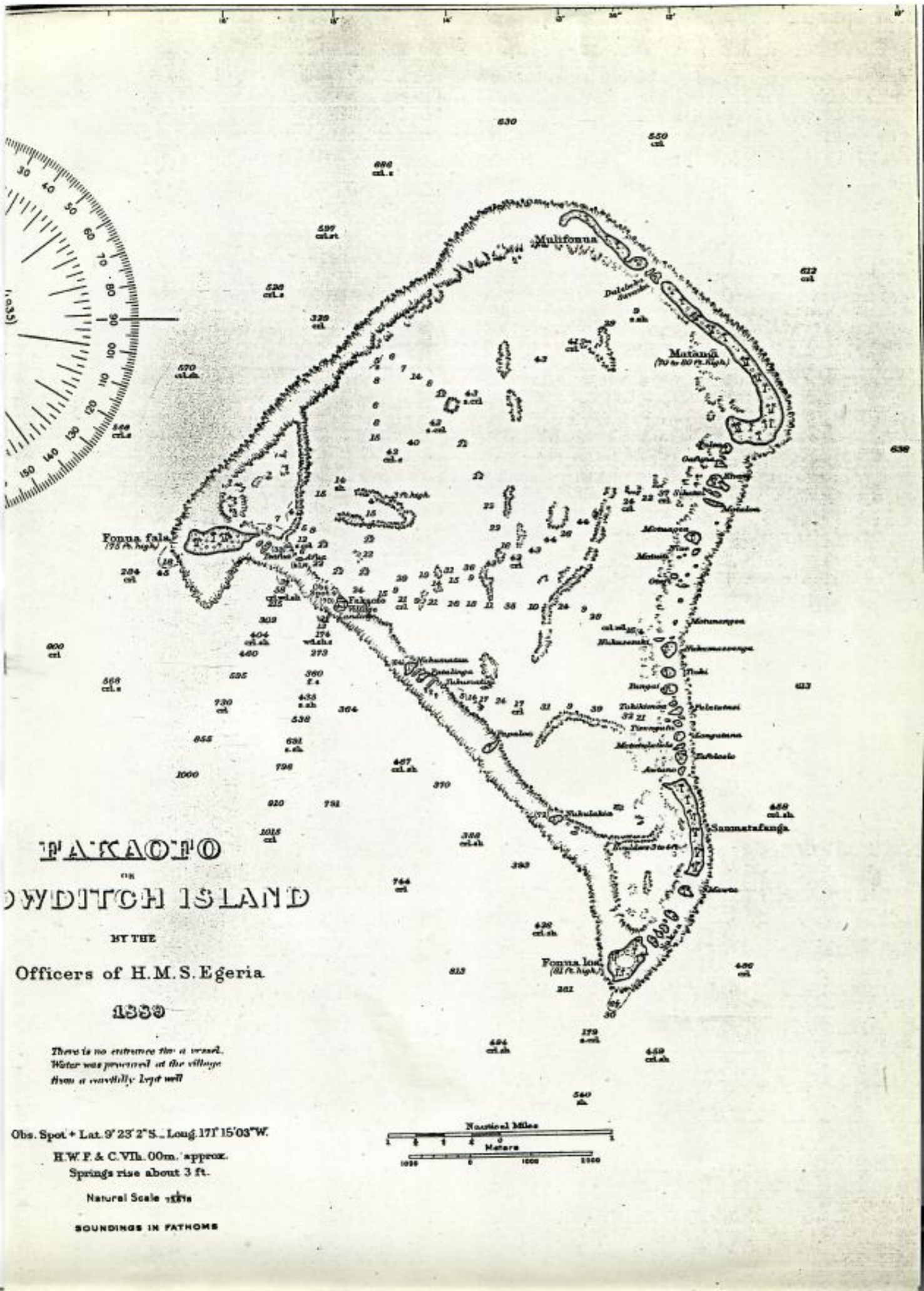
Obs. Spot + Lat. 9° 23' 2" S., Long 171° 15' 03" W.

H.W.F. & C. Vlh. 00m. approx.

Springs rise about 3 ft.

Natural Scale 1/2178

SOUNDINGS IN FATHOMS



FAKAOFO
OR
OWDITCH ISLAND

BY THE

Officers of H.M.S. Egeria

1839

There is no entrance for a vessel.
Water was procured at the village
from a carefully kept well

Obs. Spot + Lat. 9° 23' 2"S. Long. 171° 15'03"W.

H.W.F. & C. VIh. 00m. approx.

Springs rise about 3 ft.

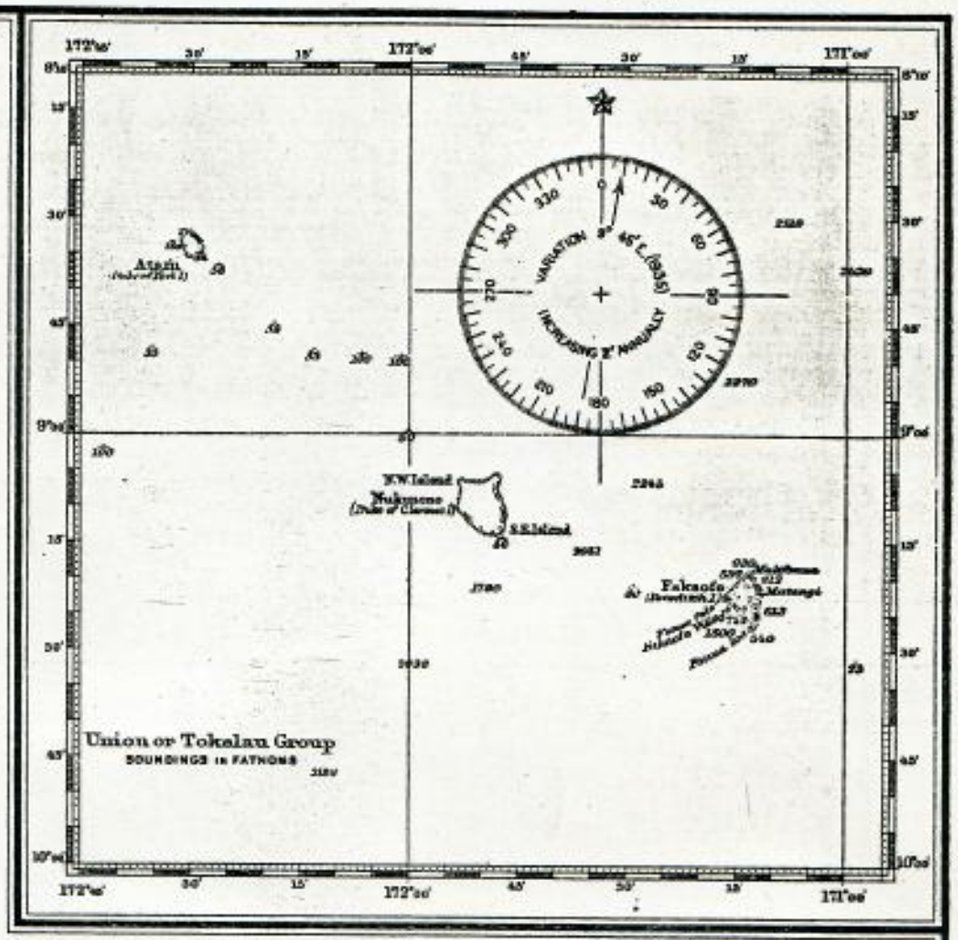
Natural Scale 1/11½

SOUNDINGS IN FATHOMS

AUTHORITIES

British Admiralty Chart No. 765

U.S. Hydrographic Office Publications:



CONVERSION TABLE

FATHOMS TO METERS

Fathoms	Meters	Fathoms	Meters
¼	0.5	6½	11.9
½	0.9	6¾	12.3
¾	1.4	7	12.8
1	1.8	8	14.6
1¼	2.3	9	16.5
1½	2.7	10	18.3
1¾	3.2	11	20.1
2	3.7	12	21.9
2¼	4.1	13	23.8
2½	4.6	14	25.6
2¾	5.0	15	27.4
3	5.5	16	29.3
3¼	5.9	17	31.1
3½	6.4	18	32.9
3¾	6.9	19	34.7
4	7.3	20	36.6
4¼	7.8	30	54.9
4½	8.2	40	73.2
4¾	8.7	50	91.4
5	9.1	60	109.7
5¼	9.6	70	128.0
5½	10.1	80	146.3
5¾	10.5	90	164.6
6	11.0	100	182.9
6¼	11.4		

OUTH PACIFIC OCEAN
SWAINS ISLAND
ED STATES POSSESSION

Mercator Projection
Scale 1:40,000 at Lat 11°03'
Astro Datum 1939

SOUNDINGS IN FATHOMS
APPROXIMATE MEAN LOW WATER

Obe Spit Lat 11°03'26.97" S, Long 171°04'24.89"W

NEW CHART NUMBERING SYSTEM

The National Ocean Survey, in cooperation with the Defense Mapping Agency Hydrographic Center, is in the process of adopting a new national chart numbering system. See Notice to Mariners No. 19, May 11, 1974, or Nautical Chart Catalog for cross references of old and new chart numbers.

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SEATTLE PACIFIC UNIVERSITY

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1 December 1981

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

Dear George,

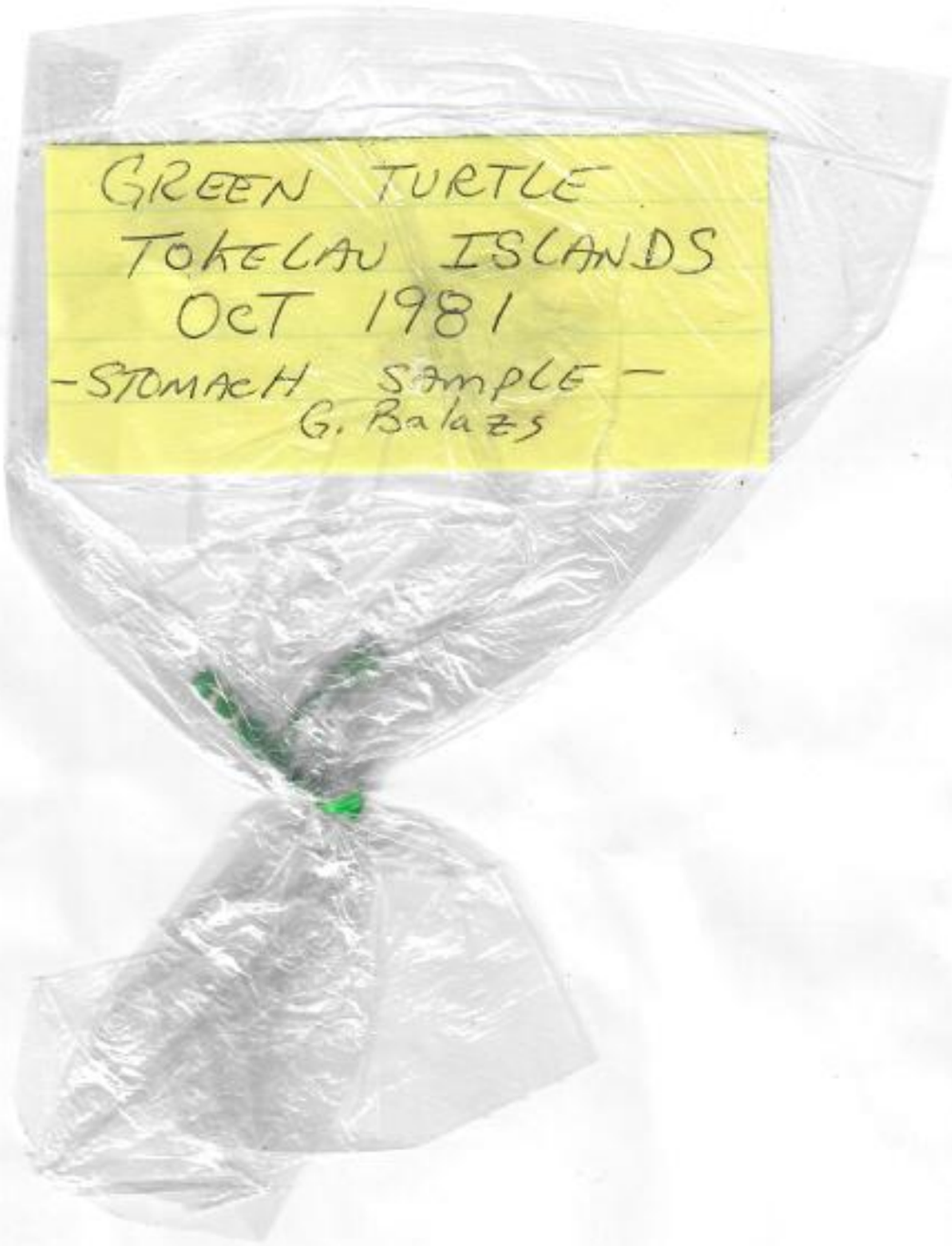
Thank you for the very unique and beautiful card with the turtle and the seal. It is a phenomenal picture!

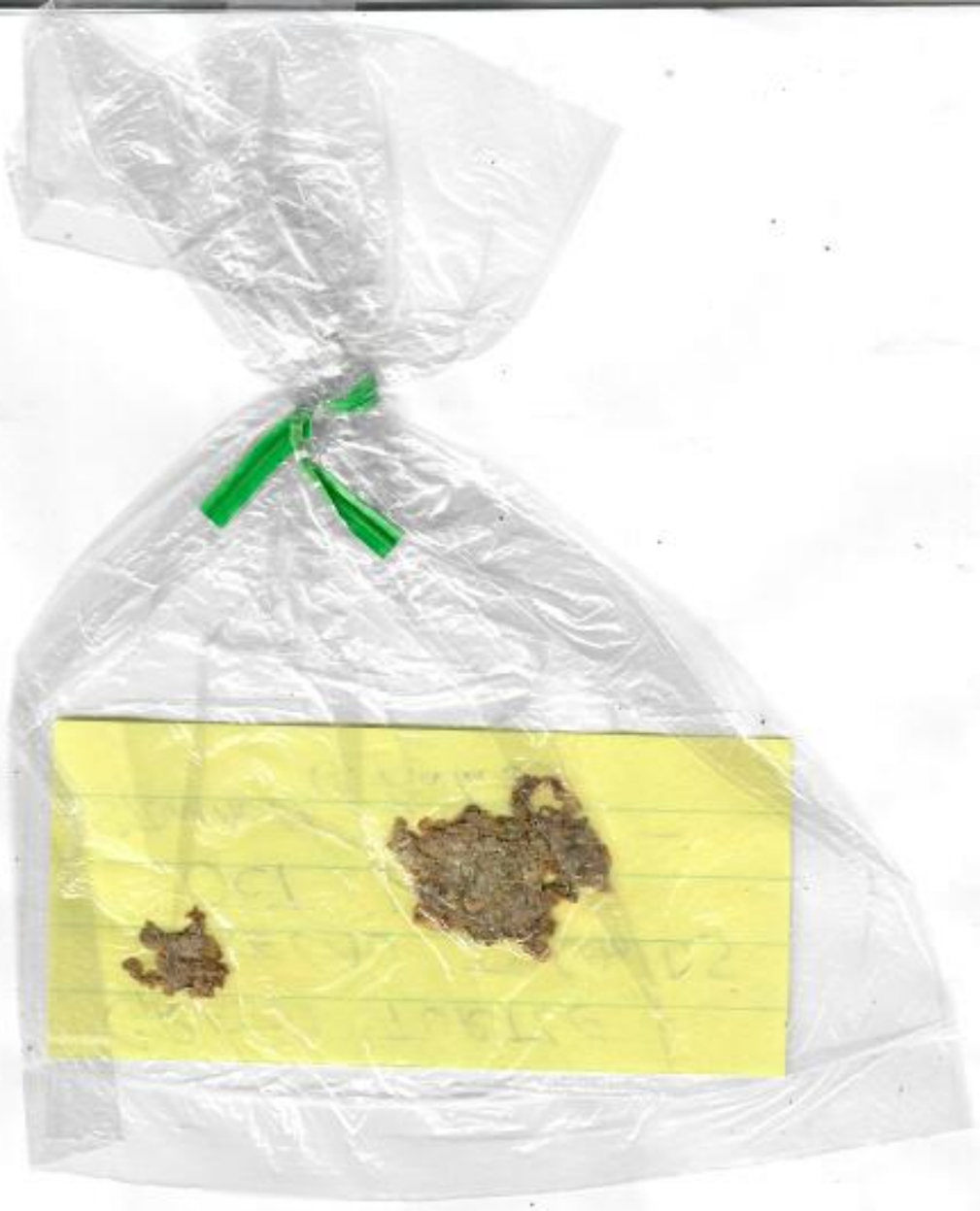
The alga that you sent to me in the envelope is Valonia aegagropila. I am sending it back now. I'll finish the identifications for you during the Christmas break. It seems that once school begins I become distracted more than I should. Thank you for your patients and for your kind reminder. Have a good holiday,

Aloha,

Dennis

from Male green
butchered at Fakaofo, Tokelau
Oct 1981
other algal component consisted
of Turbinaria ornata


GREEN TURTLE
TOKELAU ISLANDS
OCT 1981
-STOMACH SAMPLE-
G. Balazs



PACIFIC ISLANDS YEAR BOOK

TOKELAU GROUP

Administered as Part of New Zealand

THE Tokelau (or Union) Group of islands, which was attached to the Western Samoan administration from 1926 to 1948, became a part of New Zealand as from January 1, 1949. The Tokelau people are British subjects and New Zealand citizens.

The Group consists of three atolls, or groups of islands—namely, Atafu (or Duke of York Group), Nukunonu (or Duke of Clarence), and Fakaofo (once called Bowditch). The Group lies about four degrees (270 miles) due north of Apia, Western Samoa. To the south of the three is Swain's Is., also geographically part of the Group, but now, politically, part of American Samoa.

The Group had a total population of 1,832 at the census of September, 1966—862 males and 970 females. An official count in September, 1970, gave the figures as 1,687—779 males and 908 females. The fall in population can be attributed to migration to New Zealand under the Tokelau Islands Resettlement Scheme (see under "Present Day Conditions").

To some extent the Tokelauans retain linguistic and cultural ties with Samoa which are strengthened by the fact that they have access to Samoan literature and radio broadcasts. Their culture is, however, moulded by their atoll environment and they have much in common with the people of the northern Cook group.

The islands are low-lying closed atolls, encircling lagoons. Copra is the chief article of production; the people also make excellent hats and mats from pandanus leaves. With the exception of perhaps one missionary, no Europeans live there.

The land area of the Tokelaus is 2,400 acres—Nukunonu (comprising 30 islets) 1,350 acres, Fakaofo (61 islets) 850 acres, and Atafu (19 islets) 300 acres. Largest islet of the Group is on the east of the atoll of Nukunonu; it is 4 miles long and 300 yards wide.

EARLY HISTORY.

It was formerly believed that the Spanish navigator, de Quiros, discovered the Tokelaus in 1606 but it is now thought that it was Rakahanga, in the Northern Cooks, that he sighted. Commodore Byron, R.N., of the "Dolphin", who sighted Atafu on July 24, 1765, was probably the first European to visit the Group. Nukunonu was discovered by Captain E. Edwards, of "Pandora", in 1791, while searching for the Bounty mutineers in 1791. Captain Smith, of the whaler "General Jackson", was the first European to visit Fakaofo, on February 14, 1835.

Between 1850 and 1870 the population was greatly reduced by raids of Peruvian slavers, who carried off hundreds of Tokelauans for labour on South American plantations.

The three atolls became a British protectorate in 1877 although the formal flag-raising was not carried out until 1889 when Commander of H.M.S. "Egeria" visited each of the atolls in turn. Britain, at the request of the inhabitants, annexed the Group, including Swain's Island, in 1916.

For administrative purposes they were included in the Gilbert & Ellice Is. Colony. But the Group was awkwardly placed for administration purposes, and in 1925 the British Government asked New Zealand to take it over. New Zealand agreed; and at the same time America was permitted to annex Swain's Island, which had been in the occupation of an American for many years, and could be conveniently administered from Pago Pago. It was officially declared U.S. territory in 1925. (See Swain's Island, under American Samoa). The administration of the Tokelau Group was accordingly transferred to New Zealand on February 11, 1926, and placed under the supervision of the Western Samoa administration at Apia.

After January 1, 1948, the Tokelaus, though not being part of the Trust Territory, were under the direct control of the N.Z. High Commissioner of Western Samoa, with an officer of the Samoan Government secretariat handling the Group's affairs. After 1955, a special Tokelau officer was appointed and although he lived in Apia, he visited the Group frequently.

When Western Samoa attained independence on January 1, 1962, the then High Commissioner for N.Z. in Western Samoa, automatically became Administrator of the Tokelaus. A Tokelau officer still serves under the H.C. and is still domiciled in Apia although spending much of his time in the N.Z. dependency. The Administrator also visits frequently.

At Independence the Western Samoan Government signified its willingness for the Tokelau Islands Administration to function from Apia and Western Samoa still assists the Tokelaus in radio communications, health matters, post office facilities and in other ways.

Each of the three inhabited atolls has its own native administration. At its head is the Faipule who is also the Magistrate (fa'amasino). There is a Mayor (Pulenu'u), a village Clerk (Failautusi), several police, and also medical, agricultural, radio, and postal officers. The radio staff also perform meteorological duties. No European-type public accommodation exists in the Group.

PRESENT-DAY CONDITIONS.

As a result of the early slave raids, the population of each atoll was until recently concentrated on a single islet on the west side of each lagoon.

However in recent years the population has been rising rapidly, resulting first in other islets being used for housing and also in a scheme to relieve the pressure by planned and assisted migration to New Zealand under the Tokelau Islands Resettlement Scheme, introduced in 1963, under which the islanders can, of their own choice, resettle in NZ over a number of years. Up to the end of 1970, about 700 persons had migrated under the scheme and most have been resettled in the Taupo-Rotorua area of the North Island.

About 100 people a year have been participating in the project but whether the pace grows or slackens is a matter left to the Tokelauans, many of whom are conservative in outlook and prefer their simple life.

For some years the Tokelau Islands Administration has tried to persuade the people of Fakaofo to leave their village, which is grossly overcrowded, and move to the nearby islet of Fenuafala. It is the Administration's intention to build a new school and hospital on Fenuafala where the people will be able to enjoy a better standard of living, in less crowded surroundings.

Communication with the outside world has been maintained by about four visits per annum by chartered ship, and several visits by chartered amphibian plane from Fiji which replaces the RNZAF Sunderland flying-boats which were withdrawn from service in 1967. Ships and planes carry visiting officials, doctors and technicians, etc., on each trip. There are no anchorages for shipping as none of the lagoons can be entered except by canoes or small boats. All three islands are in radio contact with Apia.

11th edition 1972

Landing conditions at the main settlements of all three atolls were greatly improved by reef blasting in 1963, using obsolete ammunition delivered by Royal N.Z. Navy craft. Units of the N.Z. Army engineers stayed three months on Fakaofo in 1965 and deepened the reef channel there; however, in the disastrous hurricane that lashed the islands in January, 1966, the channel was partly filled with debris.

Copra output varies considerably with the rainfall. Meteorologically, the Group lies within the inter-tropic convergence zone from December to March, with resulting thunder-squalls and heavy passing downpours, which account for wide variations in annual rainfall. Average annual rainfall at Nukunonu is in excess of 120 inches. The hurricane that lashed the Tokelaus in 1966 caused great damage. Coconut plantations which provide the principal source of cash income as well as being a major item of diet were badly affected.

During the Pacific war, the U.S. Navy established a Loran radio station on Atafu.

The only total eclipse of the sun to occur during the International Geophysical Year was observed by a joint U.K.-N.Z. astronomical team at Atafu in October, 1958.

Three new schools were built in 1969 and in that year three NZ teaching couples took up positions at each of the three atolls to assist in raising the educational standard. There were 20 trained Tokelau teachers at work. Secondary and tertiary education is by way of government scholarships to colleges and university in NZ, to school, agricultural college or teachers' college in Western Samoa or to the Fiji School of Medicine or University of the South Pacific in Suva. About 40 students are away at any one time.

The people on Atafu belong to a protestant church and the people on Nukunonu are all Roman Catholics. On Fakaofo both faiths are represented.

Public revenue comes from an export duty of 3½ per cent. on the f.o.b. value of copra shipped from Apia; by a Customs duty of 12½ per cent. on imports; and by the sale of postage stamps which are eagerly sought overseas.

Annual revenue does not come anywhere near annual expenditure. Financial aid, usually covering a 3-years span, comes from N.Z. The aid for 1968-69/1970-71 was $NZ532,600—up $NZ248,500 on original estimates to cover the effect of salary rises for the newly-formed Tokelau Is. public service and the fact that while NZ devalued its currency in 1967, Western Samoa did not. (W.S. currency is used in the Tokelaus).

Copra exports have varied from a high of 327 tons in 1950-51 to a low of 44 tons in 1963-64. Exports for the year ending March 31, 1969, were 163 tons valued at $12,748. A certain amount of plaited wear, mats, bags, etc., shells and other handicrafts are exported.

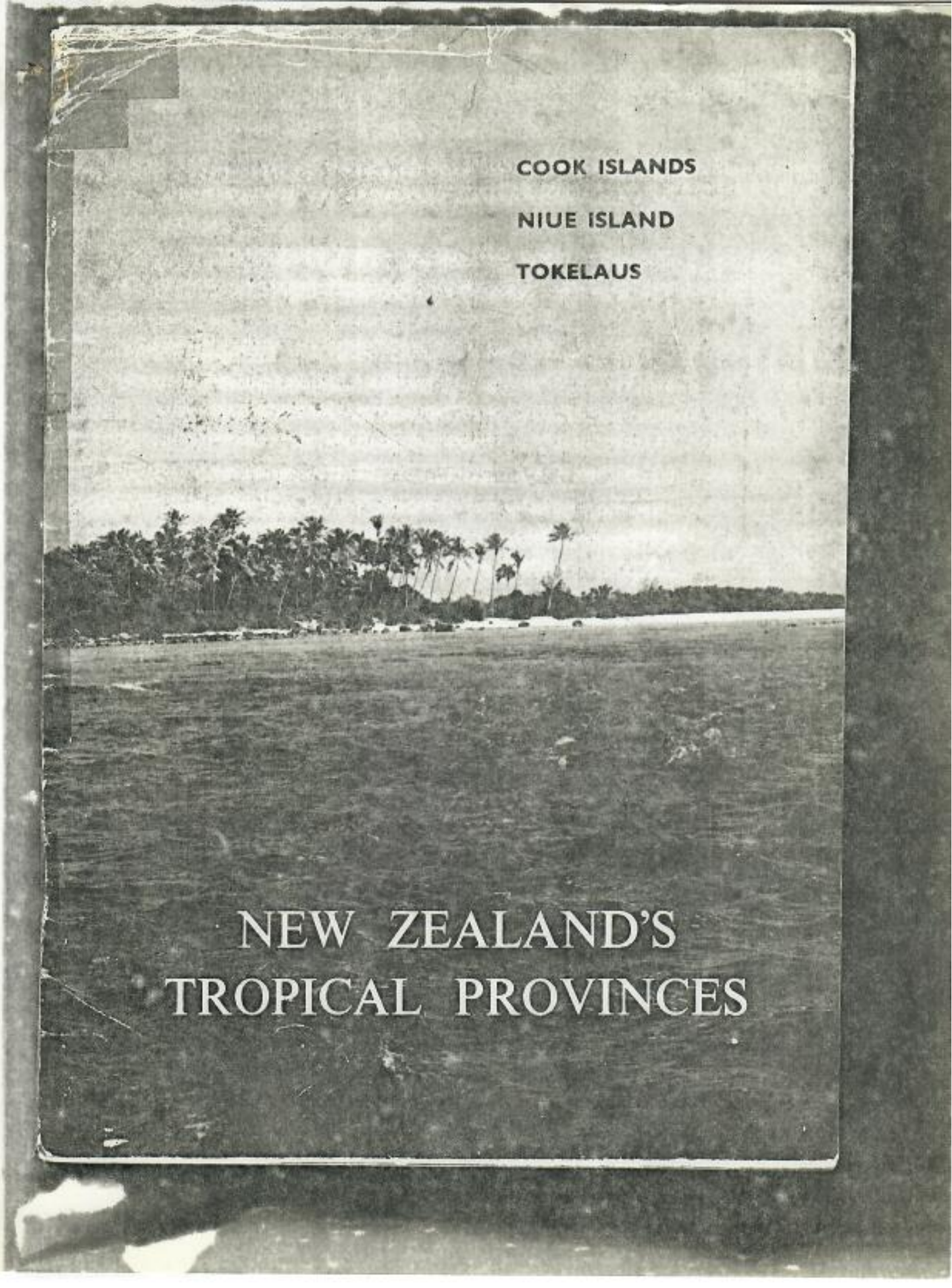
Copra production is reduced by the rhinoceros beetle with infests Nukunonu groves and by rats which affect all groves and also food crops. A scientist of the NZ Dept. of Scientific and Industrial Research completed a rat-control scheme in the Tokelaus in 1971 and it is hoped that this will lead to the eventual eradication of rats.

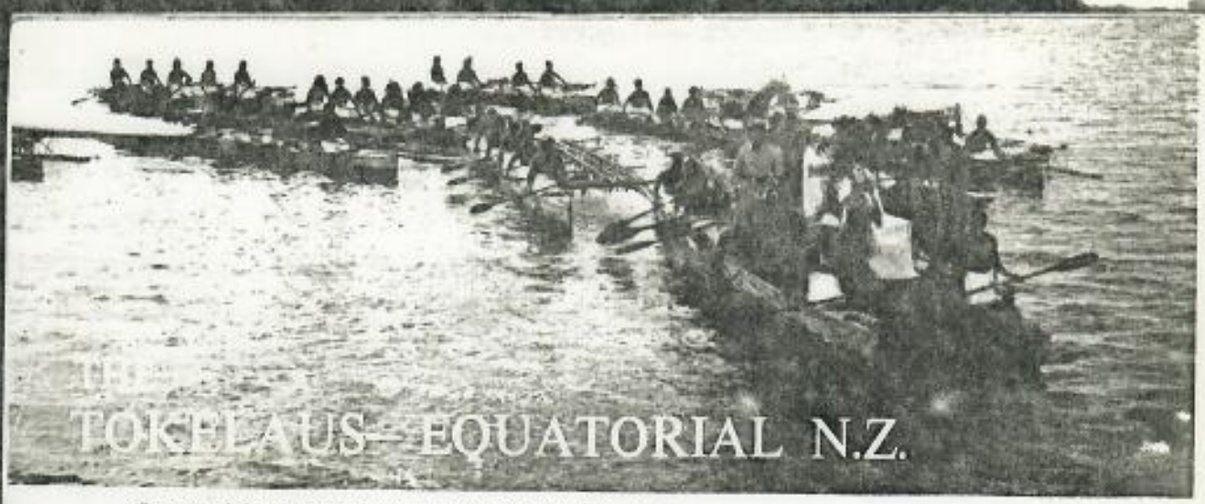
Burns Philp (S.S.) Co. Ltd., with chartered vessels, carries out trading operations in the Tokelaus from Apia.

Main imports are flour, rice, sugar, kerosene, tobacco. Total exports were valued at $NZ48,122 in 1969.

The health of the people is generally good, skin diseases and eye trouble being the most frequent health troubles. Filariasis, which until recently was common in the Tokelaus, has been almost completely eradicated due to a campaign sponsored by the N.Z. Medical Research Council in 1965-66.

There is a hospital, native medical practitioner, a small medical staff at each atoll, and a radio medical advisory service is available from Western Samoa which also supplies visiting medical officers.


COOK ISLANDS
NIUE ISLAND
TOKELAUS
NEW ZEALAND'S
TROPICAL PROVINCES



TOKELAUS – EQUATORIAL N.Z.

Ceremonial fleet of Fakaofo canoes greets a visiting flying boat.

In this little-known New Zealand community there are 1,774 citizens, who have no public debt, may not sell their land, have no prisons, and provide their labour free to erect public buildings and maintain their few roads. They have no motor vehicles, not even a bicycle, no newspapers, and only one telephone. No Pacific community has had less contact with European influence.

These people of the Tokelaus are British subjects and New Zealand citizens. Their three atolls, Fakaofo, Nukunono, and Atafu, lie within 10° of the Equator, roughly 300 miles north of Western Samoa and an average of 50 miles apart.

Each atoll consists of several tiny islets on a coral reef encircling a lagoon. On Nukunono and Atafu only one islet is occupied and on Fakaofo, which became overcrowded, the neighbouring islet on the reef, Fanuafala, has become a "suburb" of 40 families. The largest islet is Nukunono – 4 miles long and 300 yards wide.

On tiny Nukunono Island in the Tokelaus – northernmost New Zealand – missionaries show their neat school on the edge of the surf to New Zealand's Minister of Island Territories, who makes a periodical tour of inspection of the dependencies.

Copra is the main source of Tokelau income apart from the Group's own set of three postage stamps, which are popular with collectors. Each atoll has a radio station to maintain outside contact, apart from signalling daily weather reports to Apia, Western Samoa.

Government receiving sets are installed in all four villages and their schools, and full use is made of educational and other broadcasts from Radio 2AP, Apia.

The Tokelau people take great pride in the appearance of their homes which, together with village paths and grounds, are kept in immaculate order. Their large canoes, used to catch plentiful supplies of the fish, which, with coconuts, are the staple diet, are made of "prefabricated" slabs of local timber sewn together with coconut-fibre thread. Any section damaged on a reef crossing can thus be easily replaced.

Fowls are plentiful and also pigs, which are fattened on coconuts for special occasions. Though to Europeans the Tokelau diet might seem restricted, health statistics indicate that nutritional values are good, with breadfruit in season, a coarse type of taro, bananas, and eggs.

The islanders export some carved woodwork and plaited ware, being famous for the quality of their woven mats, but sun-dried copra, the meat of the coconut, is the staple export. For this they have a kind of guaranteed price – a stabilisation fund, built up from a levy on exports, which at 31 March 1959 totalled £5,085, invested in New Zealand securities.

Village women's committees meet monthly to study child welfare, and play a big part in community life. All local public services are attended to on each atoll by appointed Tokelau officials.

These officials are the faipule, chief representative of the Government, and also the magistrate or fa'amasino, the village mayor, the pulenu'u; the village clerk, the failautusi; and medical, agricultural, police, radio, and postal officers.

Only two Europeans reside permanently in the Tokelaus, a Catholic priest and a mission sister on Nukunono, and visits are paid at intervals by an Administrative Officer, based at Samoa, who is responsible to the New Zealand High Commissioner of Western Samoa in his capacity as Administrator of the Tokelau Islands.

KNOWN FOR 350 YEARS

After the first recorded European discovery in 1606, it was not until 1765 that Atafu was visited by Commodore John Byron in the British naval vessel *Dolphin*. It was revisited in 1791 by Captain E. Edwards in HMS *Pandora* during a search for the mutineers of HMS *Bounty*; Nukunono was also found on this occasion. Fakaofo was not visited until the 1840s by French and United States vessels.

All three atolls became a British protectorate in 1877, with formal declarations at each atoll in 1889. The islands were annexed in 1916 to become part of the Gilbert and Ellice Islands colony of Great Britain, which asked New Zealand to take over administration in 1925.

The people of the Tokelaus have cultural and linguistic ties with Samoa, strengthened in recent years by the introduction of the Bible in the Samoan language and the appointment of Samoan pastors, medical practitioners, nurses, and teachers to positions in the islands.

The inhabitants are all Christians, those on Fakaofo and Atafu being adherents of the London Missionary Society and on Nukunono all Roman Catholics.

The islands' revenue is derived principally from an export duty on copra, Customs duty on all imports, and the sale of postage stamps. It is insufficient to meet expenditure on health, education, and administration services, and the annual deficit is met by New Zealand Government subsidies.

Imports in the four years 1954–58 have averaged £2,862 a year, almost wholly in flour, sugar, rice, kerosene, and, to a less extent, tobacco.

A Samoan medical practitioner on each atoll has the training to cope with the great majority of cases, and can quickly obtain advice from Apia by radio. Each of the three small hospitals is staffed by Tokelau nursing aids, the best of whom are sent to Apia for a full nursing training. The medical practitioner also has the help of the village women's committees, with much influence on village health and sanitation.

No disease is a serious problem in the Tokelaus, where yaws and filaria are present, but not extensive.

Attendance at all schools in the group is close to 100 per cent. Government schools exist on Atafu and Fakaofo, while that on Nukunono is conducted by the Roman Catholic priest with the aid of one of the Missionary Sisters of the Society of Mary.

BIBLIOGRAPHY

Fundamental source of reference to printed matter relating to the native peoples of Polynesia is *A Pacific Bibliography*, compiled by C. R. H. Taylor, Librarian of the Alexander Turnbull Library, Wellington, and published by the Polynesian Society in 1951. A shorter guide to information on New Zealand's island territories (incorporating material listed in *A Pacific Bibliography*) is given below.

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Notes on the Material Culture of Niue (G. P. L. Miles)

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A Note on the Tokelau or Union Group (S. Percy Smith)
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Further information may be obtained from *A Pacific Bibliography*; Alexander Turnbull Library, P.O. Box 8016, Wellington; or the Department of Island Territories, P.O. Box 8026, Wellington.

KIN AND COCONUTS ON A POLYNESIAN ATOLL:

SOCIO-ECONOMIC ORGANIZATION OF NUKUNONU, TOKELAU ISLANDS

by

Judith W. Huntsman

April 1969

Submitted to the Faculty of Bryn Mawr College
in partial fulfillment of the requirements for
the Degree of Doctor of Philosophy

husband, who accumulated the passage for his wife and children. The brothers paid the passage for their mother to accompany their sister and her children. While I was in the islands passage arrived for the father and the eldest daughter of the eldest son still resident in Nukunonu. In November passage arrived for the last son who will work in New Zealand to accumulate the passage for his wife and the rest of his children.

The future of the atoll society in Nukunonu is a source of continual discussion. The introduction in 1964 of the rhinoceros beetle--the scourge of the coconut palm--has probably brought the issue forward more dramatically than on the other two islands. Despite efforts to control and eradicate the beast, his increased incursions are only too visible in the ragged foliage of the trees. Lacking coconuts, life in Nukunonu would be impossible without massive outside assistance. The elders discuss whether a visible community will continue to live on the atoll and the coconuts be saved, or whether Nukunonu will be abandoned to the insidious beetle. They question: is there a future for the children in their homeland, or does their future lie in New Zealand? Their juniors state that they cannot leave their parents uncared for but will move to New Zealand themselves when their parents are dead. But then perhaps their own children will feel the same way. The old pattern of emigration is continuing, but it is taking on a different cast, and its outcome and the future are no clearer to me than it is to the Nukunonuans.

LOCAL RESOURCES

Food

Local food resources fall into two major and two minor categories.

The two major ones are fish and other proteins obtained by various types of pursuit (faiva) and coconuts obtained by trips to the islets (malaga). The minor categories are domesticated chickens and pigs--the latter reserved for special occasions--and village tree and garden fruits: breadfruit, bananas, pawpaw, pumpkin, and a coarse, taro-like root (tamuu)(Alocasia macrorrhiza). (Pulaka [cyrtosperma chamissonis] does not grow in Nukunonu.) Foods fall into animal and fruit categories and a meal is considered complete when both are served, several varieties of each on special occasions. There are well-established ideas about what is the appropriate fruit (fualakau) to combine with a particular fish dish.

The major part of male conversation revolves around what kind of fishing enterprise will be undertaken, when, who will be involved, and events of previous expeditions. Weather and tidal conditions, and the recent success of others in similar enterprises contribute to the discussion. A party may go to await trevally (tali aneu) at one of their crossing places, hook kingfish (hii pales) in the sea, attract by torch and net garfish (lama ihe) on a moonless night, seek octopus (hakili feke) in their lairs on the reef, pursue butterfly fish (uhu pone) on top of the reef, make net drives (faikupega or faikalele) on top of the reef, grab birds (pokipoki manu) from the treetops, seek landcrabs (hakili ugauga) on the islets, detach clams (naunau fahua) from the reef, or watch out for nesting turtles (leoleo fonu) on the ocean beaches, or grapple with mating turtles (puke fonu) off the outer edge of the reef in season, to mention only a few.

The pursuit of bonito (faiva aalo) is the most exciting and involved enterprise, but it has been years since the shoals of bonito last appeared. (The Tokelauans attribute their disappearance to the building of

the Panama Canal!) Nevertheless all initiated fishermen have their special equipment ready, instruction is given to the younger generation in etiquette and procedure, and the day counts of the most successful fishermen are known. Only two men in Nukunonu today have arrived at the magic number of one hundred bonito hooked in a single day (and interestingly they are the grandsons of the Portuguese trader, Sese), but a number have catches in the nineties to their credit.

Fish are grouped into a number of cross-cutting categories on the basis of their appearance (bearded fish, large fish), their habits (flying fish, reef-crossing fish), their territories (ocean fish, lagoon fish), and their social entailments (sacred fish). The sacred fish are those which cannot be taken to the "family," but must be divided throughout the village. Bonito, swordfish, turtles and whales fall into this category. Large individual catches numbering two hundred or more, called ika tuu, or catches in which village-owned equipment is used are likewise distributed village-wide. A fishing party has the option of deciding to take their catch to the whole village or to distribute it among themselves. (If the party is large enough it often amounts to nearly the same thing.)

Chickens roam the village eating scraps of fish and discarded coconuts of various kinds. They are continually being chased out of houses by showers of pebbles. (One family had two pet reef herons to chase the chickens from the house.) Pigs are prohibited from roaming the village and are supposed to be kept in sties. They are fed on scraps and coconuts, and fattened when they have been chosen to grace a coming feast tray. Some people raise pigs for sale, the price ranging from about fifty cents for a piglet to twenty-eight dollars for a full-grown hog.

Each property-holding group exploits its own plantations for coconuts

and normally makes at least one trip (malaga) a week. Occasionally coconuts are harvested from communal plantations and distributed throughout the village. The minimum average coconut consumption per day is three, and by my mathematical calculations, using approximate figures, this works out to 547,500 nuts or the equivalent of ninety tons of copra, brought to and consumed in the village each year. Both because of high consumption and rapid spoilage of drinking coconuts, weekly supplies are necessary. In Nukunonu, lap-streak, double-ended sailing vessels (tulula) are used by most groups on malaga, while the native outrigger canoe (vaka) is used for fishing. In Fakaofo and Atafu where the lagoons are about half the size of the Nukunonu lagoon, the outrigger canoe is used for both malaga and faiva.

The most important forms of coconut for consumption are 1) mokomoko, the green coconut which has just reached full size, has no meat, but is filled with a bland liquid which is used as a water substitute; 2) hua, the sweet drinking-coconut with a thin jelly-like layer of meat (gasi) which is considered good food for infants and ailing; 3) niumata, in which the meat is firm and the liquid rather effervescent and used as yeast; 4) popo, mature coconuts for grating and squeezing out cream or eating as accompaniment to any meal; and 5) uto, the fallen sprouted nut containing the spongy coconut apple formed from the absorbed meat and liquid of the mature nut. As an emergency food, heart of palm (taksle) is harvested in quantity, with young trees planted for the eventuality being felled. The importance of the fruits of the coconut in the Tokelau diet is exemplified in the Samoan epithet "coconut eaters" (tagata kai popo) with which the Tokelauans concur.

The coconut is not only a major food source but the means of obtaining other food when it is made into copra. One or two months before the trading vessel is scheduled to arrive, plantations are visited in turn to collect the fallen copra nuts. These are husked, split and spread out in the

sun. The splitting operation has the aspect of a feast as young and old gather with machete or bush knife (pelu) to whack the nuts and consume the just-formed coconut apple (uto) found inside most of them. When the meat has separated slightly from the shell it is cut out and spread on woven coconut-leaf mats for further drying. Drying copra must be tended: the unshelled nuts turned over and the shelled meat put under cover in the frequent downpours. Some days it requires constant attention as torrential rain alternates with bright sunlight. If the weather is bad, copra will rot and be worthless. When the copra is judged to be dry, it is transferred to the copra shed, where each substantial producer has a separate bin, to await bagging, weighing, and shipping.

The copra money almost invariably is spent immediately for imported staples which are substituted for eating and drinking coconuts. Just after the boat, everyone eats flour instead of coconuts and drinks tea or lightly flavored sugar water instead of drinking coconuts (hua). As flour supplies diminish, increasingly large amounts of grated coconut are mixed with flour in making breadstuffs and hua replaces tea. If the interval between boats is not too long, the dregs in the bottom of the last sack of flour will serve as thickening for a soup of coconut apple (uto) and as adhesive for grated coconut balls during the last weeks before new supplies come in. If the interval is extended, flour supplies are exhausted and the plantations stripped of uto; then heart of palm (taksale) becomes the staple accompaniment to the ever present fish. In any case, the incoming flour is a necessity, not a luxury, because the uto supplies are low. The situation is more critical on Nukunonu than on Atafu or Fakaofo where breadfruit is abundant (the majority of Nukunonu breadfruit trees were killed in the 1966 hurricane and even those surviving are not producing well) and where pulaka grows (Nukunonu has no freshwater lense to support pit cultivation).

Pandanus fruit and a green known as luu, the tips of young shoots of a species of fern, are supplemental food from plantations. Pawpaw, banana, pumpkin, and a coarse taro-like root (tamuu) are tended in gardens fenced from chickens and continually nourished with coconut husks. There is no soil in Nukunonu; heavy rains carry any nutrients right through the sand and coral. The village breadfruit trees, a few of immense size, supply fruits about the size of a large Idaho potato. A variety of sweet coconut known as tamoko grows in the village. It is picked while green; the tender and sweet husk is chewed.

Raw Materials for Manufacture

Macgregor (1937) meticulously describes the manufacturing processes for all major items: canoes, houses, mats, line. I shall not repeat these descriptions but shall list only the important native raw materials, known as "important property" (mea taaua), and their uses. Access to these resources is relevant to the understanding of social organization.

Kanava (Cordia subcordata)

Repeatedly the admirable qualities of the "almost black" heart wood (tai uli) of the kanava tree were lauded to me. It is rot- and insect-proof, and is used for house posts, canoe hulls, and tuluma (round fishing gear boxes with tight fitting lids). Canoe hulls made from the hollowed trunk sections of two or three trees lashed together will last for sixty years or more. After this, the sections are unlashed and stored for final use as coffins. House posts remain standing after a house is dismantled, and can be used when necessary in a new structure. Kanava trees, whether family or village owned, are protected from over-exploitation by the village council. One must seek permission from the "mayor" (Pulenuu) before felling

any tree. Nukunonuans with family connections in Atafu often import logs from that atoll where the trees are more abundant.

Fala (pandanus) and kiekie (pandanus, Freycinetia).

The common fala is used for thatching, mat weaving, and cigarette paper. Nukunonu alone of the three atolls has a large stand of kiekie growing on the village islet. The kiekie is much stronger than fala as a basic weaving material and after involved processing results in a fine white fibre that readily takes dye.

Niu (coconut)

Besides providing the primary fruit of life, the coconut is the source of a variety of raw materials. Coconut leaves (launiu) are woven into disposable baskets (polspola), sturdy permanent baskets (kete), food trays (laulau), rough floor mats (tekepao), house blinds (pola), and roofing thatch (pola ato). Coconut husks are dried and used as fuel or the fibres processed for manufacture into sennit line of various kinds. The butt ends of the fronds provide skids for beaching boats. The shells are cups, water-carriers, and forms for basket weaving. Young frond shoots (kaukie) are processed to produce a fine white fibre used in making hats (primarily for cricket matches) and baskets (as craft exports). The removal of these shoots destroys the coconut productivity of the tree for a period of time, each shoot being equivalent to a bunch of coconuts. For this reason exploitation is controlled by the village.

Tifa (pearlshell)

This material, occasionally recovered from the lagoon, is the only proper material for making the shanks of bonito lures.

Drinking Water (Vai inu)

There are no adequate natural sources of fresh water [illegible]. According to Tokelauan history, in the past there was a fresh [illegible] in the area called Vaiinu of the present village, but a village [illegible] (aitu) from Fakaofo came and stole the fresh water. In its rush to [illegible] away from the pursuing Nukunonu spirit it spilled a few drops on [illegible] Akea, at the southern margin of Nukunonu atoll, where a small well [illegible] today. The remainder of the water was carried to Fakaofo, creating [illegible] village wells and fresh water lenses which support pit cultivation of pulaka (cyrtosperma chamissonia). The Nukunonu spirit in retaliation removed the kiekie (pandanus, Freycinetia) from Fakaofo and established it in its present plantation next to Nukunonu village. This story explains why kiekie grows only in Nukunonu (transplanting experiments to Fakaofo have failed in the past) and why there is only one small well and no fresh water lenses in Nukunonu.

The native method of accumulating fresh water is to cut triangular sections in the trunks of coconut trees with channels leading into a hollowed receptacle. Rainwater fills these cavities which are called tuga. Today they provide fresh water for bathing in the plantation areas and breeding places for mosquitos. Since the advent of iron roofing, water has been collected in storage tanks, and each new public structure starting with the church in the 1920's provides greater supplies. Presently there are two tanks at the church (the larger for the village and the smaller transferred by the village to the Catechist), a single tank at the meeting house (Falepaa), and two new tank complexes (which double the capacity of the copra shed. (Tanks at the Hospital and Radio Station are [illegible] jurisdiction of the Doctor and Radio Operator respectively.)

quently used by others on application.) When houses [illegible] complete metal roof, the householders jerry-build gutter[illegible] spill-off in forty-four-gallon drums, which are also used to store [illegible] share of village water.

Water scarcity is a recurring fact of life. When the village [illegible] get low, the allotted shares are not sufficient to allow bathing and clothes washing. Coconut liquid can be substituted for drinking and cooking, and there is of course plenty of salt water for rinsing dishes and dunking bodies. But a proper bath includes rinsing with fresh water and clothes cannot be washed in the sea. The tugu are long since dry or fouled. Parties may go to the small well on Motu Akea to bathe. When rains do come, the village is a giant shower bath, and all available receptacles are mobilized to catch run-offs where guttering does not channel the water into tanks.

CONTACTS OUTSIDE THE VILLAGE

In an atoll setting such as Nukunonu, the contacts of various kinds outside the "social isolate" can be closely documented. The four annual visits of the Aoniu bearing people, goods, and news are the only regular physical contacts. Other vessels occasionally appear off the reef, but the people are forbidden by administrative edict to traffic with them because of danger of epidemic disease introduction into their relatively germ-free environment. (This prohibition refers specifically to Chinese and Korean fishing vessels which are further proscribed from fishing in Tokelau waters. The edict is very difficult to enforce because of native curiosity and the desire to acquire goods for coconuts. Recently it has been amended to allow trade over the side of the vessel with incoming items limited to [illegible]

reside on traditional sections of the village associated with the original kaaiga. Amelika are those branches that moved out of the "ancient village" and settled new village sections.

The two moieties have different "national character" reflective perhaps of their history and area. Egelani is conservative, traditional, and close-knit. Amelika is progressive, experimental, and highly organized. The former might be said to have organic solidarity, the latter mechanical solidarity. This is the impression, anyway, of a conservative and traditional Egelani anthropologist.

THE INATI SYSTEM

The inati system is the reflection of the Tokelauan ideology of equality, whereby each individual receives from or contributes to the village or moiety his fair share. All the residents of the village are members of one named inati unit within the village inati system. In addition, every member of a moiety is a member of one named inati unit of his moiety.

The village and moiety inati systems operate in the same manner, except for composition of the named units within them. Each system has supervisors who are responsible for seeing that the system is up-to-date and who direct distributions and record contributions. Supervisors keep lists of the named inati units which are referred to whenever distributions are made or contributions levied. Below is a reproduction of the Egelani list of June, 1968:

Inati name	a x b = c*
Fatia	12 x 1 = 12
Abelemo Poseko	11 x 2 = 22
Vaha Lusiano	10 x 2 = 20
Tasesio Silao Amosa Pologa	9 x 4 = 36
Mitele Vanikai	8 x 2 = 16
Pale Ioane Mino Leone Vitale	7 x 4 = 28
Alapati Kele Tutu Tamiano Melesio Sanele Soaimo Papiano Tuilave	6 x 9 = 54
Sioli Telima Tefou Malaki	5 x 4 = 20
Sani Ioane Leo Kamilo Fati	4 x 4 = 16
Maima Mase	3 x 2 = 6
Samu	2 x 1 = 2

35 Inati
232 Tagata (persons):
116-1/2 Tau tokalua (2-person count)
58-1/4 Tau tokafaa (4-person count)
77-1/3 Tau tokatolu (3-person count)
46-1/5 Tau tokalima (5-person count)

*a: the value of the inati derived from the number of its members
b: the number of units of similar value
c: the number of people in inati of the same value

The number of persons included in the system is calculated by adding all the c numerals together. The number of inati is calculated by adding all the b numbers together.

Fig. 27. An inati list

According to the list (Fig. 27), there were thirty-five named inati units with membership between twelve persons (Fatia) and two persons (Samu). The total number of persons in the system was 232. This was divided into a number of fractions to arrive at counts that might be used in allocations.

The supervisor will use these calculations singly or in combination in making up the 35 inati, depending on the item or items divided or levied. When items of the same kind and size are allotted, he will count the items and distribute them in the inati units on the basis of inati value. If, for example, there are 407 coconuts, he will first distribute one coconut for each individual in each unit (232), then one coconut for each two individuals in each unit (116), and finally one coconut for each four individuals in each unit (58). The named inati Fatia will get 21 coconuts (12+6+3); the named inati Samu will get 3 or 4 coconuts (2+1+1?). When there are a number of items of different kind or size, they are evaluated on the basis of quantity and/or quality and distributed in preferential order to the 35 inati. If, for example, there are 70 different fish, the best and/or largest will go the named inati Fatia, the second best and/or largest to the named inati Ahelemo, and so on until thirty-five have been distributed. Then the supervisor will start again with Fatia and distribute the remaining thirty-five fish in preferential order again. When there is a single large item, it will be cut apart into different-sized portions which are appropriately allocated to the different-valued inati. If, for example, a large shark is caught, it will be cut into pieces of different sizes. The named inati Fatia will receive the largest piece; the named inati Ahelemo and Poseko will receive pieces of equal size but slightly smaller than that of Fatia, and so on.

When contributions are levied, each inati may be required to contribute one item, or each two inati may be required to contribute one item, or each inati may be required to contribute the number of items of their value (Fatia must contribute 12 and Samu 2).

In the village and Amelika moiety inati systems, the total membership is divided in two parts, keeping each inati unit intact, to facilitate actual distribution. All items to be distributed are initially divided into two exactly equal parts and each part then divided independently by teams of distributors. The parts are called alatua (ocean-side) and alatai (lagoon-side). They hypothetically correspond to the section of the village in which most of the members of the inati live. The alatai-alatua division is used in some village competitions, but more frequently in intra-moiety competitions such as a variety of casino (swipi) played by both men and women, a variety of checkers and/or chess (muu) played by men, and dominos (tomino) played with a vengeance by the old-ladies. (The clatter of their counters resounds throughout the village.) One woman laughingly told me that the alatua controls the church, and the alatai the outhouses (which are in their respective territories). If the alatua wins, they prohibit the alatai from going to Church, but if the alatai wins, they prohibit the alatua from going!

The priest, mission sisters, catechist, and hospital staff receive special portions in all village and moiety distributions, called tuuga (a Samoan word). These people are outside the village and moiety organizations as off-islanders and/or professionals. Their corresponding contribution to the village is the special services which they provide. One additional special portion is allotted to the oldest man in the village, a traditional practice. Before the coming of Church and medical personnel, there were special portions for the aliki (chief or king), oldest

man, and women who had recently given birth (fakele). Traditionally, the father of a newborn infant was prohibited from going fishing until the survival of the child was assured. His couvade probably lasted until the umbilical cord dropped off.

The village inati system is employed to distribute fresh water from the village tanks. Each inati is allowed a number of buckets corresponding to its value. Water allocations are made on Saturday mornings when the laundry is done, and on one or two afternoons during the week. The quantity allowed per head and the frequency of allocation depends on the amount of water in the tanks. When supplies are plentiful, two buckets per head will be allowed three times during the week. When supplies are scarce, one bucket per head will be allowed once a week.

Any "bonanza" is distributed in inati. I use the term "bonanza" to describe an unanticipated, large quantity of anything edible. It is not a surplus since it is not stored but consumed immediately. A bonanza is, in a sense, already allocated even though it is not anticipated. Sacred fish (ika *hea*) are a bonanza; turtles, swordfish, bonito, small whales must be distributed throughout the village in inati. Large catches of shoal fish (ika tuu) must be distributed in inati. Catches obtained with the village net must be distributed in village inati. Catches obtained with moiety nets must be distributed in moiety inati. Gifts to the village by administrative or scientific visitors, or exchange gifts between the Tokelauan communities, are distributed in inati. (The administration, for example, sends a gift of three sacks of flour to the village each year.) Harvests from village fenua are distributed in inati if they are not consumed in the course of village projects. When a large feast takes place either in connection with a Church celebration, a moiety celebration, or a wedding, the food remaining, after the feast

trays are arranged for the feasting party, is allocated in inati.

Contributions to village projects are levied through the inati system. When the village needs to raise money for some purpose, copra nuts are collected from village fenua and allocated in appropriate amounts to each inati, whose members are responsible for producing copra from them. When sheets of thatch are needed to rethatch a village structure, two or three sheets are levied from each inati. When mats are needed for village gifts, each inati is required to produce one, or, alternatively, the women may organize themselves and work together on the production, levying a given number of pandanus leaves from each inati on the basis of the inati's value. When a large village or moiety feast is in the offing, each inati will be required to provide as many baskets of food as it has members. In the latter instance, the kind of food provided is up to the inati involved; only the amount is specified. In the course of the feast, the contributions are combined in types of dishes and then allocated under the inati system. This shuffling of food results in each inati unit's receiving a combination of comestibles after contributing a single type of victual.

I describe below two of the more complex inati distributions which I witnessed to give the reader an idea of the intricacies and "flavor" of the system.

1. A pair of turtles (ulugasafonu) were captured in the sea in front of the village. The beasts were placed upside down on a bed of coconut leaves and dispatched. Under the direction of the inati supervisors (tauvaega) the carapace were removed and the various divisible edible portions of each animal separately allocated to work teams for division and counting: the internal eggs, blood, fat, meat, and entrails. The indivisible parts--

head, heart, liver, and kidneys--were either allocated in special portions for the priest, catechist, doctor, oldest man, and Mission sisters, or set aside for the feast of the butchers and dividers after the inati-making was completed.

The eggs were counted into two large bowls, an equal number in each. Using the two village lists (which each represent exactly half the village), starting with the inati units of highest value, the inati names were called out in turn. A child representing each inati extended a cup and the number of eggs equivalent to the value of the inati were doled out (one egg for each person in the inati). Because a number of eggs remained after the initial shares had been made, each name was called again and two more eggs added to each inati (two eggs for each inati unit). Meanwhile, the blood of the animals had been collected in two huge basins, again equal quantities. Each inati name was called out again and coconut-shell ladles of blood doled out into bowls, two ladlefuls for each inati over six in value and one for each inati six and under in value.

While the blood and eggs were being divided, the meat, entrails, and fat that had come out of or off from the beasts were being cut up by teams of butchers. (Some of the meat was seared in a fire tended by a team of cooks.) The parts of the male and female animals were kept separate. When the exactly equal halves were made, each half received an equal portion of all parts of the male turtle and the female turtle. Then the halves of meat, fat, and entrails were cut up into the necessary various-sized portions corresponding to the different-value inati. The entrails were literally measured and divided. The portions were arranged in clusters of the same value in each half with appropriate quantities of meat, fat, and entrail in each portion. There was a considerable amount of shuffling before the supervisors were agreed that each portion was

right. Again the names of the inati units were called and children stepped forward with baskets and basins to collect the pile of turtle pointed to by the supervisor for their inati. This inati distribution was completed in less than two hours by a large number of men divided into task groups: egg counters, blood ladlers, entrail measurers, meat butchers, carapace cutters, cooks, and portion makers. While they were working, two men roamed the village paths collecting coconuts from all houses. When the job was complete, the butchers and dividers ate the coconuts as an accompaniment to their feast on turtle "tidbits"--the rubbery carapace, liver, kidneys, tiny eggs which were inseparable from membrane, and delectable scrapings from the inner surface of the shell which had been briefly seared in the fire.

2. A party of men returned from netting fish with the village net on the northern reef. The total catch (approximately one thousand fish) was heaped in one immense and colorful pile at the lagoon shore. First, the pile was separated into fish of different types: parrot fish, butterfly fish of two types, "bearded fish," rock cod of various types, and a miscellaneous category. Second, each pile of similar fish was divided in two by one man who worked through it by grasping a fish of the same size in each hand and flinging one to his left and one to his right. Third, the fish in each pile were counted (there were now two piles of each type of fish plus the miscellaneous pile). Fourth, the number due to each inati from each pile was calculated and the piles of like fish gathered into coconut leaf baskets for allotting in the final inati piles of different fish.

Meanwhile, the supervisor was judging the miscellaneous fish. He ranked them in order of preference and distributed them in turn in the different-sized inati. (The most preferred miscellaneous fish were allocated to the special portions.) When the portions were complete, the

supervisor surveyed them, made a few changes, and was satisfied. Youthful representatives of the inati units hovering nearby were called in turn to collect the pile designated by the supervisor. Within less than an hour the huge pile of fish was spread on the hot coral of cookhouses throughout the village.

The two incidents described above are indicative of the efficiency and care with which inati are made whether the items are coconuts, sacks of flour, baskets of biscuits, or forty pounds of hard candy. The items are always carefully counted or judged as to desirability, the list is always consulted and calculations made, and amounts are always surveyed and frequently altered before the final calling out of inati names.

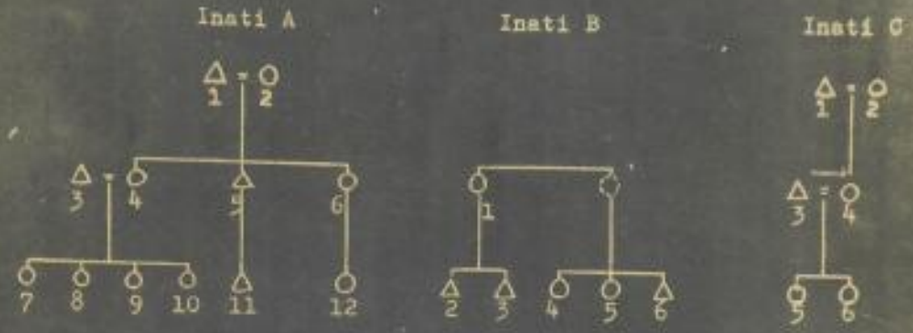
In many cases the membership of inati units in the village and moiety systems are the same, but in at least one third of the inati they are different. For example, one village inati unit is split into two moiety inati units since half of the members of the particular village unit are Egelani and half are Amelika. Inati membership is not controlled by the supervisors; each individual or his parents decides what inati he will belong to. The supervisors are responsible for seeing that 1) every resident of the village is in one and only one inati, 2) no inati exceeds 12 or falls short of 2 in value, and 3) the number of individuals in the two divisions of the system, if they are used, do not vary by more than one. In order to keep the lists correct, they must be regularly updated to account for departures and arrivals, births and deaths, and all the alterations these entail. Departure of residents will decrease the value of or eliminate units. Arrivals will increase the value of or create units. Newborn Nukunonuans have to be placed in some unit. Deceased Nukunonuans must be removed from some unit. Units that exceed twelve must

be divided or some members must be incorporated in other units. If one member of a two-value inati dies or departs, the survivor must either join another unit or find a replacement. A change in one unit often produces changes in several other units (Fig. 28, page 211).

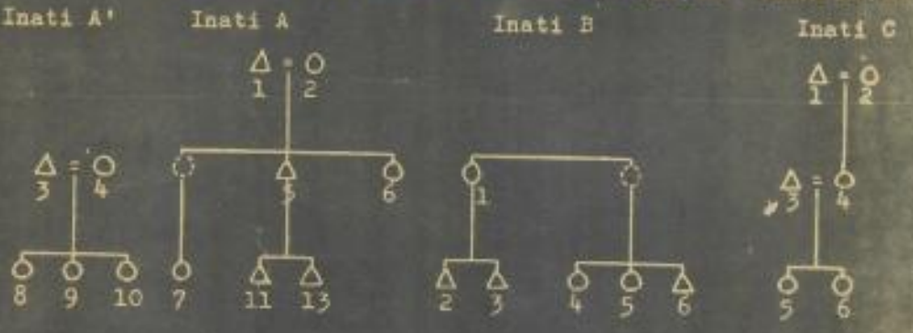
The job of keeping the inati correct and up-to-date would be impossible if the population were mobile--it is difficult enough as it is. In Nukunonu, the supervisors regularly make adjustments in the lists after each disappearance of the Motor Vessel Aoniu, allowing people at that time to make any other shifts that they wish. Once all the alterations have been made, then the inati must be regrouped into exactly equal halves. The halves were originally supposed to correspond to those inati whose members lived on the ocean-side of the village and those inati whose members lived on the lagoon-side of the village. Because of repeated regrouping of inati in the two equal divisions as well as residential shifts, the present halves have no correspondence to the original geographical division. This is not considered crucial, but the equality is.

Despite the conscientious efforts of the supervisors, there are usually more people in the inati systems than there are actually resident in the village. Incessant membership shifts create situations where consciously or unconsciously a single individual is counted as a member of two units. This is recognized by the supervisors, so that every few years they carefully recheck the systems, putting down by name each individual in every unit to make sure that no one person is claimed in more than one inati. When I first arrived, this had not been done for a number of years and as a result I had to go to an adult member of each unit to get every membership, check for multiple membership, and finally establish which unit certain individuals actually belonged in. One supervisor did a recheck just before I left the atoll, and his results jibed exactly with mine.

In November:



In January: 1 of inati B gave birth to another son which her husband, 5 of inati A, wanted to put in his parents' inati. 4 of inati A realized that she was pregnant and her husband, 3 of inati A, decided that he and his wife and children should form a new inati. But he left one daughter with his wife's parents. 6 of inati A decided to put her child in her FZ inati.



In May: Inati B and C were combined because 1 and 2 of inati C had gone to Samoa. 2 of inati B was shifted to inati A to compensate for the absenses of 1 and 6 in Samoa.

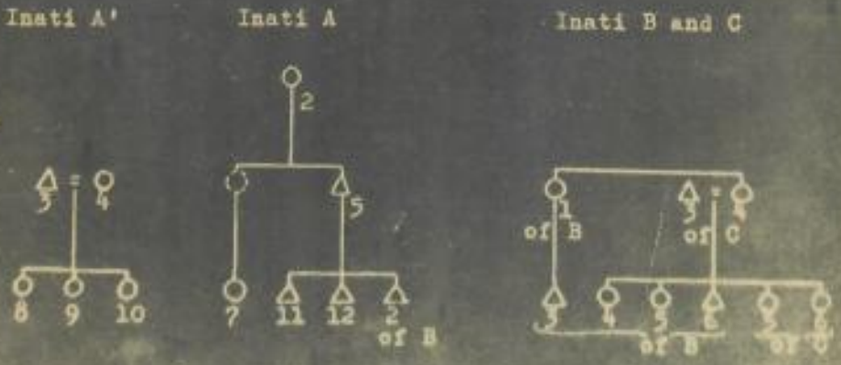


Fig. 28. Inati Shifts

Atolls With a New Value

The Tokelau, or Union Group

AS various specks of islands, some uninhabited, hitherto neglected, are now considered as having value as filling stations for aerial services, or strategic points in time of war, it is worth noting that New Zealand controls three equatorial atolls, consisting of 102 islets, almost on the track of the sea-route from Auckland to Vancouver. They have a total area of seven square miles, and are known as the Tokelau (or Union) Group, and comprise Fakaofo, of 700 acres, 270 miles from Apia (Samoa); Nukunono, 1372 acres, 42 miles from Fakaofo; and Atafu, 603 acres, 53 miles from Nukunono. There are actually four atolls in the Group; but the fourth, Swain's Island, belongs to the United States. It is about 170 miles from Apia.

The Tokelau Group, for many years, was included in most maps as in the British zone, but it was practically ungoverned and rarely seen by officials.

But in 1916 the Tokelauans (who then numbered nearly 1000) decided to cede the group to Great Britain; and, for the nine years, to October 1, 1925, they were governed as part of the Gilbert and Ellice Islands Colony, through the District Officer at Funafuti.

At the request of the British Government, the New Zealand Government took over the control of the Group, from October, 1925, as part of the Administration of Western Samoa.

Local government is wholly in the hands of natives, specially appointed by the Administrator. These comprise a faipule and magistrate (who acts as chief representative of the Government), a mayor of villages, clerk and wireless operator, chief of police, three policemen, a native medical practitioner, a wardress, and a nurse. In the first year of New Zealand's administration, the total salaries of these officials amounted to £35. For the year 1936-37 the salary list aggregated £276. In that first year, also, the revenue was £1160 and the expenditure £710. Towards this fine record the natives contributed considerably by way of taxation in the form of copra. The copra tax in the 1936-37 season realised £117. This is the only tax the natives have to pay. The Group's last budget (1936-37) disclosed a credit balance of £124.

Copra is the only exportable product, for only two varieties of banana will grow, owing to lack of humus in the soil, and these do not always produce sufficient fruit for the natives' own use.

POPULATION INCREASING

THE population in 1926 was 1033, excluding about 100 who were absent on adjacent islands, and 25 girls at school in Samoa. The last census, in November, 1936, shows that, since, there has been an increase of 170.

Communication between the Group and Apia was provided by means of the Burns, Philp vessel "Makoa", but she was wrecked in July, 1937; and, since then, there have been only occasional visits from small cutters out of Samoa. The warship "Achilles" called at Nukunono in August of last year. However, the New Zealand Government is providing a new vessel, in June or July, 1940. A wireless station keeps this remote community in touch with other places.

The Tokelaus are out of the usual track of hurricanes, but when these do diverge to the eastward, Nukunono gets more than its share. The tropic gales, from their lair in the Kurile, sweep fiercely southward across the Tropic of Cancer, gathering force as they tear through the Marshall, Caroline and Gilbert groups, their easterly slant increasing till, with hot, tempestuous blasts, they lash to foam the sea around the reef-girdled Tokelaus, and spatter their spent gusts across Samoa and Tonga.

A MYSTERY LAKE

IN the cabin of a "blackbirding" schooner, lying in Levuka Harbour one night, the skipper, who had just returned from a three-months' cruise, told of a visit to the Tokelaus. Listening to the tales of old men on the beach, he heard a story of a lake that had existed in Nukunono many years previously. Tree-fringed and unfathomable, its level never varied throughout the year, though torrential rains fed it constantly. Not more than 50 yards across, and almost a perfect circle, its surface was seldom ruffled by the vagrant winds that crooned through the tree-tops; but, in its centre, tiny waves circled so swiftly that they resembled tiers of seats round a stadium.

The lake was seldom without its freight of coconuts and branches that had fallen from the overhanging trees. These might drift for days, or weeks, on the quiet water along the shore of the lake; but, inevitably, they were drawn within the circle of the outspreading ripples, and then their voyaging became more ordered. Slowly at first, but gaining impetus with their near approach to the central spirals, the forest jetsam circled closer and closer to the vortex. The end was then near. Three or four revolutions of the maelstrom, and then—they were gone.

Days later, mariners out of sight of land could view the strange spectacle of tropic products drifting in an unusual setting. None knew the secret locked safely in Nukunono's bosom.

The tradition has it that unfaithful wives and husbands were cast into this lake. There was no appeal from such a sentence.—T.D.G.

Mr. Satya N. Sabharwal, whose address is: c/o Mr. B. R. Sabharwal, Namoli, Lautoka, Fiji, writes: "I would like to correspond with pen friends in the British Colonies and other countries, who who may be interested in stamp collecting, photography, etc."

NINETEEN YEARS

IN

POLYNESIA:

MISSIONARY LIFE, TRAVELS, AND RESEARCHES IN THE ISLANDS OF THE PACIFIC.

BY

THE REV. GEORGE TURNER,

OF THE LONDON MISSIONARY SOCIETY.

LONDON:
JOHN SNOW, PATERNOSTER ROW.
MDCCCXLI.

people who went away in a ship, and came back, were killed; and all this was occasioned by a dread of the introduction of disease. For years, too, after they began to venture out to ships, they would not immediately use anything obtained, but hung it up in the bush in quarantine for weeks.

Eleven years ago, the exclusive system, against which we had so long been struggling, gave way, and the wish was formally made known to us that Samoan teachers would be received; and, *now*, nothing would be more grateful to them than the arrival of white missionaries. Soon may God grant them the desire of their hearts! Nor is the great change confined to their reception of Christianity as a religious system, but, as is manifest from what I have already said, the whole framework of their political and social life is changed. Their wars, and more clandestine lurking for each other's blood, are ended. Old grievances are laid aside, and free intercourse is the rule all over the island. The pig-sty dwellings are fast giving way to the Samoan model of large houses, well spread with mats. Instead of destroying all the plantations and fruit-trees of a person who dies, that they might go with him, all is now spared, and the consequence is an abundance of food such as they never had in the days of heathenism. Instead of living in single families, and migrating here and there in the bush, the five teachers' stations which encircle the island are fast becoming the nuclei of settled villages, with magistrates and laws; and the change of the whole state of affairs

is as amazing to the people themselves as it is to a stranger. I have never seen a more inviting field of missionary labour. Happy the men who are sent to cultivate it!

In thus describing the triumphs of the gospel on these once savage shores, I have great pleasure also in giving publicity to the fact, that the young men and women in the Bible-classes connected with the United Presbyterian Church, Campbeltown, Scotland, under the pastoral care of the Rev. Dr. Boyd, have contributed towards the support of two teachers on that island for upwards of ten years. They have doubtless often prayed as well for that heathen land, and who can tell to what a large extent the success over which we now rejoice is to be traced to the "effectual fervent" prayers of these friends of missions! May they continue the good work, and may many others imitate their praiseworthy example.

FAKAAFO, TOKELAU.

Owing to the amount of business we had to do in the Westward Islands, together with hindrances from contrary winds, the time allotted for our missionary cruise expired, without our being able to call at Fakaafo, as we had hoped to do when we left Samoa. This little coral island is in 171° W. long. and 9° 22′ S. lat. It is the principal of three, which are inhabited in that group, called Union Group, or by the natives, Tokelau. The entire population of the three islands may not exceed 600.

The natives there say that men had their origin in a small stone on Fakaafo. The stone became changed into a man. After a time he thought of making a woman. This he did by collecting a quantity of earth, and forming an earth model on the ground. He made the head, body, arms, and legs all of earth, then took out a *rib* from his left side and thrust it inside of the earth model, when suddenly the earth became alive, and up started a woman on her feet. He called her Ivi (Eevee), or *rib*, he took her to be his wife, and from them sprang the race of men.*

The government is monarchical, and the king, Tui Tokelau, is high priest as well. There are three families from which the king is selected, and they always select an aged man. They say that a young man is a bad ruler, and that mature age is essential to the office. They are a quiet people, and rarely fight.

Their great god is called Tui Tokelau, or king of Tokelau. He is supposed to be embodied in a stone, which is carefully wrapped up with fine mats, and never seen by any one but the king, and that only once a year, when the decayed mats are stripped off and thrown away. In sickness, offerings of fine mats are taken and rolled round the sacred stone, and thus it gets busked up to a prodigious size;

* This reminds us of Prometheus and his clay models (εἰκόνα), but it is more interesting still as a manifest fragment of the Divine doings as recorded in the Mosaic cosmogony.

but as the idol is exposed to the weather out of doors, night and day, the mats soon rot. No one dares to appropriate what has been offered to the god, and hence, the old mats, as they are taken off, are heaped in a place by themselves, and allowed to rot.* Before the idol is its house, or temple, a great thatched shed, which may hold some 400 people. Once a year, viz., about the month of May, a whole month is devoted to the worship of the god. All work is then laid aside. Great quantities of food are prepared. The people assemble from the three islands, pray for life and health and a plentiful supply of fish and cocoa-nuts. They have dancing too, men with men, and women with women, and light up the temple all the night over during the month with what they call "light in honour of the god."

No fire is allowed to be kindled at night in the houses of the people all the year round. It is

* How remarkably this compares with what the Earl of Roden says of a stone idol, in his "Progress of the Reformation in Ireland:" "In the south island, in the house of a man named Monigan, a stone idol, called in the Irish 'Neevougi,' has been from time immemorial religiously preserved and worshipped. This god resembles in appearance a thick roll of home-spun flannel, which arises from the custom of dedicating a dress of that material to it whenever its aid is sought; this is sewn on by an old woman, its priestess, whose peculiar care it is. Of the early history of this idol, no authentic information can be procured, but its power is believed to be immense; they pray to it in time of sickness; it is invoked when a storm is desired to dash some hapless ship upon their coast; and, again, the exercise of its power is solicited in calming the angry waves, to admit of fishing or visiting the mainland."

sacred to the god, and so, after sundown, they sit and chat in the dark. There are only two exceptions to the rule: 1st, fire to cook fish taken in the night, but then it must not be taken to their houses, only to the cooking-house; and, 2nd, a light is allowed at night in a house where there happens to be a confinement.

The origin of fire they trace to Mafuike, but, unlike the Mafuike of the mythology of some other islands, this was an old blind *lady*. Talanga went down to her in her lower regions, and asked her to give him some of her fire. She obstinately refused until he threatened to kill her, and then she yielded. With the fire he made her say what fish were to be cooked with it, and what were still to be eaten raw; and then began the time of cooking food.

Polygamy prevails. Cocoa-nuts and fish form the prevailing food of the people. There are no fowls or pigs there, but swarms of rats. Boys at sport play at catching rats. They who catch the most win the game. Canoes are made from a single log hollowed out. They are now getting iron tools, but formerly they used shell hatchets. They sometimes burned the trunk of a tree to make it fall, but as the fire occasionally ran up the heart of a tree and destroyed it all, they usually cut away at the trunk with their shell hatchets, day after day, until it fell. It took ten, fifteen, and thirty days to fell a tree. Another plan was to dig down and cut the roots. They shew some ingenuity in the manufacture of buckets with lids. They are made by hollowing out a solid block of wood. They do it by burning.

When a ship is seen, they consult the king and high priest whether they shall go out to it. He decides for or against. If they go they do so with great fear, praying all the way that they may be preserved alive, and free from harm. When a party goes, the king will probably go with them. When he goes, one sits a little before him, holding up a cocoa-nut leaflet, as a sort of protecting flag, or charm, and the king sits immediately behind, praying all the while, as the rest paddle, that they may be kept from harm. A party of them once went out to visit a ship, and when near the vessel, one of their number was shot dead, all the rest fled to the shore. They supposed that the people in the ship thought they had gone out to fight.

Of old they thought a foreign ship something unearthly, and the white crew sailing gods from some region of spirits. The fire burning in their inside, and sending forth volumes of smoke (tobacco smoke) seemed superhuman, and the guns, belching out fire and smoke and "stones," seemed to be no work of man. If any one died about the time a vessel had been seen, they concluded that the party of sailing gods had come for his spirit, and when they happened to see any on board ship with their hair cut short, they supposed they were some of the spirits but lately received.

Apart from the god Tui Tokelau, there is a particular disease-making god, whose priest receives

offerings from the sick of fine mats. When the friends of a sick man take a present to the priest, he says he will pray to the god for recovery; and then he goes to the sick person and anoints with oil the part affected. He uses no particular oil. When he sits down, he calls some one of the family to hand him some oil, and dipping his hand in the cup, passes it gently over the part two or three times. No medicines are used for the sick. If the body is hot, they go and lie down in cold water; if cold, kindle a fire and warm themselves.

After death, the friends of the deceased are anxious to know the cause of his death. They go, with a present, to the priest, and beg him to get the dead man to speak, and confess the sins which caused his death. The priest may be distant from the dead body, but he pretends to summon the spirit, and to have it within him. He speaks in his usual tone, and tells him to say before them all what he did to cause his death. Then he (the priest) whines out, in a weak, faltering voice, a reply, as if from the spirit of the departed, confessing that he stole cocoa-nuts from such a place; or, that he fished at some particular spot forbidden by the king; or, that he ate the fish which was the incarnation of his family god. As the priest whines out something of this sort, he manages to squeeze out some tears, and sob and cry over it! The friends of the departed feel relieved to know the cause, get up, and go home.

At death, one will say to his friends, "I'm going to the moon—think of me as being there." Another will say, "I'm going to be a star;" and mentions the particular part of the heavens where they are to look for him. Another will say, "I shan't go away; I shall remain in the grave, and be here with you." Thus they seem to think they have only to choose where their disembodied spirits are to go after death.* They tell of a Tokelau man who went up to the moon, and have their tale, also, of "*the man in the moon.*" They say, too, that the moon is the special residence of the kings and priests of Tokelau. The stars they believe to be the spirits of the departed. When the full moon begins to wane, they suppose that it is being eaten by the inhabitants of the region. From the new moon until the full they consider that the food is growing again. An eclipse of the moon is thought to be some sudden calamity, destroying the food of the departed kings, and occasions special concern; and prayers and a meat-offering of grated cocoa-nut are immediately presented to their great god, Tui Tokelau, to avert the evil. As the eclipse passes off, they think it is all owing to their prayers.

Two young men belonging to Fakaafo, who

* They believe, however, that there are certain evil spirits always on the watch for human beings, and that, if any are caught, their souls are dragged up and down the universe for ever, as the slaves of these demons, and never find a resting-place. Hence it is a common saying at Tokelau, "Take care of the soul, it lives for ever; never mind the body, it dies and rots in the grave." And hence, too, a man would rather die than go at night to certain haunted spots, where he thinks it probable he might be seized by one of these evil spirits.

had long been in Samoa, were taken there lately. One of them lived with us at Malua for three years; was a member of the church; knew the Samoan language well, and took with him the entire Bible, and all the books printed in the Samoan dialect. We cherish the hope that, if his life is spared, he may act as a Christian teacher to his countrymen, and prepare the way for other teachers. From this young man, and also from the other, I received some curious mythological and other fragments, of which the above are a specimen.

CHAPTER XXXV.

CONCLUSION.

In summing up our progress in these islands just visited, where twenty years ago we had not a single missionary, or a single convert from heathenism, and at the very entrance to which John Williams then fell, we find that out of a population, in the twelve islands which we now occupy, of about 65,500 souls, we have 19,743 who have renounced heathenism, and are professedly Christian. Of these there are 645 church members, and 689 who are candidates for admission to the church. And there are now labouring among them ten European missionaries, and 231 native teachers and assistants. Three printing-presses, also, are at work, especially devoted to the Papuan vernacular of the respective islands.

While in the New Hebrides and Loyalty Islands, I submitted to the missionaries there a plan, which had occurred to us in Samoa, for such a change in the future course of the "John Williams" as shall enable her to visit these Westward Islands twice in the course of the year, instead of once, so as to enable our brethren there to go on extending their labours to the heathen islands to the north. They

The Agriculture of Nukunonu Island

By K. A. Newton*

During March, 1964, a short visit was made to Nukunonu atoll, one of three atolls referred to collectively as the Tokelau Islands. Atafu atoll to the north and Fakaofo atoll to the south are the other two members of the group, which lies about 270 miles due north of Apia, Western Samoa.

NUKUNONU atoll, low lying, completely closed and encircling a lagoon some five to seven miles in width, comprises 30 islets of which only one, the island of Nukunonu, is inhabited. This island, approximately 1¼ miles in length and some 200 yards wide, is populated by some six hundred people whose activities are centred around a Catholic mission located there.

The native name *Nonu* refers to a commonly occurring local shrub, *Morinda citrifolia*, from the dark yellow-coloured wood of which is extracted a yellow dye; the wood is also used for making children's toys. The shrub is severely attacked by mealybug.

As Nukunonu is a coral island on which there has been no soil development, the range of plant species has naturally been restricted. Principal sources of food for the local people are the coconut, breadfruit, and pandanus palm, supplemented with fish and a small supply of bananas and sometimes Colocasia taro.

These last two items are cultivated under rather special conditions—in compost pits. In addition, pigs are raised and at ceremonies and feasts are sometimes killed and eaten. The health of the inhabitants appears to be quite good although yaws, filaria, skin diseases, and eye diseases have been recorded.

Breadfruit

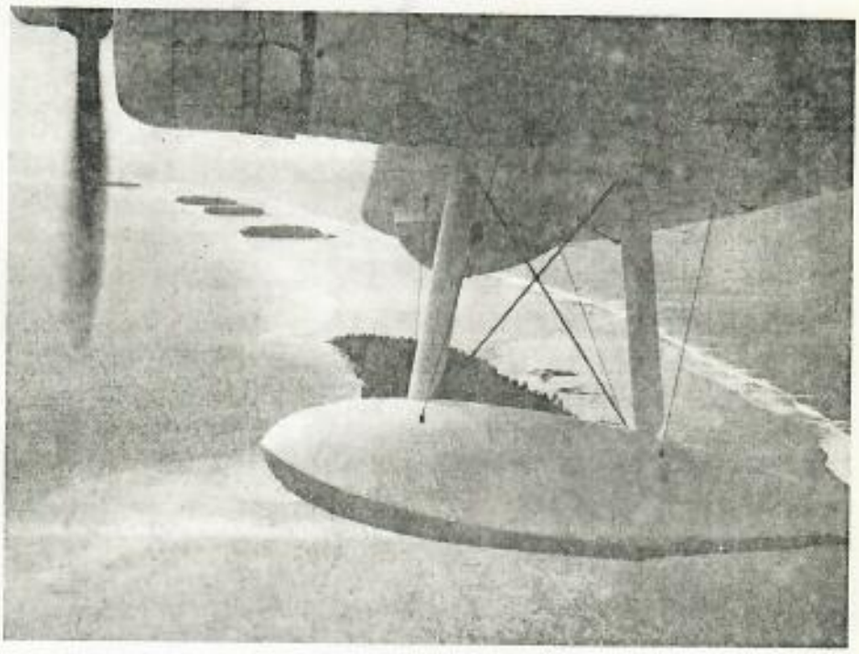
The two distinct varieties recognized by the local people are—

(i) "Ellice" breadfruit. This variety was supposedly introduced from the Ellice Islands and produces an elongated, rough-skinned, seeded fruit. When fully mature, this variety can be eaten without cooking.

(ii) "Samoan" breadfruit. A variety originating from Samoa which produces a rounded, seeded fruit with a smoother skin than the Ellice variety but which cannot be eaten unless cooked.

Into a third class can be placed those trees which cannot be categorized as either Ellice or Samoan types, and are considered to be crosses between these two varieties.

Many of the breadfruit trees on Nukunonu, and also many of the bananas, pawpaws, and pandanus, exhibit the typical chlorosis symptoms associated with lime-induced iron deficiency; whether or not this deficiency was the actual cause of the chlorosis could not be confirmed at the time. However, it was learned that when planting coconuts, and in some cases other trees, the local practice was to place empty tin cans at the bottom of the planting hole in order to ensure that the palm grew well.



An aerial view from an RNZAF Sunderland flying-boat of part of Nukunonu atoll

Coconuts

Apart from a few red and yellow dwarf coconuts brought in from one of the Western Samoan estates and planted in the mission grounds, all cultivated coconuts on Nukunonu were classified locally into the following three categories—

(i) Niu or Niu Noa. These are tall palms which bear fruit throughout the year. Nuts are generally large and angular, averaging three to seven nuts on each inflorescence, and green, greenish-red, or red in colour.

(ii) Kita Noa. Tall palms which bear fruit throughout the year. Nuts are somewhat smaller and rounder than those of the Niu Noa-type palms, from five to ten nuts on each inflorescence, and greenish-brown in colour.

(iii) Kita. Tall palms which *do not* bear fruit for a certain period of each year. Nuts are quite small, twelve to fourteen on each inflorescence, and green or greenish-brown in colour.

Although palms on Nukunonu show evidence of attack by stick insects it is probable that natural biological control is operative. The most important insect problem on the island is that of the

* Tropical Agriculturist, South Pacific Commission.

On the left—the central path through Nukunonu village, and right—the compost pit used for the cultivation of bananas

rhinoceros beetle (*Oryctes rhinoceros*). Inspection of palms over the whole island area indicated that at present the degree of damage from rhinoceros beetle attack is not severe—a situation which is no doubt related in part to the methods of control currently exercised by the islanders. Essentially, these methods consist of the regular dusting of palm crowns with insecticide, and a certain amount of removal of stumps and litter.

The important point concerning the presence of the rhinoceros beetle in this area is that as far as it is known, this is the only island out of the 30 islands of the Nukunonu atoll on which it is established. The rhinoceros beetle does not occur within either of the other two atoll areas of the Tokelau group. This fact, coupled with the dependence of these people on the coconut palm as a source of food, material, and revenue, brings a degree of urgency to plans for eradication of the pest before it spreads to adjacent areas. In this respect, dusting of palm crowns will continue, and fallen coconut palms and palm stumps will be cut up and either burnt or dragged into the sea.

It is anticipated that the introduction of parasites and predators of the rhinoceros beetle may soon be effected through Dr. C. P. Hoyt, the Project Manager of the *UNSF/SPC Project for Research on the Control of the Coconut Rhinoceros Beetle*, which is based in Apia.

The inhabitants of Nukunonu will also be discouraged from using coconut palm logs as fencing for their pig yards, since it has been found that the beetles favour the base of these logs as a breeding site. Kapok and Erythrina have been suggested as possible substitutes.

Compost Pit Cultivation of Food Crops

Mention has already been made of the use of compost pits for the cultivation of bananas and a few other food crops as a supplement to the somewhat restricted diet of the local people. Because of the lack of soil development on the islands of the atoll, the only way in which food gardens can be prepared is to dig pits in the coral and fill them with material for the preparation of a compost. Generally these pits are about 20 feet long by 10 feet wide, but as may be expected, the size varies. Depth of the pits is usually about 24 inches, and after excavation, they are mainly filled with coconut husks, fallen fronds, and a limited amount of other refuse. This material is not only of poor quality for the preparation of a compost, but in no case was it seen to have been broken down sufficiently before bananas were planted.

One of the obvious problems which is associated with these pits is their attraction to the rhinoceros beetle as breeding sites. Fortunately the number of pits is limited—between twenty and twenty-five in all—and in relation to the quantity of material lying about the island, which is also suitable as breeding sites for the beetle, the problem is relatively small. However, efforts are being made to bring the compost pits within the scope of the general plan of campaign against the beetle by the regular application and incorporation of B.H.C. dust.

If the rhinoceros beetle was eliminated from the area, an expansion of the pit culture of food crops could be supported with the view to widening the range and increasing the quantity of foods grown by improving the quality of the compost used. This would call for the establishment by each family of two pit gardens—one garden to be under cultivation and the other under preparation.

Legumes

Close inspection of the vegetation of the island revealed a complete absence of leguminous plants. Previous attempts to establish some legumes have failed, probably because of the absence from the soil of the appropriate rhizobia. As a consequence it is intended that a selected range of pulse crops will be introduced to the area; these include—*Vigna sesquipedalis*, *Vigna unguiculata*, *Cajanus cajan*, *Dolichos lablab*, and *Phaseolus* spp., together with *Arachis hypogaea* and a few leguminous cover crops, including *Vigna marina*. Establishment of these legumes would assist in the improvement of the local diet and also provide better material for compost preparation. The introduction will be associated with the inoculation of seed with *Rhizobium phaseoli*, *Rhizobium japonicum*, and *Rhizobium leguminosarum* prior to planting.

One of the principal food crops is the Pandanus palm, shown here bearing fruit.

SOME NOTES ON . . . . . .

Fisheries In The New Hebrides, Fiji And Tokelaus

Seven Japanese longliners are being kept busy supplying fish to a new cannery at Santo, in the New Hebrides. In Fiji, the stocking of rivers with new fish species is being considered. Blacklip pearl shell and trochus may shortly be introduced to the Tokelaus. These are highlights of this brief report, prepared following a recent field visit to the three territories by . . .

H. VAN PEL*

Mr. Van Pel, aided by a local diver, investigating marine life on a small reef plateau in the lagoon of Fakaofo Atoll.

FROM a fisheries officer's point of view one can hardly imagine three territories more dissimilar from one another than those under review here. The contrasts were brought into even greater relief when of necessity I had to visit all three in a short period of time—from late August to late October last.

New Hebrides Developments

In the New Hebrides, fisheries were practically non-existent until about a year ago. At the time of my visit, however, it had become one of the foremost fish-producing areas in the South Pacific. This change was brought about by the establishment on the island of Espiritu Santo of the South Pacific Fishing Company, in which are represented American, Japanese and local interests.

Activities of the company include fishing as well as the cold storage, curing, transport and marketing of fish. The fishing fleet consists of seven Japanese boats averaging 100 tons gross, with a crew of 25 to 30 fishermen each. The fishing technique used is longlining. The catches average 60% albacore, 20% yellowfin tuna, 15% marlin and sailfish, and 5% miscellaneous fish.

At the time of my visit, 42 New Hebrides islanders and 34 Japanese labourers were employed in the freezing plant, ice factory and curing plant. The frozen albacore and yellowfin tuna are shipped to San Francisco at the rate of 600 tons every two months. Every three months, 100 tons of frozen and processed fish are sent to Japan. Small quantities of frozen fish are sent to Honiara and Nouméa, and a certain amount is marketed locally.

As mentioned elsewhere in this issue, the plant is now ready to produce fish flakes commercially.

Apart from this large undertaking, fisheries in the New Hebrides have made modest but interesting progress along other lines. Lakes, streams and swamps in several islands have been stocked with *Tilapia mossambica*, which are now thriving. Specimens 10" long, weighing 14 ounces, have been recorded in Santo.

Quite a few enquiries from private people have been answered. Subjects included the construction and operation of fixed fish-traps, reef nets, and fish preservation.

Lastly, in order to conserve natural resources, fishing for trochus and green snail has been suspended in the New Hebrides, pending the framing of new regulations.

Stocking Of Rivers In Fiji

In Fiji, considerable attention has been devoted lately to fisheries matters.

One item worthy of mention here is the possibility of stocking the rivers with

*Fisheries Officer, South Pacific Commission.

Above: This haul resulted from a communal fish drive carried out by inhabitants of Atafu Atoll. The entire village will share in the catch. Right: Seven hundredweight of green and red parrot fish taken in another drive off Atafu Atoll.

Above: A Japanese longliner, one of the fleet of seven engaged in catching fish for the South Pacific Fishing Company at Santo, in the New Hebrides. Right: The Company's jetty at Santo, with combined conveyer belt, crusher, and chute for loading crushed ice direct into the holds of the longliners.

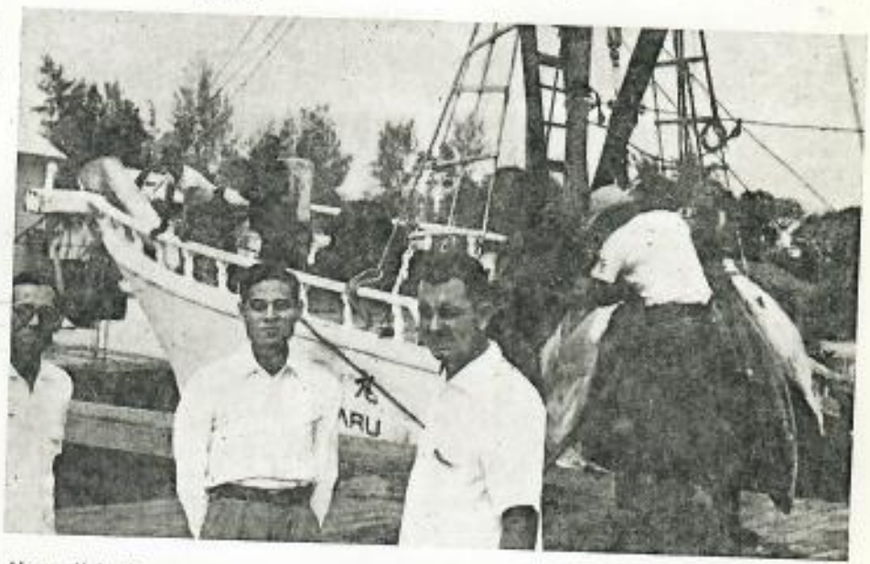
new species. A preliminary investigation of the Navua River has already been made. It is hoped that a more extensive survey of this and other rivers and streams of Viti Levu can be carried out early in 1959.

Shell Introduction For Tokelaus

Atafu and Fakaofo, two of the three atolls comprising the Tokelau Islands, under New Zealand administration, were visited. Present fishing methods and gear seem quite adequate to provide the islanders with their subsistence requirements without depleting the resources of the lagoons and reefs. Fish and shellfish are staple foods there. Communal fishing was observed in Atafu and the resulting catches were fairly good.

As a result of the survey, recommendations are being made for the introduction of blacklip pearl shell and trochus, which should, as far as can be seen now, find suitable habitats in the lagoons and on the reefs.

On the trip from Fiji to the Tokelau Islands some live trochus were taken along in order to test the "dry" method of transport. In spite of adverse conditions they survived for three days without losses.



Above: Unloading tuna at Santo. Mr. Don Gubay, Director of the South Pacific Fishing Company is in the foreground (right) with a Japanese representative of the Company. Below: Navua River, Fiji. A preliminary investigation has been made with a view to stocking this and other rivers in Fiji with new species of edible fish.

Breadfruit Study In French Polynesia

Close on one hundred varieties of breadfruit were studied by the Commission's plant introduction officer, Dr. Jacques Barrau, during a fortnight's cruise he made of the Marquesas, Society and Leeward Islands in September on board the French Navy frigate "La Confiance".

Data he collected formed a valuable contribution to the regional study he is making of breadfruit, which it is hoped will enable the present short season of yield in most islands to be extended by introducing strains bearing at different times of the year.

MIDWAY ISLAND

The dramatic increase in toxicity at Midway in 1959 has been reported (Banner, et al., 1960). Previous to that date, the "colored fish" of the reefs and lagoons were suspect but many of the civilian residents had been eating Caranx cheilio Snyder (Hawaiian: "papio"); suddenly in the latter part of October, 1959, even these fish became toxic and within two months 25 persons were treated for the characteristic symptoms of ciguatera at the Naval Hospital.

Although exact data is lacking, the toxic conditions appear to continue and in 1963 a construction worker upon the island reported a case where a total of 18 men were afflicted from eating a 75 lb Seriola dumerlii (Risso) (Hawaiian: "kahala"). No recent information has been obtained from the medical personnel on the island.

PHOENIX ISLANDS

No recent information could be obtained from the Phoenix Islands other than from Canton. At Canton the picture is somewhat confused but there have been medical records on the island of typical cases of ciguatera since World War II and four outbreaks involving 14 persons in Honolulu have been reported from snappers and groupers imported from the island.

Cooper (1964) reports the case of an Administrative Officer who was poisoned after eating the fatty portion of the belly of a black moray eel caught in the lagoon at Canton Island. Six other men who ate other portions of the same eel were unaffected. Bouder, Cavallo and Bouder (1962) state that ciguatera is the principal cause of infant mortality on Sydney Island (which was completely evacuated in 1958), however Cooper (1964) believes that malnutrition contributed to these deaths.

In 1962 the junior author questioned the Gilbertese living on the island and was told that Lutjanus monostigmus (Cuvier and Valenciennes), the viscera of Cheilinus undulatus Ruppel ("te karoa") and the liver of Carcharinus menisorrah (Müller and Henle) were toxic if caught near the mouth of the lagoon but that the flesh of brown moray eels (Gymnothorax javanicus [Bleeker]) from the lagoon up to 20 lbs in weight is commonly and safely eaten.

TOKELAU ISLANDS

In 1961 the author was able to inverview two medical practitioners in Apia, Samoa, whose home islands were in the Tokelaus. They reported that there were well-known areas off the islands where certain fish were toxic; the picture that they drew was of rather mild toxicity. Unfortunately the detailed notes on this interview were destroyed in the fire at the Laboratory, and attempts to elicit further information on the group have been to no avail.

THE DISTRIBUTION OF CIGUATERA

IN THE

TROPICAL PACIFIC

Albert H. Banner

Philip Helfrich

Final Report
Contract SA-43-ph-3741
"An Epidemiological Survey of Fish Poisoning
in the Tropical Pacific"
National Institute of Neurological Diseases and Blindness
National Institutes of Health
Public Health Service

October 15, 1964

Hawaii Marine Laboratory Technical Report #3
University of Hawaii
Honolulu, Hawaii 96822

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20 822 20 823

P.O. BOX 865 APIA
WESTERN SAMOA

P/F

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

10 February 1982

Mr George Balazs
Hawaii Institute of Marine Biology
P O Box 1346
Coconut Island
Kaneohe, Hawaii 96744
United States of America

Dear George,

Please accept my apologies for my dilatoriness in replying to your note of 10 December, but I was on extended leave over the December/January period.

Many thanks for the photographs. It brought back pleasant memories of a happy meal and a good trip. I only hope that the photo is not in true to life colour - I prefer to think that my complexion is not quite so florid!

With kind regards,

Yours sincerely,

(J P Larkindale)
Official Secretary

JPL:mnc

TOKELAU FILE

they sailed on a west-north-west course along it at a distance of 7 to 8 Dutch miles, and later in the day saw another high island to the west-south-west, the previous island being still in sight. They could not get much idea of the extent of the second island to the west. The second island was named Groeningen.

The first of these islands, Thienhoven, was Tutuila, which rises to 2,141 feet, and the second, Groeningen, was Upolu, which has a number of peaks of which the highest is 3,607 feet[1]—both in the Samoa group. Tutuila is about 50 miles west of the Manua Islands, and Upolu is about 38 miles west-north-west of Tutuila. It is plain that the expedition did not proceed far enough before dark to appreciate the full extent of Upolu, or to see Savaii to the west of it.

No more islands were seen until Roggeveen reached New Ireland on 17 July 1722.

The contributions of Jacob Roggeveen to the discovery of the Pacific Islands were as follows: On 5 April 1722 he encountered Easter Island, a landing being made. This was a new discovery because it is not credible that Davis had seen it (see section 22). On 18 May 1722 Roggeveen discovered Tikei; on 25 May 1722 he discovered, or rediscovered after Le Maire (see section 16), either Manihi or Ahe; on 27 May 1722 he discovered Apataki; on 28 May 1722 he discovered Arutua; and on either 1 or 2 June 1722 he discovered Makatea, a landing being made; all these islands being in the Tuamotu Archipelago. On 6 June 1722 Roggeveen discovered Borabora and Maupiti in the Society Islands. On 13 June 1722 Roggeveen discovered Rose Island and the Manua Islands, and on 15 June 1722, Tutuila and Upolu, in the Samoa group, these discoveries being first seen from his second ship the *Thienhoven*.

[1] *Pacific Islands Pilot*, vol. ii, pp. 405–6, 410–11.

earliest date for Nautical mag?

Scilly ?

kure ? NUKUNONO

28. Norton Hutchinson, James Dewar, and Thomas Baddison

On 5 March 1761 three British ships, the *Carnarvon* (Captain Norton Hutchinson), the *Warwick* (Captain James Dewar), and the *Princess Augusta* (Captain Thomas Baddison) passed Mapia, south of the western Carolines, on the way to China, and some months later came back over the same course, being on occasion separated from one another. A chart embodying the information of one Scott of the *Warwick* shows that the expedition on the way to China, after leaving Mapia, encountered an island in the western Carolines, the position shown for it being that of Pulo Anna. It would appear that another island to the south-east of this position and corresponding to that of Merir was seen by the *Carnarvon* on the way back.[1]

These would appear to be the first reasonably well-established European sightings of Pulo Anna and Merir. Either or both of these islands may have been seen by the Portuguese (see section 4).

29. John Byron

In 1765 John Byron came through Magellan Strait into the Pacific as commander of a British expedition of two ships, the *Dolphin* and the *Tamar*, sent by the British Government on a voyage of exploration. The authority for this voyage is Byron's journal as edited by Hawkesworth.[2]

By Byron's time the improvement in navigation had reached a stage where figures for latitude were fairly precise, although not yet for longitude. The modern abbreviations for degrees, minutes, and seconds were becoming generally adopted, being a token of the improvement. These latter are therefore used in the present and ensuing sections.

[1] Eilers, A., in *Ergebnisse der Südsee-Expedition 1908–1910. H. Ethnographie B Mikronesien*, vol. ix, part 1 (Hamburg, 1935), p. 164—citing Dalrymple, A., *A Collection of Charts* (London, 1781–94).

[2] Hawkesworth, J., *Voyages* (London, 1773), vol. i, pp. 1–139.

Leaving Masafuera near the South American coast on 30 April 1765, Byron took a predominantly north-west course. On 7 June 1765 he came to two low inhabited islands, the position given being close to latitude 14° S., lying close to each other north-west and south-east, the south-east one, which consisted of a cluster of islands, most of them joined by a narrow neck of land, being the larger, the other being judged to be about 5 miles in circumference. Being unable to anchor, or to land on account of the hostility of the inhabitants, Byron called them the Islands of Disappointment. Leaving these islands on the morning of the 8th, the expedition came the next afternoon, 9 June 1765, to a long low inhabited island with a lagoon, the latitude given being 14° 29′ S., with another island south-west by west, these two islands being separated by about 4 leagues. A landing party found on the second of these islands, in one of the huts, an old worm-eaten rudder from a Dutch longboat, with some metal items. The latitude here was taken as 14½° S. These islands were named King George's Islands.

These data show that the first two islands were Napuka and Tepoto, and the second two were Takaroa and Takapoto, on the northern fringe of the Tuamotu Archipelago, corresponding closely in latitude and description with Byron's details. The latter two were not a new discovery, having been visited previously by Le Maire (see section 16), and Takapoto again by Roggeveen (see section 27). Napuka and Tepoto were, however, discovered by Byron. The remains of the Dutch longboat were no doubt relics from the wreck of Roggeveen's *Africaansche Galey*, which was wrecked on Takapoto 43 years previously. Apparently no survivors of the five deserters from Roggeveen's expedition remained on Takapoto to welcome Byron's men, or to tell the world what other islands they might have seen in the meantime.

Byron describes the people of Napuka and Tepoto as of a deep copper colour, well made and active, and armed with very long spears. The people of Takaroa and Takapoto were armed in the same manner, and had large, double sailing canoes as well as small ones, very well constructed. Their economy was largely based on the coconut tree. They had dogs and pearl oysters. Close by their huts were funeral places, near which were boxes full of human bones.

The next day the expedition came to a long, narrow, inhabited island lying east and west, to which they gave the name Prince of Wales's Island. This appears to have been Manihi, which may have been discovered by either Le Maire or Roggeveen or both (see sections 14 and 27).

On 21 June 1765 Byron came to land having the appearance of three islands from the north-east, lying north-east by north and south-west by south, with rocks and broken ground between them and reefs at either end, the latitude being taken as 10° 15′ S. Byron called them the Islands of Danger. The next island was discovered on 24 June 1765, and called Duke of York's Island. It was a low, tree-covered island with a lagoon, in latitude somewhere near 8° S., as judged by the fact that after leaving the island and proceeding west for several days, Byron says that this was the latitude at that time. A landing party found no sign of habitation. On 2 July 1765, while making in the direction of the Ladrones, they saw to the north a low flat island, of delightful appearance with trees, but with much foul ground on which the sea broke. They skirted the south-west side, which they judged to be about 4 leagues long, seeing great numbers of islanders on the beach, from which more than sixty canoes, 'or rather proas' (this being the current term for Micronesian outrigger canoes as known from contacts with the Marianas), put off. This island was named Byron's Island. The latitude was taken as 1° 18′ S. The expedition reached the Ladrones on 28 July 1765, having seen no more islands.

The 'Islands of Danger' were no doubt Pukapuka in the northern Cooks, consisting of three main islets and some rocks and sand-banks. These are still occasionally called the Danger Islands. They had been discovered by Mendaña on his second voyage (see section 12). Byron's Duke of York's Island must have been Atafu, the northernmost island of the Tokelau group, in 8½° S. When visited by Captain Hudson of the U.S. Exploring Expedition in 1841, who was looking specifically for Byron's Duke of York's Island and who subsequently saw both Nukunonu and Fakaofo to the south, some people on Atafu told the Americans that they were subject to Fakaofo and mentioned Nukunonu, which lies between. Later contacts with the people of these three islands indicate that Fakaofo and Nukunonu had been inhabited since long before Byron's time.[1] In reference to Byron's Island, when Wilkes of the U.S. Exploring Expedition of 1838–42 visited

[1] Macgregor, G., *Ethnology of Tokelau Islands* (Honolulu, 1937).

Tabiteuea, the largest of the southern Gilbert Islands, he was told that there were other islands in the vicinity including Nukunau, and identified the latter with Byron's Island, although he did not visit Nukunau.[1] Nukunau is, however, a small island, and if it had been Byron's Island it would have been hard for Byron to miss the main Gilbert chain on his north-west course after leaving it. Tabiteuea itself answers much better to Byron's description, being a large island with much foul ground on the south side, and densely populated in historical times, which conforms with the launching of sixty canoes from one part of the island in question. It is also the most likely island in the vicinity of the stated latitude to be seen from the south-west and south without sight of any other island before or after. On the other hand, Byron's longitudes of other islands in the South Pacific are all several degrees to the west of their true position, whereas his longitude for Byron's Island is one degree only to the west of Tabiteuea. There are not sufficient grounds for an identification of Byron's Island beyond concluding that it was either Tabiteuea or Beru or Nukunau, all of which are in or near the stated latitude.

Byron gives a lively picture of the Gilbertese he saw in the canoes and on the ship at the time of this first European contact. Their canoes contained between three and six people. Some of the men came aboard, and showed an intrepid and cheerful disposition. They were tall, well-proportioned, and clean-limbed, their skin a bright copper colour, their features extremely good. One of them captivated the Englishmen by his lively antics and clowning. They wore attractive shell ornaments round their necks, wrists, and waists, and their ears were bored and elongated. Some of them had a kind of spear stuck full of shark teeth, sharp as a lancet, for about 3 feet of its length.

John Byron, on 7 June 1765, discovered Napuka and Tepoto in the Tuamotu Archipelago; on 24 June 1765 Atafu, the northernmost of the Tokelau Islands, a landing being made; and on 2 July 1765 either Tabiteuea or Beru or Nukunau in the southern Gilbert Islands.

[1] Wilkes, C., *Narrative of the United States Exploring Expedition* (Philadelphia, 1845), vol. v, pp. 5–17, 80.

30. Samuel Wallis

After Byron's return to England (see section 29) the *Dolphin*, in command of Captain Samuel Wallis, was sent on another voyage of exploration, in company with the *Swallow*, commanded by Philip Carteret. Carteret's ship became separated from the *Dolphin* as they were entering the Pacific, and its voyage across the Pacific, being virtually an independent one, is covered in the next section. The authorities for Wallis's exploration are his own journal as edited by Hawkesworth,[1] and the log or diary of the master, George Robertson.[2] The first of these is followed except where Robertson is specifically named.

Having come out of Magellan Strait on 12 April 1767, Wallis decreased his latitude slowly, and on 6 June 1767 discovered a low island about 4 miles long and 3 miles wide, with a large internal basin, the latitude given being 19° 26′ S. To this island he gave the name Whitsun Island. Here, according to Robertson, some of the men swam ashore to visit the island. Another island lay to the north-west distant about 4 leagues, some 6 miles in length and a mile wide according to Wallis's estimation. At this latter island, to which the name Queen Charlotte's Island was given, the Englishmen made contact with the inhabitants, who sailed off to the west-south-west in some large double canoes. A landing was made on Queen Charlotte's Island. The expedition proceeded in the direction the canoes had taken, and saw an island south-west of Queen Charlotte's Island while the latter was still in sight. This new island, which they called Egmont Island, had the appearance of two islands joined by a reef, the whole enclosing a lagoon, the latitude given being 19° 20′ S. They saw some inhabitants. The date of the finding of Egmont Island was 10 June 1767. Leaving in the evening, the next day they saw another inhabited island surrounded by rocks, of much the same appearance as Egmont Island, but narrower, to which they gave the name Gloucester Island, the latitude given being 19° 11′ S. This was on 11 June 1767. At five the next morning, 12 June 1767, they set off again, and soon saw another island to which they gave the name Cumberland Island. At dawn the next morning, 13 June 1767, they saw another small island which had the appearance of small keys, to which they gave the name Prince William

[1] Hawkesworth, J., *Voyages* (London, 1773), vol. i, pp. 362–522.
[2] In *The Discovery of Tahiti*, ed. Carrington, H. (London, 1948).

A few days' sail to the west, the *Bounty* came to a small low island with inhabitants, and evidently with a lagoon, where a landing was made.[1]

The small island must have been either Vatoa or Ono-i-Lau, which are the only two detached lagoon islands to the west of the southern Tonga islands. Vatoa had been discovered by Cook (see section 37). Ono-i-Lau, if it were the island, had not been previously reported.

45. Captain Douglas

CAPTAIN DOUGLAS, of the British vessel *Iphigenia*, while proceeding north-west from Niihau in the Hawaiian Islands, discovered, on 19 March 1789, an island or rock in the form of a saddle, covered with verdure on the south, but on the north, west, and east sides barren rock, with very steep sides.[2]

The topographical description of this island,[3] and its location in relation to Niihau, show that it was Nihoa, 116 miles north-west of Niihau, in the Hawaiian Islands.

46. Captain Wilkinson

CAPTAIN WILKINSON, of the British vessel *Indispensable*, while on a passage from New South Wales to China in 1790, passed between two islands to the south of the main Solomon Islands. Other vessels in due course reported contacts with islands in this vicinity. The British hydrographer Arrowsmith, in his chart of 1798, showed two islands in this area north-west and south-east of each other, the north-western one being named Bellona, the other unnamed. In due course as the geography of the area became better known, it became established

[1] Narrative of 'Jenny' in *Sydney Gazette*, 17 July 1819, and *Bengal Hurkaru*, 2 Oct. 1826, cited by Maude, C. E., *Journal of the Polynesian Society*, vol. lxvii, pp. 125–6 (Maude's analysis is followed).
[2] Meares, J., *Voyages* (London, 1790).
[3] *Pacific Islands Pilot*, vol. iii, pp. 293–4.

that there are in fact only two islands there, namely Bellona and Rennell.[1]

These facts may be considered to establish that Wilkinson discovered Rennell and Bellona in 1790.

47. Edward Edwards and Oliver

IN 1791 Edward Edwards made an extensive search in the South Pacific in the British naval vessel *Pandora* for the *Bounty* mutineers (see section 44). A petty officer named Oliver, in charge of a prize crew in a small schooner built by the mutineers in Tahiti, became separated from Edwards in the Samoan Islands, and made a separate traverse of the Pacific from there to the south coast of New Guinea, rejoining Edwards later in Java. An account of the voyage was given in an official report by Edwards, to which some details are added in an account by the surgeon, George Hamilton. These accounts make a few references to Oliver's separate traverse.[2]

Coming from the east, Edwards first encountered Ducie, to the south-east of the Tuamotu Archipelago, and then an island stated to be in latitude 21° 31′ S., longitude 135° 32′ 30″ W., and about 8 miles long, which was evidently Marutea in the Tuamotus. Both these islands had been discovered by Quiros (see section 14). Edwards then discovered another low lagoon island, called by him Carysfort's Island, thought to be 5 miles long, the position given being latitude 20° 49′ S., longitude 138° 33′ W. Hamilton says the date was 19 March 1791.

This is the position of Tureia, in the Tuamotu Archipelago, an island with no others very close to it.

After capturing some of the *Bounty* mutineers in the Society Islands, Edwards, accompanied by Oliver in the tender, as the mutineers' locally built ship is called in the accounts, came west to Aitutaki and Palmerston, in the southern Cooks. He then went to look for Byron's Duke of York's Island, namely Atafu in the Tokelau Islands (see section 29). On 6 June 1791 he came to a lagoon island, on which a landing

[1] Arrowsmith, A., *Chart* (London, 1798); Findlay, A. G., *A Directory for the Navigation of the Pacific Ocean* (London, 1851), vol. ii, p. 1017.
[2] Both are in *Voyage of H.M.S. Pandora*, ed. Thomson, B. (London, 1915).

party found huts and other signs of human visitors, the position given being latitude 8° 34′ S., longitude 172° 6′ W., and on 12 June 1791, found another lagoon island on which people were seen, the position given being latitude 9° 9′ 30″ S., longitude 171° 30′ 46″ W. A landing party found that the inhabitants appeared to have left the island after seeing the ships. Edwards called this second island Duke of Clarence's Island, having concluded that the first was in fact Byron's Duke of York's Island.

The position of the first island corresponds closely to that of Atafu, Byron's Duke of York's Island. It would appear from the latitude given for the second island, and the probabilities from the course in relation to Atafu, that it was Nukunonu in the Tokelau Islands. This was a new discovery.

Edwards then spent some time in the Samoan Islands, where he became separated from Oliver, and then at Tonga, after which he came to Uvea, known from Wallis's discovery (see section 30).

Leaving Uvea on 5 August 1791, Edwards, on the evening of 8 August 1791, came to more land, which the next morning proved to be rather high, well populated, about 10 miles long, with islands at its west end joined to it by a reef. This island he named Grenville Island, the position given being latitude 12° 29′ S., longitude 183° 3′ W.

This was Rotuma, a large detached island north of the Fiji Islands, conforming with Edwards's data. This was a new discovery, the thought that Bougainville's L'Enfant Perdu might have been Rotuma being untenable.

A great number of paddling canoes came off from Rotuma to the ship. No sailing canoes or double canoes were seen. The people said they were in contact with the Tongans. They were tattooed distinctively, with fish, birds, and other things marked on their arms. Their language appeared to bear some resemblance to that of the Tongans.

On 12 August 1791 Edwards saw a small island with 'two high hummocks and a steeple rock', named Mitre Island, which appeared uninhabited. The position given was latitude 11° 49′ S., longitude 190° 4′ 30″ W. This he named Mitre Island. Soon afterwards another island, high but small, and well cultivated, was seen, the position given being latitude 11° 37′ S., longitude 190° 19′ 30″ W. This was named Cherry Island.

These data show that the two islands were Fataka and Anuta, two detached islands lying west of the Santa Cruz Islands. They correspond closely with Edwards's positions and descriptions.

Oliver, after his separation from Edwards, according to Hamilton, came down to Tofua in Tonga. Edwards says that Oliver, after leaving Tofua, steered 2 days to the westward, and fell in with an island which Edwards supposed to be one of the Fiji Islands, where he waited for Edwards for 5 weeks, and then proceeded through Endeavour Straits, between Australia and New Guinea. Hamilton says that Oliver and his company were attacked at Tofua, and were 'obliged to be much on their guard afterwards, at those islands which were inhabited', and that 'after much diversity of distress, and similar encounters', they at last made the reef between Australia and New Guinea.

It must therefore be presumed that Oliver saw one or more of the Fiji Islands, and probably other islands between them and the Torres Strait area. So far as the islands between Fiji and Torres Strait are concerned, all had already been discovered with the exception of the Torres Islands to the west-north-west of the Banks Islands, and the position of the latter is such that on Oliver's course from the south-east the possibility of his having seen them can be virtually ruled out, since the Banks Islands are so placed in relation to them that sailing vessels coming from the south-east would be likely to pass well to the east or south-east of the Torres Islands. Any discoveries that Oliver may have made, therefore, may reasonably be regarded as in the Fiji Islands, and Tasman, Cook, and Bligh had already discovered most of these. Some of those Fiji Islands which had not in fact been discovered by these previous explorers might however have been discovered by Oliver.

The islands discovered by Edward Edwards were Tureia, in the Taumotu Archipelago, on 19 March 1791; Nukunonu, in the Tokelau Islands, on 12 June 1791; Rotuma, north of Fiji, on 8 August 1791; and Fataka and Anuta, on 12 August 1791.

Edwards's associate Oliver may have discovered one or more of the islands in the Fiji group which had not been discovered by previous explorers.

117. D'Wolf Island

STEPHEN R. CROCKER, of the American whaling ship *General Jackson*, on 28 January 1839 visited a low, well-wooded island where the natives were friendly. When 5 miles to the south-east of it he took his position as latitude 9° 26′ S., longitude 171° 7′ W. Crocker says in his log that this island was D'Wolf Island, discovered on 14 February 1835, William De Wolf of Bristol being the owner of the ship.[1]

The position given is that of Fakaofo, in the Tokelau Islands. The existence of Nukunonu (some 35 miles west-north-west of Fakaofo), which had been discovered by Edwards in 1791 and named Duke of Clarence's Island (see section 47), would presumably be known to Crocker and his contemporaries from the charts. D'Wolf Island can therefore reasonably be taken to be Fakaofo, of which there is no previous direct record.

118. Robert Fitz-Roy

ROBERT FITZ-ROY, a British naval captain, in command of the *Beagle*, while passing from Pukapuka to Fakarava in the Tuamotu Archipelago, discovered two uncharted islands on 13 November 1835, 4 days after leaving Pukapuka. He said in his narrative of the voyage[2] that their native names were 'Tairo' and 'Cavahi', this knowledge being apparently derived from indirect native information, since he passed the islands without visiting them. 'Cavahi' was seen a few hours after leaving 'Tairo'. 'Tairo' was an islet, 'Cavahi' consisted of a number of islets surrounding a lagoon.

Taiaro and Kauehi are two atolls lying on a westerly course from Pukapuka, so placed that a sailing time of four days from Pukapuka to Taiaro, during which no islands were seen, and then of a few hours to Kauehi, is realistic. Taiaro is a small circular islet only about 3 miles wide. Kauehi is a much bigger atoll. It is evident that Taiaro and Kauehi, in the Tuamotu Archipelago, were discovered by Fitz-Roy on 13 November 1835.

[1] Stackpole, E. A., *The Sea-Hunters* (Philadelphia–New York, 1953), p. 282, citing log of the *General Jackson*.

[2] Fitz-Roy, R., *Narrative of the . . . Beagle*, vol. i (London, 1839).

119. R. L. Hunter and Captain Grimes

CAPTAIN R. L. HUNTER, of the British vessel *Marshall Bennett*, on 25 December 1835, while coming from New Georgia to the Banks Islands, saw, while travelling east in the parallel of 14° S., the 'Torres islands' to the northward, and other islands to the east which, from his descriptions, were Vanua Lava and Gaua in the Banks group.[1]

The southernmost of the modern Torres Islands, a group of five islands to the north-west of the Banks Islands, is 896 feet high and lies 34 miles north of the 14th parallel. It is not clear whether the 'Torres islands' seen by Hunter included any of the Torres Islands of today or were confined to the northern islands of the Banks group discovered by Quiros (see section 14), namely Vanua Lava and Ureparapara.

When Hunter referred to the 'Torres islands' he no doubt got the name from the contemporary charts. Thus Arrowsmith in his chart of 1798 showed islands called by him Banks Islands in consequence of Bligh's reports of islands in the area, with islands to the north-west of them called Torres, supposed to have been discovered in 1606, no doubt in consequence of the islands reported in that year by Torres of Quiros's expedition (see section 14).[2] The discoveries both of Quiros's expedition and Bligh, however, were confined to the Banks Islands as they are known today. It was by a mere coincidence that the Torres Islands of the nineteenth-century charts lie in somewhat the same relationship to the Banks Islands as the Torres Islands of today, which were in fact unknown.

Hunter on another occasion encountered an island which was not on his charts. In September 1836, while coming from Laughlan's Islands, i.e. the Nada Islands to the north of the Louisiade Archipelago (see section 81), he went north and then west-south-west, and so came to a large inhabited island, estimated to be about 40 miles in extent, nearly east by south, and west by north, of moderate elevation with some hills in the interior, the highest being of a remarkable sugar-loaf shape. Hunter made the eastern end of the island in latitude 9° 9′ S., longitude 153° 5′ E., and the western end in latitude 8° 53′ S., longitude 152° 24′ E. Hunter commented that three small, high islands could be

[1] In *Nautical Magazine* (London, 1840), p. 468.

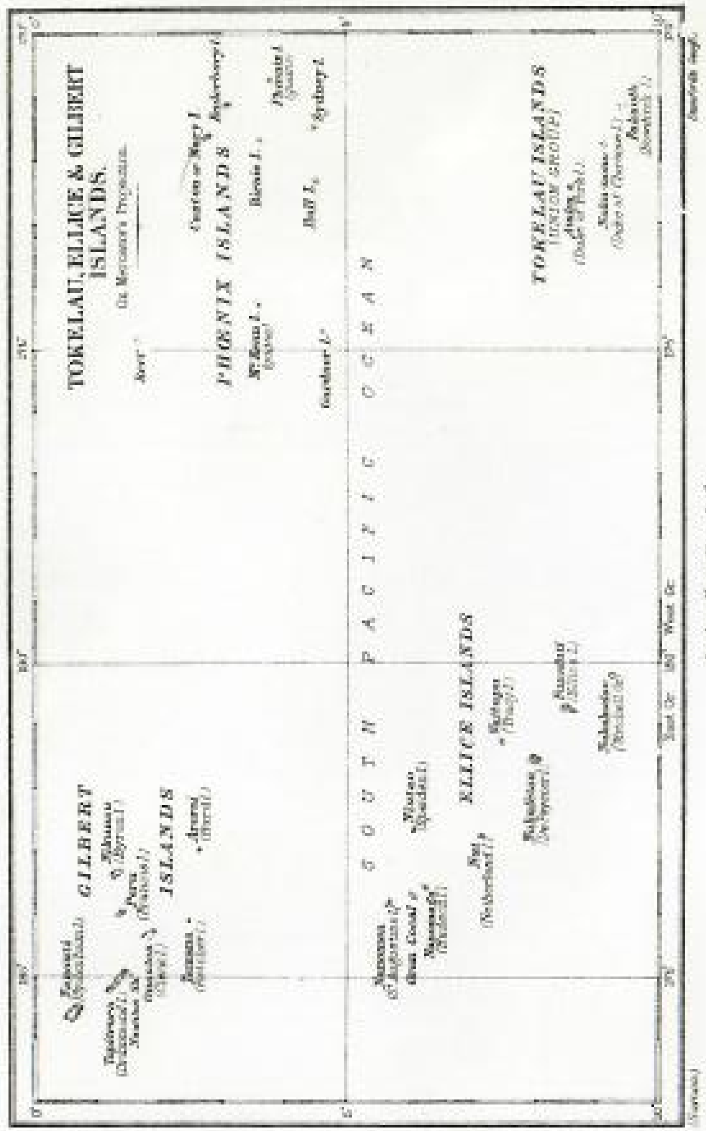
[2] Arrowsmith, A., *Chart* (London, 1798).

THE DISCOVERY OF THE PACIFIC ISLANDS

BY

ANDREW SHARP

OXFORD
AT THE CLARENDON PRESS
1960



CHAPTER XXIII.

ETHNOLOGICAL NOTES FROM OTHER ISLANDS.

In the course of my missionary voyages in the Pacific I have had opportunities of collecting ethnological and other facts from various islands at distances of from 200 to 2000 miles from Samoa. In most instances I have used as my interpreters Samoan native teachers who had lived for years among the people from whom I wished to elicit information. Without a lengthened personal residence reliable details are necessarily limited. The following notes, however, will not be unacceptable:—

1. Fakaofo, or Bowditch Island.

Lat. 9° 26′ S. Lon. 170° 12′ W.

The natives there say that men had their origin in a small stone on Fakaofo. The stone became changed into a man called Vasefanua. After a time he thought of making a woman. This he did by collecting a quantity of earth, and forming an earth model on the ground. He made the head,

body, arms, and legs all of earth, then took out a *rib* from his left side and thrust it inside of the earth model, when suddenly the earth became alive, and up started a woman on her feet. He called her Ivi (Eevee), or *rib*, he took her to be his wife, and from them sprang the race of men. To this day the children play on the sand at making models of men—body, hands, feet, head, and face, with holes for the eyes.

The government was monarchical, and the king, Tui Tokelau, was high priest as well. There were three families from which the king was selected, and they always selected an aged man. They said that a young man was a bad ruler, and that mature age was essential to the office. They were a quiet people, and rarely fought.

Their great god was called Tui Tokelau, or king of Tokelau. He was supposed to be embodied in a stone, which was carefully wrapped up with fine mats, and never seen by any one but the king, and that only once a year, when the decayed mats were stripped off and thrown away. In sickness, offerings of fine mats were taken and rolled round the sacred stone, and thus it got busked up to a prodigious size; but as the idol was exposed to the weather out of doors, night and day, the mats soon rotted. No one dared to appropriate what had been offered to the god, and hence the old mats, as they were taken off, were heaped in a place by themselves

and allowed to rot.[1] Before the idol was its house, or temple, a great thatched shed, which might hold some 400 people. Once a year, viz. about the month of May, a whole month was devoted to the worship of the god. All work was then laid aside. Great quantities of food was prepared. The people assembled from the three islands, prayed for life, and health, and a plentiful supply of fish and cocoa-nuts. They had dancing too, men with men, and women with women, and lighted up the temple all the night over during the month with what they called "light in honour of the god."

No fire was allowed to be kindled at night in the houses of the people all the year round. It was sacred to the god, and so, after sundown, they sat and chatted in the dark. There were only two exceptions to the rule: 1st, fire to cook fish taken in the night, but then it must not be taken to their

[1] How remarkably this compares with what the Earl of Roden says of a stone idol in his *Progress of the Reformation in Ireland*:—"In the south island, in the house of a man named Monigan, a stone idol, called in the Irish 'Neevougi,' has been from time immemorial religiously preserved and worshipped. This god resembles in appearance a thick roll of home-spun flannel, which arises from the custom of dedicating a dress of that material to it whenever its aid is sought; this is sewn on by an old woman, its priestess, whose peculiar care it is. Of the early history of this idol no authentic information can be procured, but its power is believed to be immense; they pray to it in time of sickness; it is invoked when a storm is desired to dash some hapless ship upon their coast; and, again, the exercise of its power is solicited in calming the angry waves, to admit of fishing or visiting the mainland."

houses, only to the cooking-house; and, 2d, a light was allowed at night in a house where there happened to be a confinement.

The origin of fire they traced to Mafuike, but, unlike the Mafuike of the mythology of some other islands, this was an old blind *lady*. Talanga went down to her in her lower regions and asked her to give him some of her fire. She obstinately refused, until he threatened to kill her, and then she yielded. With the fire he made her say what fish were to be cooked with it, and what were still to be eaten raw; and then began the time of cooking food.

Polygamy prevailed. Cocoa-nuts and fish formed the prevailing food of the people. There were no fowls or pigs there, but swarms of rats. Boys at sport played at catching rats. They who caught the most won the game. Canoes were made from a single log hollowed out. They now use iron tools, but formerly they used shell hatchets. They sometimes burned the trunk of a tree to make it fall, but as the fire occasionally ran up the heart of a tree and destroyed it all, they usually cut away at the trunk with their shell hatchets, day after day, until it fell. It took ten, fifteen, and thirty days to fell a tree. Another plan was to dig down and cut the roots. They showed some ingenuity in the manufacture of buckets with lids. They were made by hollowing out a solid block of wood. They did it by burning.

When a ship was seen they consulted the king

and high priest whether they should go out to it. He decided for or against. If they went they did so with great fear, praying all the way that they might be preserved alive and free from harm. When a party went the king often went with them. When he went, one sat a little before him, holding up a cocoa-nut leaflet, as a sort of protecting flag, or charm, and the king sat immediately behind, praying all the while, as the rest paddled, that they might be kept from harm. A party of them once went out to visit a ship, and when near the vessel one of their number was shot dead; all the rest fled to the shore. They supposed that the people in the ship thought they had gone out to fight.

They thought a foreign ship something unearthly, and the white crew sailing gods from some region of spirits. The fire burning in their inside, and sending forth volumes of smoke (tobacco smoke) seemed superhuman, and the guns, belching out fire and smoke and "stones," seemed to be no work of man. If any one died about the time a vessel had been seen, they concluded that the party of sailing gods had come for his spirit, and when they happened to see any on board ship with their hair cut short, they supposed they were some of the spirits but lately received.

Apart from the god Tui Tokelau, there was a particular disease-making god, whose priest received offerings from the sick of fine mats. When the

friends of a sick man took a present to the priest, he promised to pray to the god for recovery; and then he went to the sick person and anointed with oil the part affected. He used no particular oil. When he sat down he called some one of the family to hand him some oil, and, dipping his hand in the cup, passed it gently over the part two or three times. No medicines were used for the sick. If the body was hot, they went and lay down in cold water; if cold, kindled a fire and warmed themselves.

After death the friends of the deceased were anxious to know the cause of his death. They went with a present to the priest, and begged him to get the dead man to speak, and confess the sins which caused his death. The priest might be distant from the dead body, but he pretended to summon the spirit, and to have it within him. He spoke in his usual tone, and told him to say before them all what he did to cause his death. Then he (the priest) whined out, in a weak, faltering voice, a reply, as if from the spirit of the departed, confessing that he stole cocoa-nuts from such a place, or that he fished at some particular spot forbidden by the king, or that he ate the fish which was the incarnation of his family god. As the priest whined out something of this sort he managed to squeeze out some tears, and sob and cry over it! The friends of the departed felt relieved to know the cause, got up, and went home.

At death one would say to his friends, "I'm going to the moon—think of me as being there." Another would say, "I'm going to be a star," and mentioned the particular part of the heavens where they were to look for him. Another would say, "I shan't go away, I shall remain in the grave, and be here with you." Thus they seemed to think they had only to choose where their disembodied spirits were to go after death. They believed, however, that there were certain evil spirits always on the watch for human beings, and that, if any were caught, their souls were dragged up and down the universe for ever, as the slaves of these demons, and never found a resting-place. Hence it was a common saying at Tokelau, "Take care of the soul, it lives for ever; never mind the body, it dies and rots in the grave." And hence, too, a man would rather die than go at night to certain haunted spots, where he thought it probable he might be seized by one of these evil spirits. They tell of a Tokelau man who went up to the moon, and have their tale, also, of "*the man in the moon*." They believed that the moon was the special residence of the kings and priests of Tokelau. The stars they believed to be the spirits of the departed. When the full moon began to wane they supposed that it was being eaten by the inhabitants of the region. From the new moon until the full they considered that the food was growing again. An eclipse of the moon

was thought to be some sudden calamity, destroying the food of the departed kings, and occasioned special concern; and prayers and a meat-offering of grated cocoa-nut was immediately presented to their great god, Tui Tokelau, to avert the evil. As the eclipse passed off they thought it was all owing to their prayers.

At one time a chief called Feuku on the neighbouring island of Nukunonu ruled the group. One of his subordinates, however, became rebellious and was banished to Fakaofo. There he gathered partisans and raised war against Nukunonu. They fought; many of Feuku's people were killed, and the case seemed hopeless. When preparing for another fight he asked his son to give up his body to be put to death, so as to get *blood* sufficient with which to smear all the remaining people, so that the enemy, when they came and saw all laid down and smeared with blood, might pass over them and stop the fighting. It was the custom there in war that if any one was found lying down and with marks of blood on his body, he was not touched, but passed over, and not killed or beheaded as in Samoa.

When the expected day for another battle came the son of the king Feuku, out of love to his father and the people, consented to be killed. His body was divided in two, and the blood smeared on all the people. All were much excited, and touched with this wonderful love of their king and his son.

After some speechifying they determined to show their love in return, and, when the enemy came, rise and fight to the death rather than seek life by lying down and showing the stains of blood. This was done; the war party came from Fakaofo; Feuku's people stood up, fought bravely, defended their chief, and drove the enemy to sea and back to Fakaofo.

2. Manahiki, or Humphrey's Island.

Lat. 10° 20′ *S.* *Long.* 161° 4′ *W.*

The following notes I had from a native of Manahiki:—He and other ten set out in heathen times to see and learn something of islands to the west of which they had heard. They left in a canoe with a small supply of cocoa-nuts and water in cocoa-nut shells. After being five weeks at sea they landed at Quiro's Island. The most of them went in a whaling vessel to the Tokelau group, but the man to whom I refer came to Samoa, and was for some time in our mission seminary.

Of his countrymen he said they were all light brown Eastern Polynesians like himself. At the birth of a child only the woman and her mother were present. The umbilicus was separated by a shell. If a girl it might be strangled by the father, as he was afraid the child in after years might by bad conduct be a disgrace to the family. Twins were not infrequent, and they have known of four

SAMOAN WOMAN IN COSTUME OF THE PAST.

Frontispiece.

SAMOA

A HUNDRED YEARS AGO

AND LONG BEFORE.

TOGETHER WITH

NOTES ON THE CULTS AND CUSTOMS OF
TWENTY-THREE OTHER ISLANDS
IN THE PACIFIC.

BY

GEORGE TURNER, LL.D.

OF THE LONDON MISSIONARY SOCIETY.

WITH A PREFACE BY

E. B. TYLOR, F.R.S.

London
MACMILLAN AND CO.
1884

p. 20, para 2 - This is an interesting anecdote but what does it have to do with method of capture?

p. 38, item 6 - Perhaps this point should be strengthened. After all the whole thesis for condoning the continued ~~[illegible]~~ subsistence use of turtles in the Fiji Islands is because they have traditionally done that & it is their way of life. So why not stick to their traditional way of catching turtles.

HOY

CSIRO
MARINE LABORATORIES

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Leach Street, Marmion, W.A.

A Division of the Institute of Animal and Food Sciences
A Division of the Institute of Physical Sciences

PO Box 20, North Beach, W.A. 6020
Telephone (09) 447 1388 Telex 93366

REJ:jt

12th July 1982

Mr. G. Balazs,
NMFS,
P.O. Box 3830,
HONOLULU, HAWAII 96812,
U.S.A.

Dear George,

Many thanks for your Tokelau MS. I enjoyed reading it. It is well written, full of interesting information and conveys a genuine sympathy for the people you worked with. You needn't reword the part about renesting on page 23 on my account. I made a mistake and you caught it. It seems like a fair comment.

What needs to be done to the MS for publication depends on where you publish it. It could go into Atoll Research Bulletin with only a little condensing. It could go into Pacific Science with moderate condensing. For most other journals you would probably have to cut fairly substantially. Whereas none of it is superfluous, the section that could survive the heaviest pruning is the introduction.

I like your recommendations - the best thought-out programme for Pacific islanders I've seen. I would hope you could publish some place that would allow the inclusion of these recommendations because they form a useful template for others framing conservation programmes in other island areas.

I'm going to try to find in my files the names and addresses of two New Zealand anthropologists that have been working in the Tokelaus for years and have gathered a great deal of (unpublished) information on fishing. I met them in Apia on their way to Tokelau for about the tenth time. You imply in your MS that the project is to be a continuing one. If so it might be useful to compare notes with these people. (Later - their names are Tony Hooper and Susan Huntsman, but I don't know what university they are affiliated with in New Zealand).

With regard to your comment that nesting is uncommon on lagoon beaches; I have a recollection of reading this comment in connection with other atolls too. If it is a general phenomenon, perhaps this should be mentioned with the appropriate citations. I imagine you know more about this than anyone else.

On page 26 - "delectable" portions? Seems a peculiar choice of phrase, not only value-laden but implying that all of the turtle is delectable. Including the shell?

P. 28, keratinous (spelling).

2/....

On rereading the paper it strikes me that a lot of the flavor of Tokelauan behavior and customs will have to be excised to make the paper acceptable to most journals, and this would be a pity. That's why I would favor Atoll Research Bulletin, unless you are under pressure to get something out quickly.

On or around page 34 you might insert a suggestion to the effect that the following recommendations might be considered by others for adoption in other Pacific island areas.

On page 36 I think you should expand in a sentence or two on the implications for harvesting of the long time it takes turtles to reach maturity, perhaps citing your paper, Limpus's and the third person's (I'm working at home and don't have my references) providing data on how much longer it takes than was previously thought to reach maturity.

On the bottom of page 36 you mention turtles ought to be viewed like kanava trees - but don't tell us how they are viewed.

I spent a very educational afternoon and evening in Queensland last week with Col Limpus and two of his dedicated assistants. He's a fascinating fellow.

My research trip up north to follow up on the sand moisture salinity work provided a big surprise, and I won't be sending you a manuscript for a while after all.

You'll recall that I found significantly lower sand moisture salinities in 15 nesting beaches than in 16 non-nesting beaches. I had virtually taken it for granted that I would find a relationship between sand moisture salinity at nesting depth and the salinity of the underlying groundwater. To my great surprise I found 1: no relationship between the two and 2. groundwater salinities every where were much higher than overlying sand moisture salinities.

Since there had been less than 1 cm of rain total in the four months preceding my sand moisture salinity measurements one cannot attribute the low salinities here to rain. It has been demonstrated that moisture moves up from the water table to keep the insides of coastal sand dunes moist. The mechanism has not been established. Capillary forces are not strong enough to do it. A process of "internal dew formation" has been proposed, whereby water vapor moving up from the water table cools and condenses between sand grains. This could explain the low salinities of sand moisture overlying salty groundwater.

Even if this is so, it doesn't explain why non-nesting beaches should contain significantly higher sand moisture salinities than nesting beaches. Could this be influenced by the degree of exposure of the beach to salt spray? That's the only explanation I can think of at the moment. When I go up in January I'll check this out, and also take samples of surface (dry) sand directly above the spots where I take samples at nesting depth to see if there is any relation.

3/...

Another problem with my observations - in the non-nesting beaches the sand-moisture salinities were far below salinities at which hatchling mortality occurs.

But despite all these perplexing questions the fact remains that turtle nesting beaches in the area are distinguished by sand-moisture salinities that are lower than those in non-nesting beaches and the data is highly statistically significant ($p < .002$). It seems to me there's got to be something I can learn from this, but I'm not sure what now.

In January I'll extend my observations to some loggerhead-green nesting beaches in the nearby Muiron Islands and see if they still hold.

I would be delighted if you would take some sand samples on your travels too. I should warn you however that I misled you in an earlier letter concerning how easy it is to measure salinities. Once you have mixed enough distilled water with the sand so as to be able to draw off enough for a salinity determination, you have knocked the salinity down so low that you can't read it with a refractometer. You have to titrate it with $AgNO_3$. So, if you take sand samples you have several alternatives. 1. Get someone in the lab at NMPS to process the samples (method enclosed) if such an analytical services lab is available there to you. 2. Get the Coconut Island analytical services group to run them for you at a price. (I think I can afford to pay for it - if you decide to go this route let me know what the costs are). 3. You can mail the samples to me and I'll get them run here.

In order for the data to be useful, control samples from non-nesting beaches of similar general appearance are needed, along with samples taken from nesting beaches. In either type of beach the samples should be taken after digging to the depth at which turtles nest and at likely nesting sites - i.e. in the case of North West Cape the turtles almost always nest right beside dune vegetation in sand with plenty of rootlets. It would also be desirable to have surface sand samples for comparison. The results will be less ambiguous if you can sample during the nesting season and at times when it hasn't rained for a while.

I find about 25~ grams of sand in an airtight vial is about right. That means a vial of about 2 cm diameter and 4 cm long.

If you only sample a few beaches, get ten or 15 samples from each. If you can do a dozen of each of nesting and non-nesting beaches then three or four samples (both at nesting level and at the surface) from each would be enough to demonstrate salinity differences if they exist. This may be considerably more arduous than you realized when you volunteered. Don't feel apologetic if you decide that too much work is involved and prefer to drop it.

Are nesting beaches in areas where you have worked liable to be less exposed to salt spray than similar beaches that are not used for nesting? (I assume that lagoon beaches aren't used much by turtles because of the long distances hatchlings would have to swim to get to the relative safety of deep water. Turtles that lay on such beaches would presumably be selected against by higher hatchling mortality).

4/....

One of my tangential hypotheses has been that groundwater carrying essence-of-turtle-eggshell into water near the beach might provide the olfactory cue that enables turtles to identify nesting beaches. (In such an instance the salinity of the groundwater would be irrelevant). I understand from Col. Limpus that this notion is not original with me, and the Pritchard has put it forward. Can you give me any reference to this?

Cheers,

R.E. Johannes
PRINCIPAL RESEARCH SCIENTIST

During the second study period three sand samples were taken from each of 31 beaches after digging on or near the beach platform to a depth equal to that at which the turtles deposited their eggs - about 1 m. The samples consisted of about 25 g of sand and were stored in air-tight plastic vials. The moisture content of the sand was determined by weighing the samples before and after drying for 48 hours at 110°C in a drying oven. The salinity of the moisture was measured after adding 10 ml of distilled water to the dried sand, shaking the mixture to redissolve the salts, and titrating 1 ml aliquots of the supernatant against $AgNO_3$ with 5% K_2CrO_4 indicator.

RESULTS

For purposes of statistical analysis the beach sample sites were divided into two groups - those which contained no nests, and those where 15 or more nest depressions were visible within a 30 m radius. A third category of beach, only an occasional nest depression could be found, is not discussed here, nor are beaches where beach rock outcropping prevented access by turtles.

The moisture content of the nesting beaches was higher than that of non-nesting beaches (Table 1) but the difference was not statistically significant ($p < 0.1$). The mean salinity of sand moisture of the nesting beaches was about one half that of moisture in the non-nesting beaches (Table 1) and the difference was highly significant ($p < 0.002$). In both types of beaches and the salinity of the sand moisture, ~~samples~~ was almost always less than 25% of that of seawater, although a few individual samples contained salinities considerably higher than the means (maximum 11.3°/$_{oo}$ in one nesting beach sample; 22.9°/$_{oo}$ in one non-nesting beach sample).

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20 822 20 823

P.O. BOX 865 APIA
WESTERN SAMOA

18/2/4

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

9 June 1982

George H.Balazs,
Assistant Marine Biologist,
Institute of Marine Biology,
P O Box 1346,
University of Hawaii,
MANOA. C

Dear George,

I am not an eloquent writer for that matter to persuade you to accept my apologies for not responding earlier. I did receive your first letter and the copy of your report. After reading through the report I gave it to someone for the purpose of getting different opinions of it. In trying to trace up its whereabout later was futile.

Anyway after having read through the report I did not pick out any points that I disagreed with. In reference though to Dr.J. Huntsman comments I wish to say the following:-

P.12, para.2 : Our (us in the office) understanding of "Tuahivivalu", it is an exceptionally huge specimen of any specie of turtle. P.12, para. 3: "kea" is the juvenile turtle. It is not the ~~name~~ hawksbill only. Hawksbill is known as the "kea puhi".

P.24, para.3: Skipjack in Fakaofo and Atafu (?) is not regarded as an "ika ha". They are only given out to the village when the catch exceeds what the fisherman and his family can handle.

I hope my comments are not too late to be of any use to you.

BBest regards,

Yours sincerely

(S Ulii)
for : Official Secretary

SU/ea

16 February 1982
Dept. of Anthropology
University of Auckland

Mr George H. Balazs
Assistant Marine Biologist
Hawaii Institute of Marine Biology
P.o. Box 1346, Coconut Island
Kaneohe, Hawaii 96744

Dear Mr Balazs,

I am sorry to be so tardy in responding to your letter of November 12th. It appears we have been wandering in the same circles, but our paths never crossed. I returned to Auckland only two weeks ago, after being in Tokelau for six months before you got there, being in Chicago when you were in Tokelau, and returning to Tokelau in early December via Hawaii.

I have pondered long but can think of no paper in which I have described the "usage of sea turtles in Tokelau". I have in two works made some brief remarks about sea turtles, and you should be able to see those works in Hawaii. In the Working Paper series from this Department (both the Bishop Museum Library and the University of Hawaii Library have standing orders for these) No. 47 is entitled "Ten Tokelau Tales". The first of the ten is The Tale of Hina and Turtle, and the notes to it contain some remarks on turtles. My Ph.D. thesis also contains some brief remarks, pp. 23-4 on capturing turtles, and pp. 206-8 on the distribution of turtles. A microfilm or xerox copy of the thesis may be in one of the Libraries in Hawaii. If not, Dr Julia Hecht, a post-grad fellow at the Department of Anthropology, has a xerox copy.

At the moment, this is all I can offer, short of composing a paper for you, which time does not at present allow.

My colleague, Tony Hooper, would be very interested in your report on sea turtles - as would I. He has begun a small scale study of Tokelau fisheries, which may spawn a more major study.

Sincerely yours,

Judith Huntsman

Judith Huntsman

THE UNIVERSITY OF AUCKLAND

PRIVATE BAG AUCKLAND NEW ZEALAND TELEPHONE 792-300

10 April 1982

Dear George,

Thanks for sending along the project report on sea turtles in Tokelau. I found it informative, sensible and sensitive, and am amazed at the amount you accomplished in a short time. All in all a very commendable piece of work. As you requested, here are a few corrections and comments.

p. 5, para. 3: The epidemic of dysentary was introduced just before the slavers by L.M.S. returned Tokelau castaways (something the L.M.S. could not exactly be proud of). Subsequently, one slave ship captured infected Tokelauans with disastrous results for that enterprise (see H.E. Maude 1981: chapters 9 and 15).

p. 6, para. 3: The USCG episode was not publicly recorded for security reasons. Atafuans claim to have misinformed officers of a Russian ship who asked them about it in the 1950.

para. 4: In the absence of any solid archaeological or linguistic evidence, any attempt to determine a date for settlement is futile. Traditional histories we have recorded posit autchtonous founders for each atoll, rather than settlement by voyagers. Assignment of dates is a European preoccupation, as is seeking the source of settlers - and these preoccupations have led Tokelauans to give very speculative information. I would suggest: "The traditional histories of Tokelau posit separate autchtonous founding populations in each atoll, and record the subsequent hegemony of Fakaofo established by driving off the "true" Atafuans and conquering the people of Nukunonu. Atafu was not resettled until about 1800. Fakaofo's dominance was symbolised by the location of the temple and stone effigy of Tui Tokelau on that island." While Fakaofo's hegemony was "officially" ended in 1918(?), it effectively ceased with the Christian conversions of Atafu and Nukunonu in 1861.

p. 7: para. 1: Tokelauan should be referred to as a language of the Polynesian family.

para. 2: The New Zealand Tokelau population is now at least 2500.

p. 8, para. 2: To label Tokelau society "patriarchal" is misleading. Descent principles are thoroughly cognatic; an egalitarian ethic dominates; authority rests with the elders, who in the public sphere are male. Politically it might be labelled an "egalitarian gerontocracy" but probably "Tokelau society is traditionally egalitarian in ethic and cognatic in terms of descent and inheritance."

p. 9, para. 1: Mr. N. Walters

p. 12, para. 2: "Tuahivivalu" is the name of a specific large turtle which was sighted at all three atolls and finally captured at Atafu, probably in the mid-19th century.

p. 12, para. 3: My understanding was that "kea" referred to the hawksbill, but I may be wrong.

p. 17, para. 2: I have heard Tokelauans claim that sharks simply do not attack them. I specifically asked for instances of shark attacks and the only one I got was a traditional account of a shark attacking and killing a man in retribution for violation of some tapu. His companions were completely ignored.

p. 19, para. 1: I am virtually certain that the Vavau referred to is the Vavau in Tonga, on the basis to references to Vavau in other tales. A Samoan student once claimed that it referred to a place in Samoa, but I think she was being chauvinistic.

p. 20, para. 4: It is important to note that outrigger canoes are still used almost exclusively in Atafu. When I was there earlier in 1981, only one aluminium runabout was in use, and that was an administration boat assigned to Semu's agricultural workers. There were aluminium boats (and at least one fibreglass one) lying around the village, but men said that they were no good, the rivets kept falling out. The Atafuans, because they have plenty of large kanava trees, can build substantial outrigger hulls which can easily carry outboards, but can also be sailed or paddled. They have very sensibly maintained the traditional versatile craft.

p. 21, para. 1: I doubt that type of vessel has been a major factor in changed patterns. Certainly, wage/salary employment and required school attendance has, for both require families to be in the village. During May school holidays in Nukunonu, a considerable number of people, mostly women and children, spent several days at the plantation motus.

p. 24, para. 3: Skipjack are also known as "ika hā" if caught in any substantial number. Formerly, they were occasionally caught - one or two - when fishing below the surface, and these were not shared out. But the usual method of catching them was the classic casting with pearlshell lures, and this fishing was done - as it is today - by the village fleet and entailed much etiquette and many prohibitions. The patterns have been somewhat compromised by the development of fast trolling indulged in by individual crews, which hooks kahikahi 'immature yellow-fins' and skipjack. More skipjack are thus coming into the village in individual catches and not being shared out. However, when shoals appear a ban is put on fast trolling with imported lures.

p. 25, para. 2: Most people who do not eat turtle do not do so from either personal repugnance or because it is something "of the kāiga" - an inherited repugnance or perhaps because of some kāiga prohibition in the past.

p. 25, para. 3: Whereas women allocate produce within kāiga, inati are public village allocations under the auspices of the tau-pulega, and thus handled by men choosen by them. In Atafu at least, those selected as tauvaega must be from among the descendants of the two daughters of the present populations founder. Though male, they are tama-fafine within the village polity (just as the women who do the allocating in kāiga are tama-fafine within the kāiga).

Also - thanks for the New Yorker cartoon - Bryn Mawr is a rather common target for New Yorker humour.

Best regards

Judy

Judith Huntsman

SMITHSONIAN TROPICAL RESEARCH INSTITUTE

BOX 2072
BALBOA, REPUBLIC OF PANAMA
OR
APO. MIAMI 34002
U. S. A.

TELS. 52-5859
22-0211
CABLE: STRI

23 September 1983

Dr. George H. Balazs
National Marine Fisheries Services
P.O. Box 3830
Honolulu, Hawaii 96812

Dear George:

Unfortunately I lost the gentleman's address in the Tokelau Islands who described the recent disturbance there to corals, and the lagoon cut-off due to sea level lowering. I called Dr. Wyrtki's office for a copy of his letter, but he was away on an extended trip. Could you please help me out on this?

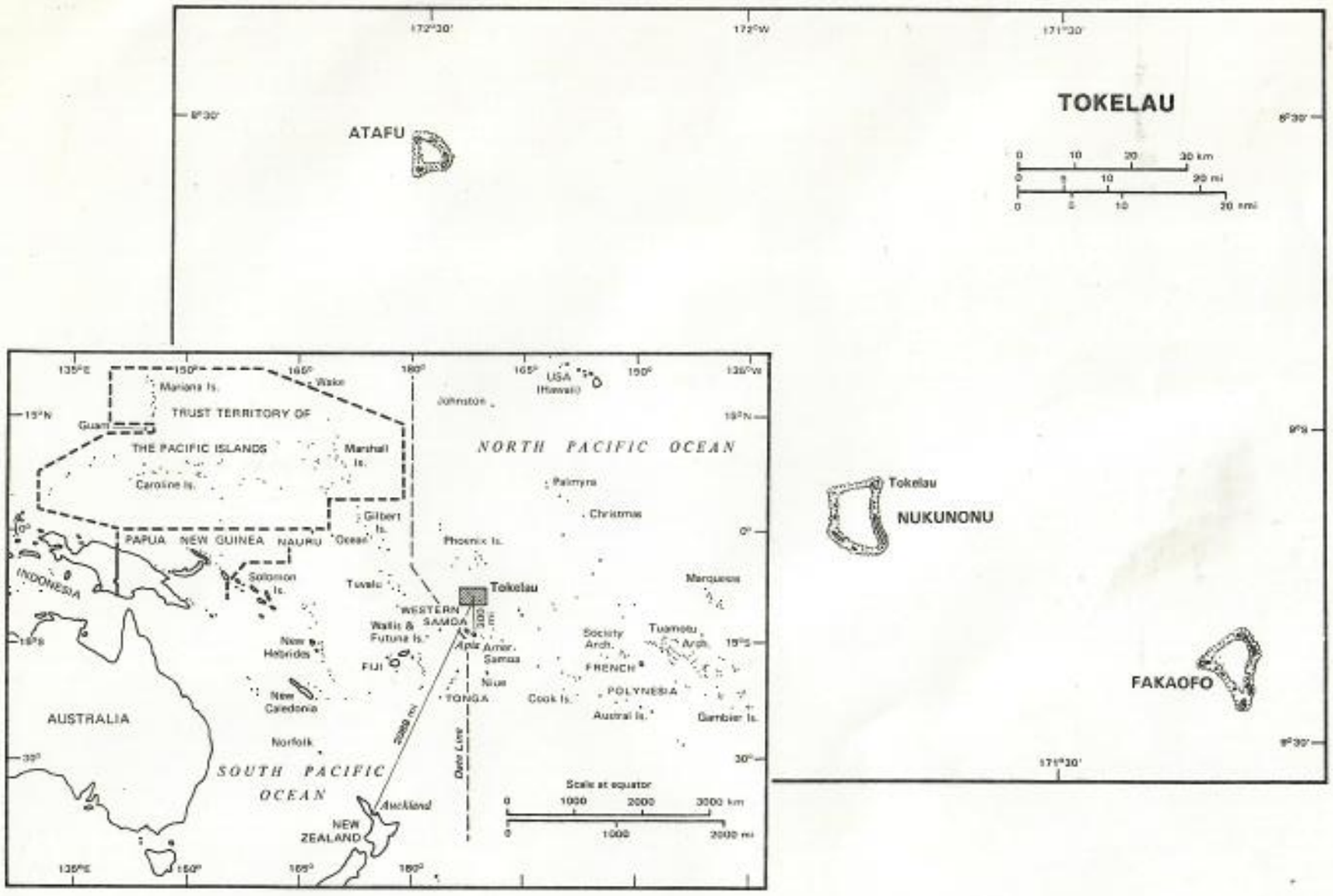
If yes, would you please drop the Tokelau gentleman a letter asking him specifically when he first noticed bleaching corals (date), the kinds bleaching, and also the depths. In other words, was this a near-surface disturbance or did it also extend to 10 meters depth or so? This information would be very useful, as pools of warm water associated with the 82/83 El Nino were observed in that area. If you could send on this letter for me it would speed up things considerably. Just send me a copy so that I have his address in the future. Enclosed are two preprints describing the dying reefs off the Pacific coast of Panama. Perhaps you could send one to Tokelau?

I appreciate any help you can give me on this. With best wishes,

Sincerely,

Peter W. Glynn

Peter W. Glynn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SOUTH PACIFIC OCEAN
TRUST TERRITORY OF THE PACIFIC ISLANDS
PAPUA NEW GUINEA
NAURU
INDONESIA
AUSTRALIA
NEW ZEALAND
Mariana Is.
Guam
Caroline Is.
Marshall Is.
Gilbert Is.
Ocean I.
Solomon Is.
Tuvalu
Wake
Johnston
USA (Hawaii)
Palmyra
Christmas
Phoenix Is.
Tokelau
WESTERN SAMOA
Apia
Amer. Samoa
Wallis & Futuna Is.
New Hebrides
FIJI
New Caledonia
Norfolk
TONGA
Niue
Cook Is.
Society Arch.
Tuamotu Arch.
FRENCH POLYNESIA
Austral Is.
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200 mi
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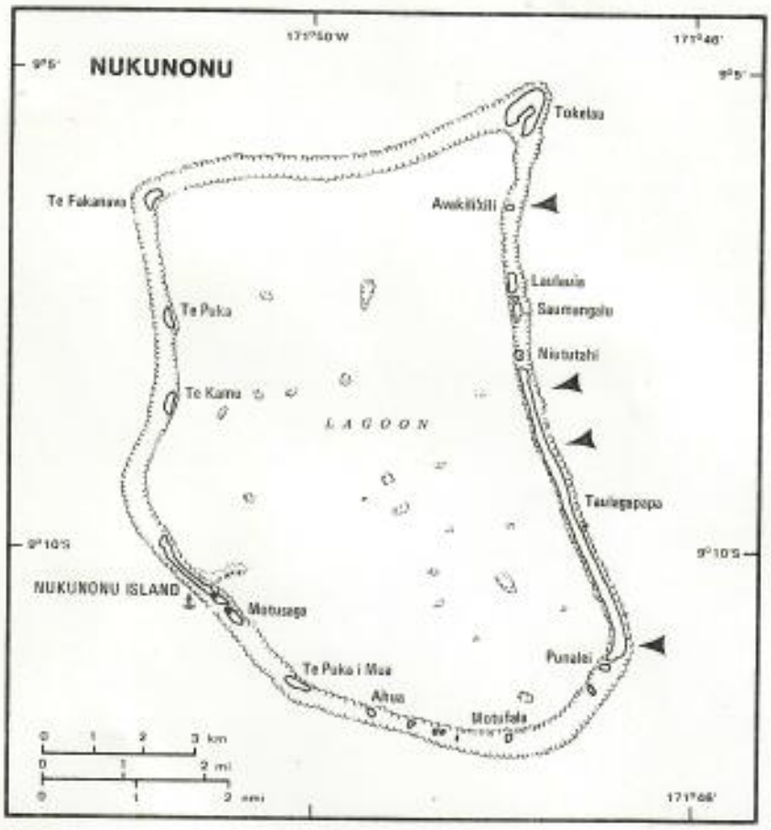
NUKUNONU
171°50'W
171°46'
9°5'
9°10'S
Tokelau
Te Fakanavo
Awakitiliti
Lasilasia
Te Puka
Saumangalu
Niuturahi
Te Kamu
LAGOON
Taulagapapa
NUKUNONU ISLAND
Motusaga
Te Puka i Mua
Punalei
Ahua
Motufala
0 1 2 3 km
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San José State University
SAN JOSE, CALIFORNIA 95192

SCHOOL OF SOCIAL SCIENCES
Environmental Studies Dept. (408) 277-2940

7/23/84

George H. Balazs
Southwest Fisheries Center
Honolulu Lab
National Marine Fisheries Service
NOAA
P.O. Box 3830
Honolulu, Hawaii
96812

Dear Dr. Balazs:

I just received a copy of Atoll Research Bulletin wherein your article, "Sea Turtles and Their Traditional Usage in Tokelau," appeared. I found it very interesting, indeed. Congradulations!

Since we seem to have similar interests, I thought you might find a few publications of mine of interest. My Ph.D. dissertation (see Vita) apparently was of some use to Robert Johannes when he began his work out in Belau (Palau), Micronesia. As you can see by my review of his book, Words of the Lagoon, I am a real fan of Bob Johannes.

Please keep me posted on any further work you do on traditional conservation techniques in Oceania.

Sincerely,

Gary A. Klee
Associate Professor
& Program Coordinator

Paper given in the Symposium "Pacific Basin Biogeography" presented at the TENTH PACIFIC SCIENCE CONGRESS of the Pacific Science Association, held at the University of Hawaii, Honolulu, Hawaii, U.S.A., 21 August to 6 September, 1961, and sponsored by the National Academy of Sciences, Bernice Pauahi Bishop Museum, and the University of Hawaii. Published 1963, Bishop Museum Press.

RATS, COCONUTS, MOSQUITOES, AND FILARIASIS*

MARSHALL LAIRD†

Institute of Parasitology, McGill University, Quebec, Canada

NUKUNONO, the largest member of the Tokelau Islands group, lies 64 kilometers west-northwest of Fakaofo and 91 kilometers southeast of Atafu. Its reef, 38 kilometers in circumference, 11 kilometers long north–south and 10 wide east–west, bears many islets of varying size of a total area of 546 hectares (New Zealand, Dept. Island Territories, 1959). Only outrigger canoes and sailboats are available for transportation in the Tokelaus; hence, biological exploration there necessitates spending considerable time in traveling among the islets. Each atoll has upwards of 40 of these, and from the air it is very evident that they are "just incidents on the reef," to quote the apt remark made by Marston Bates in reference to one of the Caroline Islands (Bates and Abbott, 1958).

After the corals of which they are built, the most conspicuous biological elements in these atolls are the islanders themselves, the coconut palms yielding the copra that is the staple export, and the container-breeding mosquitoes and rats which arrived long ago aboard ocean-going canoes. A census conducted on September 25, 1958, gave the following figures for the indigenous population: Fakaofo, 723; Atafu, 524; Nukunono, 462; total for the group, 1,709. There were only two resident Europeans, at the Roman Catholic Mission at Nukunono, and ten temporary visitors. Settlement is concentrated upon a single islet of each atoll, although a second islet is being developed for habitation at Fakaofo to alleviate overcrowding. *Rattus exulans* subsp., the "little Burmese rat" of the Oriental Region, became widespread among the islands of the central and south Pacific in pre-European times. These rats are common on most islets of the Tokelaus, and extremely so on certain of the larger ones devoted to copra production. They are very evident in the undergrowth and can often be seen among the crowns of the coconut palms also.

*This paper is a contribution from the Institute of Parasitology, McGill University, Quebec, Canada, with financial assistance from the National Research Council of Canada. The observations herein are a by-product of field work undertaken in 1958 and 1960 in the three atolls that comprise New Zealand's Tokelau Islands dependency. The main project, which concerned the potentialities of employing specific parasites of mosquitoes in the control of disease vectors, and the encouraging results of which have led to the initiation of related investigations elsewhere, will not be mentioned further here. Thanks are due, however, to its sponsor, the World Health Organization, to the New Zealand authorities, and to Tokelauans too numerous to mention individually for making the study possible. The cooperation of Bernice P. Bishop Museum, Honolulu, in the identification of insect collections, and of my colleague in the project, Dr. D. H. Colless of the C.S.I.R.O., Canberra, is also acknowledged with appreciation.

† Present address: World Health Organization, Geneva, Switzerland.

The rats gnaw a characteristic orifice 2–3 centimeters in diameter near the attachment point and feed on the growing nuts. These damaged coconuts soon fall to the ground, with estimated losses to the copra crop of up to 40 percent (New Zealand, Dept. Island Territories, 1959). Any retained fluid and the kernel ferment rapidly, and the contents of recently fallen nuts appear to be both attractive and toxic to insects for they become loaded with dead ants, myrmecophilous flies of the family Phoridae, sciarid flies, cockroaches, and beetles of the families Staphylinidae and Nitidulidae. Somewhat later, living maggots of muscid flies become dominant, and once the fluid contents

FIGURE 1.—Green, green-brown, and brown stages of fallen rat-gnawed coconuts. Matautu district of Nukunono's largest islet, April 14, 1960.

are no longer milky and putrid, *Aedes* (*Stegomyia*) *polynesiensis* Marks begins to utilize rat-gnawed nuts as larval habitats. The liquid within such nuts seems mostly derived from the original organic contents, the small orifice seldom admitting significant amounts of rain water. Shell and husk soften as decomposition proceeds, a process characterized by exterior color changes. The nuts are at first green, then a brown area develops and spreads over the entire surface (Fig. 1). Both green-brown and brown stages of this series are highly suitable for mosquito development, but rotting ultimately reaches a point beyond which liquid can no longer be retained (Fig. 2).

FIGURE 2.—Old, rotted coconut, far beyond the stage of being able to retain liquid. Atafu, April 10, 1960.

A. polynesiensis is the chief vector of Bancroftian filariasis in the eastern Pacific and also a transmitter of dengue. It is the only species of mosquito present at Nukunono and Atafu and by far the dominant one of the two found at Fakaofo. Natural and man-made tree holes, and, to a lesser extent, crab holes, constitute its chief semipermanent larval habitats throughout the group. Domestic water containers are also utilized on the village islets, and two further types of temporary habitats are afforded by coconuts as a result of human activities. These are nuts split longitudinally for the collection of copra, which usually contain relatively clean rain water; and discarded drinking nuts, which provide mosquito larvae with environmental conditions paralleling those found in rat-gnawed nuts. The latter, however, comprise the great bulk of temporary larval habitats.

This is reflected by the fact that throughout the group, the incidence of *A. polynesiensis* is in direct proportion to that of rat-gnawed coconuts. Thus at Atafu, *R. exulans* is scarce on the islet of Alofi and in the Motungangia district of Whenualoa, and the bulk of the *A. polynesiensis* population originates from tree holes; but rats reach their peak of abundance for the group on Atafu's largest islet, where gnawed coconuts, often teeming with larvae, lie everywhere. In 1958, the districts of Ahanga and Utua on the latter islet yielded mosquito biting catches of 524 and 321 (2 men/15 minutes), the two highest individual figures registered during the entire project, compared with only 44 for Alofi and 36 for Motungangia. Nineteen such catches at various parts of the atoll provided a mean of 123.1, about twice that for Nukunono (61.8) and Fakaofo (65.4). Furthermore, the incidence of Bancroftian filariasis increasing in direct proportion to the number of infective bites, the highest microfilaria rate determined during the human blood survey conducted in 1958 was that for Atafu (21.9 percent). The extreme abundance of rats in the most productive coconut-producing islets of this atoll can thus be blamed for the relatively high local incidence of *A. polynesiensis* and thereby of filariasis. In addition to these matters of public health concern, Atafu's copra yield is the lowest for the whole group.

Rat control is therefore of pressing importance to the Tokelau Islands in general and to Atafu in particular. The New Zealand authorities are well aware of these facts, and aluminum strips are being used (Fig. 3) in a palm-banding program (New Zealand, Dept. Island Territories, 1959). Such rat guards, when properly applied, are of course an effective deterrent, but it is one matter to employ them in regulated plantations and quite another to do so on relatively undeveloped atolls. Proper supervision of banding operations is not always available, and the task therefore proceeds rather sporadically and with varying effectiveness. After all, on a windless day it may take a long time (three to four hours, from experience at Nukunono) to paddle across a lagoon in blazing sunlight from the village to an outlying islet. Once there,

FIGURE 3.—Coconut palms banded with aluminum strips, Matautu, Nukunono, April 20, 1960.

an unaccompanied canoe-load of Tokelauans may, not unnaturally, decide to abandon tree-banding for the day and go fishing instead. Furthermore, the intermediate plant stratum is often insufficiently cleared away, the heads of pandanus plants, valued for their fibrous leaves and fruit, being allowed to remain in contact with coconut palms that have guards nailed to their lower trunks. I have seen rats using bridges of this sort to reach the coconut canopy, where intermingled fronds allow them to move freely from palm to palm.

Attempts made thus far to employ modern rat poisons in the Tokelaus have met with little success owing to baiting difficulties, although it would be surprising if this impediment could not be overcome through research. Biological control has not been contemplated at all, and there are some interesting possibilities here.

While local vector potential would limit the variety of arthropod-borne pathogens that might be considered for introduction, excluding, for example, such agents as the anopheline-transmitted *Plasmodium berghei* Vincke and Lips, the small size and isolation of atolls combine with their limitation of fauna, flora, and habitats to render circumstances exceptionally favorable for experimenting with microorganisms, whether alone or in combination with pesticides, against dense populations of a nonimmune host. As regards predators, it was first brought to my notice by Robert P. Owen (1961) that prior to World War II the Japanese introduced monitor lizards, *Varanus indicus* (Daudin) (Fig. 4), into certain Micronesian islands to control *R. exulans*. Bates and Abbott (1958) remarked that this introduction was effected from Yap or the Palaus, and that it may have been undertaken with the potential food value of varanids as well as rat control in mind. They contrasted the density of the *R. exulans* population on Ella Islet, Ifaluk (Carolines), where there are few monitors, with the relative scarcity of rats on islets where these predators are common, and learned from the older islanders that rats had been much more destructive of coconuts prior to the establishment of varanids.

Of course, before any such introduction were contemplated for the Tokelaus, possible secondary consequences would have to be carefully evaluated. Bates and Abbott stated that monitors eat crabs (including land crabs, the burrows of which may harbor *A. polynesiensis*), other lizards, and even birds, as well as rats. Furthermore, the poultry-robbing propensities of *Varanus* are well known. Despite the latter fact, however, monitors are thought deserving of protection as rat killers in the Malay Archipelago (Dammerman, 1929), and in any case chickens are confined to the vicinity of the villages in the Tokelaus. As they are allowed to run wild there, and muscid-fly breeding in their faeces constitutes a health hazard, it is submitted that some varanid pressure would do no harm in forcing the restriction of poultry to wired runs.

Apart from a few scarce Pacific pigeons and long-tailed cuckoos, the latter being present only during the southern winter, the avifauna of the

Tokelaus (an account of which is in preparation) consists of sea birds. Some of these, particularly the white tern and two species of noddies, nest in trees on certain islets of all three atolls. (They are not utilized as food by the islanders.) Such birds might suffer to some extent from the establishment of monitors, although whether this new predation would in fact be more significant than that to which they are already subjected by rats is open to question. The necessary background data on the over-all disturbance of biotic balances by *V. indicus* could be sought in the Carolines. Obviously the initial requirement is an appraisal of the Tokelau rat problem by a competent ecologist

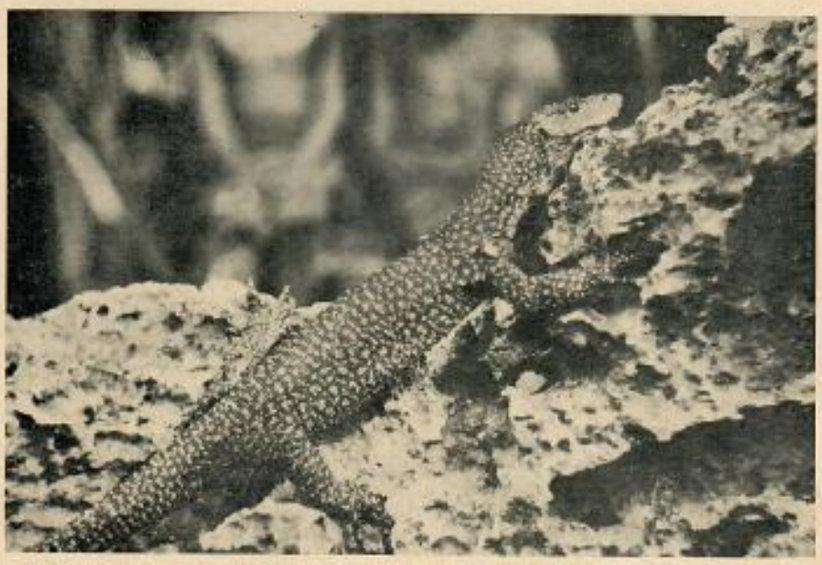

FIGURE 4.—*Varanus indicus indicus* (Daudin). Photographed on Bellona Island, British Solomon Islands Protectorate, August 15, 1953.

given also the means to make parallel investigations in the former Japanese mandated territories in Micronesia. It is contended that under prevailing circumstances efficient rat control in the Tokelaus is unlikely to result from palm-banding alone, rodenticiding alone, or biological procedures alone. The development of a practicable procedure integrating mechanical, chemical, and biological measures is viewed as the only means of attaining such control, and perhaps even the eventual eradication of *R. exulans*. An integrated control procedure, designed as a result of ecological studies under the highly suitable conditions for such activities existing in the Tokelau Islands, would be of equal application in many similar Pacific territories, upon all of which it would confer far-reaching medical as well as economic benefits as outlined herein.

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A CORAL ISLAND EXPERIMENT

A CORAL ISLAND EXPERIMENT

A New Approach to Mosquito Control

by Dr Marshall Laird [1]

The Tokelau Islands in the South Pacific have been the scene of trials of new techniques in the control of mosquitos, including a biological method—the introduction of fungi pathogenic to mosquito larvae. Such fungi are self-perpetuating and self-distributing, causing a marked drop in the mosquito population. Tests were also made of a larvicidal technique using dieldrin-cement briquettes placed in mosquito habitats. These experiments have cleared the way for a broader research programme, and field trials on a larger scale are now being considered.

Chemical insecticides are still the main weapon against insects, mites, and ticks of public health importance. However, it is unwise to rely on them exclusively. Many insects have now developed a degree of resistance to them, and the insufficiently selective use of chemicals can give rise to secondary problems. For example, larviciding operations may so disturb the balance between the aquatic stage of the target vector and its natural enemies as to lead to the early resurgence of the vector population to an even higher level than before.[2] Not least among the disadvantages of relying too heavily on insecticides is the resulting tendency to neglect other possibilities of control.

For a number of years WHO has been seeking ways to remedy this situation, notably through a comprehensive screening programme to find new and effective insecticides for vector control. Research on novel control procedures (including biological and genetic ones) is also being encouraged, and it is anticipated that these will ultimately be combined with highly selective chemical methods, so as to achieve maximum effectiveness with minimum harm to the natural enemies of the vector.

The present article describes parallel field experiments on the biological and chemical control of an important vector of filariasis in a group of isolated atolls in the South Pacific. The biological method involved the use of highly host-specific parasitic fungi.

Nukunono, the largest of the three atolls comprising the New Zealand Tokelau Islands Dependency, is situated about 500 km north of Western Samoa. It has a reef 38 km in circumference bearing many islets of varying size totalling 546 hectares (1350 acres) in area. The sister atolls, Atafu and Fakaofo, are 91 and 64 km distant from Nukunono respectively.

Only two species of mosquito are found on the Tokelau Islands—*Aedes polynesiensis*, which is present on all three atolls and is the vector of filariasis, and *A. vexans nocturnus*, which is present only on Fakaofo atoll. The mosquitos breed in water containers of various types, either natural or artificial—such as the water drums used by the islanders, rat-gnawed coconut husks, or holes in trees, including the man-made reservoirs hollowed into the lower part of the trunks of palm trees and locally called *tungu*. Surface water

[1] Vector Biology and Control, World Health Organization, Geneva.

[2] In this connexion, it should be noted that at present insecticides are generally applied against disease vectors much more selectively than they are against economic pests. Thus, the spraying of DDT, dieldrin, and other compounds on the inner walls of houses against malaria-carrying mosquitos poses very much less risk of undesirable side effects on other living organisms than does aerial spraying of the same substances over large tracts of land.

suitable for mosquito larvae is lacking except in crab burrows and the taro marsh in which *A. v. nocturnus* is established on Fakaofo. The only other surface water consists of a few brackish seepages unsuitable for either species of mosquito. Earlier ecological studies had indicated that the mosquitos in the Tokelaus were free from harmful parasites or other natural enemies. In particular, there was no sign of the pathogenic fungi of the genus *Coelomomyces*—organisms that are virtually restricted to mosquito hosts and are of importance in the natural regulation of mosquito populations in some areas. The infected mosquito larvae usually die from a combination of causes including the physical effects of parasitism and nutritional side effects.

Several factors favoured the choice of the Tokelau Islands as the site of WHO's first pilot project to develop integrated methods for mosquito control—the small size of the islands, their extreme isolation, their limited fauna and flora, and the restricted range of freshwater habitats that they afford to a filariasis vector singularly free from natural enemies. The three atolls, being widely separated from each other, lent themselves to parallel trials. Nukunono was used for the biological-control experiment, Atafu was the scene of a larvicidal-briquette experiment, and Fakaofo acted as a control atoll on which no experiments were conducted. The project was carried out with the co-operation of the Government of New Zealand.

The introduction of fungi on Nukunono

Operations started in September 1958, with the introduction of a Singapore strain of *Coelomomyces stegomyiae* into Nukunono atoll. The samples of fungus were derived from parasitized larvae of *Aedes albopictus*. The batches were of four kinds. The first consisted of debris from the bottom of laboratory containers in which the sporangia-rich remains of parasitized *A. albopictus* larvae had been allowed to accumulate, the second of sediment from Singapore tree-holes from which infected larvae had been taken for several months. All the material in these first two batches was treated at the outset to induce the hatching of any eggs it might contain so that no insects would be inadvertently introduced. The third batch consisted of the bodies of parasitized *A. albopictus* larvae individually dried on pieces of filter paper, and the fourth of living *A. albopictus* larvae exhibiting *C. stegomyiae* sporangia. The latter larvae either died in transit or were killed on arrival at Nukunono, their bodies yielding a rich concentration of what was hoped would prove infective material. The inoculum did in fact produce infections in second and third instar *A. polynesiensis* larvae kept under observation in the field laboratory on Nukunono. Evidence was thus obtained of the susceptibility of this host to *Coelomomyces*, the only such evidence procured during the three weeks spent on the atoll in 1958. However, all the larvae concerned died before reproductive stages of the fungus could develop, and there was thus some doubt as to whether the fungus would be able to propagate itself in its new host.

During the three-week period, every islet of the atoll was systematically searched for mosquito larval habitats. Throughout the operation, none of the *A. polynesiensis* larvae sampled proved to harbour any parasites other than a cosmopolitan protozoan, *Lankesteria culicis*, which is generally regarded as non-pathogenic and has proved to be of high incidence in *Stegomyia* populations wherever it has been sought. In all, 761 permanent or semipermanent larval habitats—notably tree-holes, including many *tungu*—were located and seeded with the fungal inoculum. It was estimated that these represented at least 80% of the habitats of this kind existing at the time of the visit. Periodic microscopic examination of the different batches of inoculum throughout the seeding operation proved that apparently viable *Coelomomyces* sporangia remained plentiful.

The use of dieldrin briquettes on Atafu

On Atafu, a larvicidal trial was carried out, using dieldrin-cement briquettes, each weighing about 20 g and made according to the

following formula: two parts of cement, five parts of coral sand, and three parts of dieldrin (50% water-dispersible power). Once again, all islets of the atoll were visited, and, in order to obtain as high a kill as possible, a briquette was placed in each larval habitat discovered, without regard to the permanence of the habitat. In all, 6500 such habitats were treated, among them being 125 drums and tanks used mainly for domestic water storage in the village. More than half the habitats were rat-gnawed coconuts, which are especially abundant on Atafu and are a major source of *A. polynesiensis* there. The day after the briquette was introduced, a larval mortality of 100% was noted in every mosquito habitat checked.

A survey of initial conditions

Estimates were made of the mosquito population (adult females and aquatic stages) on all three atolls. The mean number of adult female *A. polynesiensis* attempting to bite during catches of 15 minutes' duration, using an unprotected volunteer and a repellent-protected collector, were: Nukunono, 61.8 mosquitos; Atafu, 123.1 mosquitos; Fakaofo, 65.4 mosquitos. A microfilaria survey was also undertaken, for which, in addition to preparing the usual Giemsa-stained thick films from each person concerned, immediate examinations of covered drops of fresh blood were made by means of a McArthur field microscope. The author found this technique a more sensitive method of detecting microfilariae than the traditional one. Even in very light infections, any living microfilariae can easily be seen moving within fresh blood preparations, whereas in thick films of dried blood some of the very few microfilariae originally present are likely to be lost during the laking and staining processes.

Progress surveys

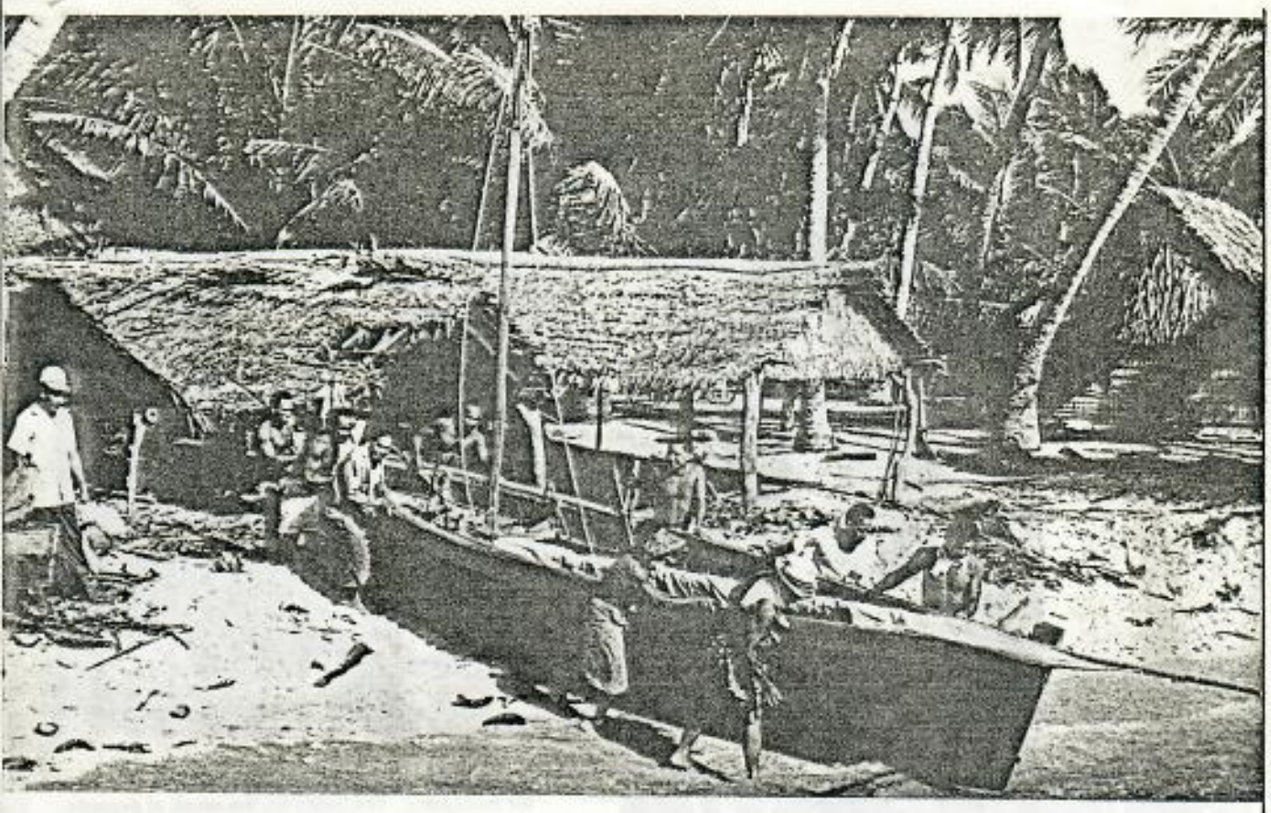
Towards the end of 1959, the New Zealand authorities arranged for an interim report to be made on the progress of the experiments. Based on a very brief visit to the Tokelaus, the report provided the first evidence that *Coelomomyces* had become established on Nukunono (two of 11 *tungu* containing *A. polynesiensis* yielded 27 parasitized larvae) and revealed the continuing effectiveness of the dieldrin-cement briquettes on Atafu. On this atoll, 31 domestic water drums and tanks still containing briquettes were without any mosquito larvae, while, out of 49 lacking briquettes, 25 harboured developing larvae of *A. polynesiensis*. A number of briquettes were sent to Singapore, where Dr. D. H. Colless (who, together with the author, had initiated these experiments in the Tokelaus in the previous year) tested them against *A. albopictus* larvae and confirmed that they were still 100% effective larvicidally, despite the fact that they had spent over a year submerged in water.

WHO supported a more extensive assessment survey in the islands in April 1960. At Nukunono, 118 of 667 *tungu* and natural tree-holes seeded with *Coelomomyces* inoculum in 1958, were relocated. Sporangia-packed larvae were collected from eleven of these, and viable resting sporangia identified in the bottom debris of three more. Furthermore, proof of natural dispersal from hand-seeded habitats was obtained, for parasitized larvae were found in two halved coconut shells (which from their condition obviously post-dated the first visit) a short distance from three *Coelomomyces*-positive *tungu*. It was thus evident that the fungal pathogen was now established, at a level well above that prevailing in nature at Singapore.[3]

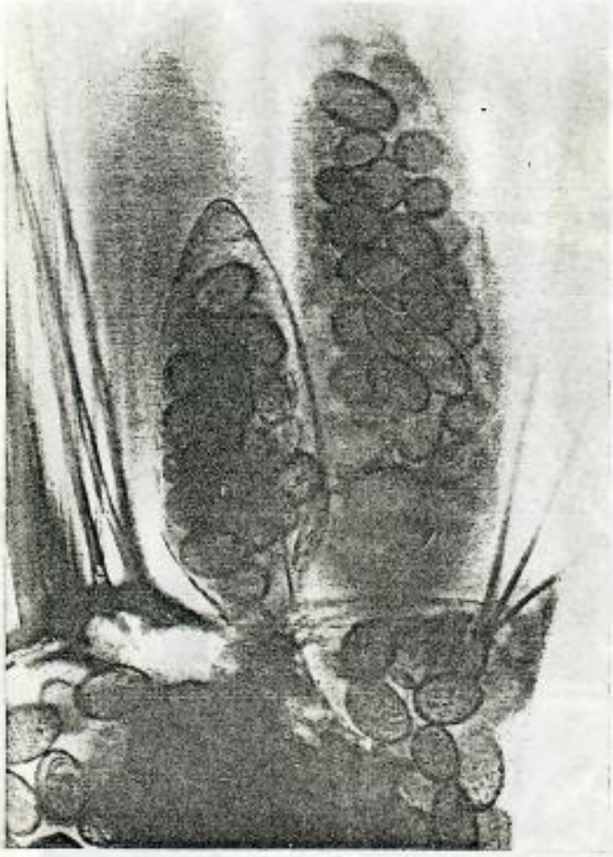
All the 1960 *Coelomomyces* findings concerned only three of the islets of Nukunono atoll. On these, biting collections yielded appreciably fewer adult *A. polynesiensis* than they had 18 months previously. Catches were repeated at the same sites and same times of day, the 1960 mean for the whole atoll being only half the 1958 mean.

On Atafu, 23 of the village water drums still held dieldrin-cement briquettes. Twenty-two of them (96%) were free from *A. polynesiensis*, while of the 103 other domestic

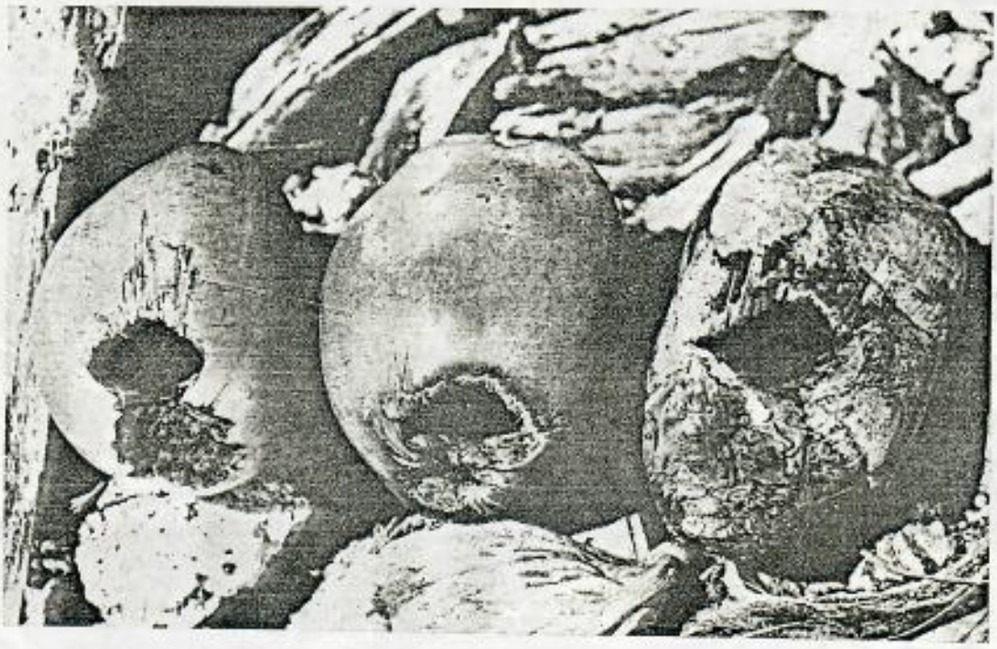
[3] The preliminary field work at Singapore in 1958 had revealed parasitized larvae in only 48 of 2454 containers (i.e. 2%), but on Nukunono, taking into consideration only the 118 relocated seeded habitats mentioned earlier and leaving aside those exhibiting viable sporangia but no parasitized larvae, 9.3% were positive.



Launching a *talula* for a field trip to one of the islets of Nukunono atoll.

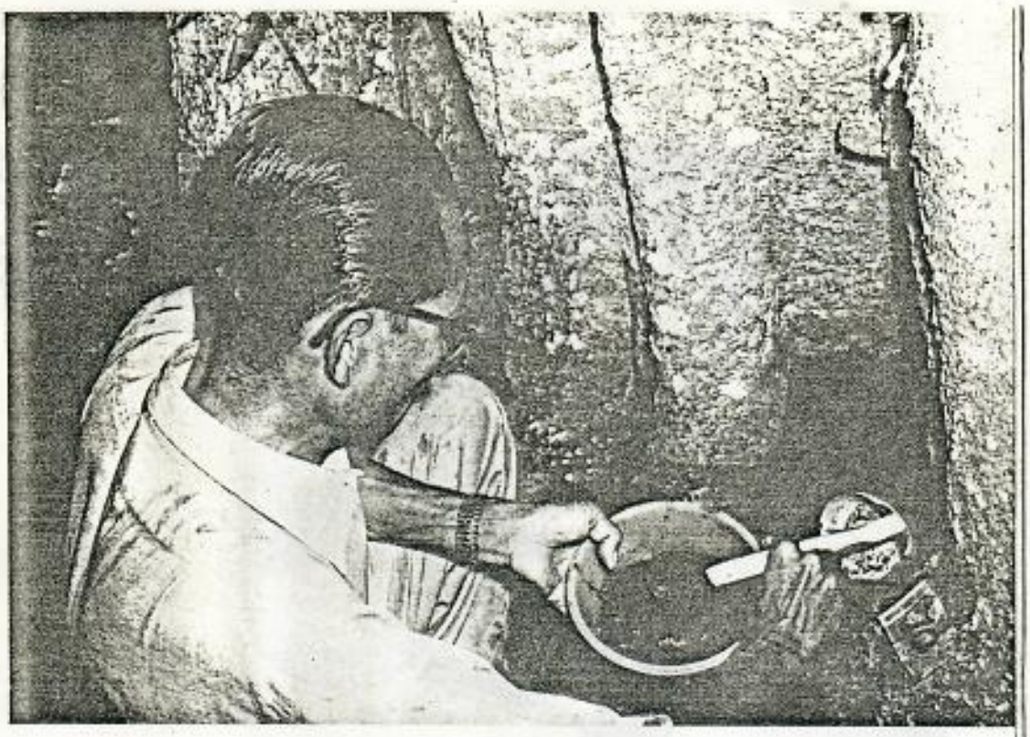


The biological method of mosquito control involves the infection of the mosquito larvae with self-perpetuating fungi. This microscope view shows the infection of a larva with *Coelomomyces* fungus spores. Magnification × 275.



Rat-gnawed coconut husks are attractive habitats for mosquitos. The husks are the result of depredations by rats, which climb the palm trees and gnaw holes in the nuts close to their stalks in order to reach the milk and kernels. The nuts fall to the ground and rot, providing reservoirs in which larvae can develop. The three nuts pictured above represent different stages of rotting, and the two nuts on the right were heavily infested with larvae and pupae.

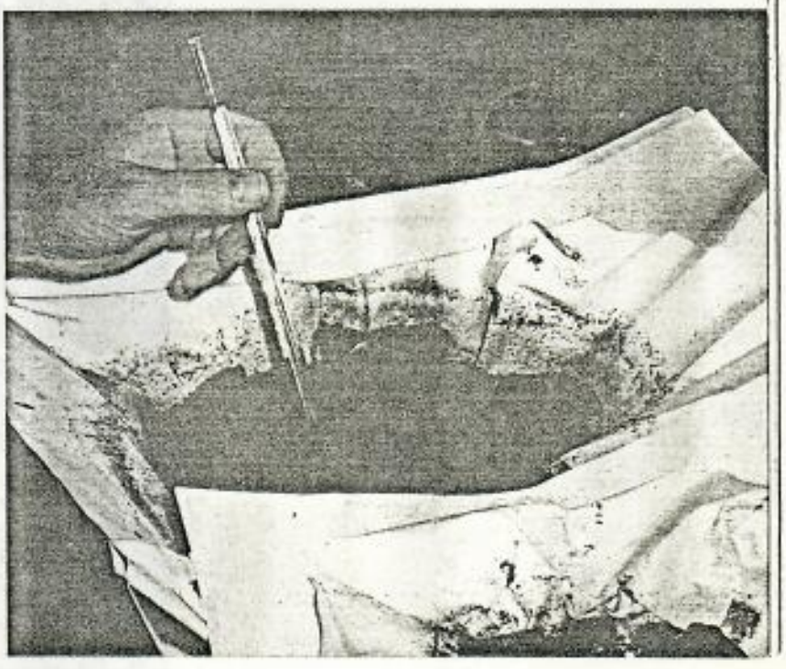
In an effort to prevent rats from reaching the nuts, aluminium guards are placed round the trunks of the palm trees. The method is not always successful, however, because the rats are sometimes able to bridge a guard by climbing the branch of an adjacent shrub, and they are then able to move from tree to tree among the foliage. Thoughts have therefore turned to ways in which efficient rat control could be implemented. Relevant measures might include the use of chemical rodenticides and the introduction of a natural enemy of the rat into the islands.

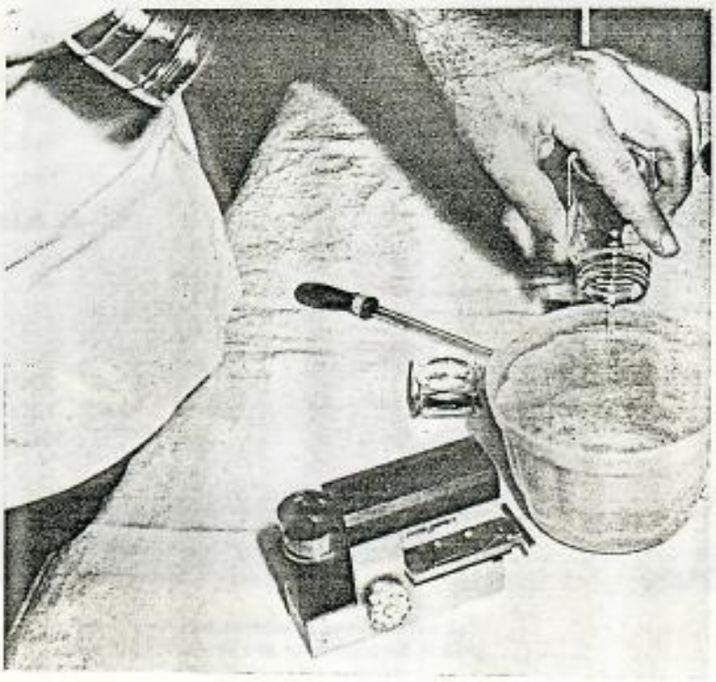


The collection of *Coelomomyces* fungi from a tree-hole in Singapore for use on Nukunono atoll.

Searching *tungu* for mosquito larvae with the aid of a torch. *Tungu* are man-made reservoirs cut into the trunks of palm trees to collect rain-water that runs down spiral channels cut into the bark. They may each contain as much as 100 litres of drinking-water. But they also provide ideal habitats for mosquito larvae.

Concentrated inoculum of fungi being prepared for seeding mosquito larval habitats on Nukunono atoll.





Testing the effect of fungi on mosquito larvae. *Aedes polynesiensis* larvae are exposed to fresh *Coelomomyces* sporangia from living tissues. In the foreground is a McArthur field microscope, which proved invaluable in many phases of the project, particularly in examining fresh blood samples from the islanders for microfilariae.

Placing a dieldrin briquette in a coconut husk.

containers located, only 18 (17%) lacked larvae.[4]

In many cases, household water containers in the Tokelaus are replenished two or three times a week from the large central village tank (for which the church roof acts as a catchment area). Even though they are often completely emptied before refilling, larvae have a good chance of surviving the short interim period in the water film that clings to the bottom of an up-ended container. This was found to be the case at one village where, before the survey took place, many householders inverted their 44-gallon drums, having gained the impression that they were to be reprimanded if the search disclosed active mosquito-breeding on their premises!

Numerous briquettes were relocated in *tungu* and natural tree-holes, and a few were also found in the rat-gnawed coconuts in which they had been put in 1958. All these coconuts proved to be rotten and far beyond the stage of holding liquid and serving as habitats for mosquito larvae. Of 50 *tungu* that contained briquettes, 31 (62%) lacked larvae, as compared with a 100% larval incidence in 25 *tungu* without briquettes.

Briquettes from larva-free containers were tested against freshly collected *A. polynesiensis* larvae, and complete and rapid kills were registered. On the other hand, briquettes from tree-holes and the drums in which mosquitos were developing failed to kill any of the larvae exposed to them at either atoll. From their irregular size and shape it was concluded that all these non-toxic briquettes belonged to the first of the two batches manufactured on Atafu in 1958. These were of a rather granular appearance as compared with those of the second batch and it is considered that their dieldrin was released prematurely, if indeed the larvicide had been evenly distributed throughout the mix in the first place.

[4] It is noteworthy that, if the 1960 figures for briquette-free 44-gallon drums on Atafu are combined with those for untreated drums on Fakaofo and Nukunono, 122 (85%) of the total of 143 held *A. polynesiensis* larvae. It would seem, therefore, that the 1959 party (having recorded larvae from only 51% of the briquette-free household water containers) may have overlooked some light infestations; many of the drums and tanks searched in 1960 held very few larvae, which were located only after a prolonged inspection using a powerful torch.

On Atafu, where rats were commoner than on the other two atolls and where a higher percentage of the mosquito population originated from rat-gnawed coconuts, adult catches gave a mean of 90.5 by comparison with the 1958 figure of 123.1. On certain islets of this atoll, *tungu* and tree-holes produce the bulk of the mosquitos because of a local scarcity of rats, and the incidence of adult mosquitos there was below the level of the overall figure.

In July 1963, another New Zealand expedition to the Tokelaus obtained further follow-up information. On this occasion, *A. polynesiensis* larvae were collected from 35 container habitats on Nukunono. These specimens were sent to Professor J. N. Couch of the University of North Carolina, a leading authority on *Coelomomyces*, who recorded parasitized larvae from 13 (37.1%) of the samples—a fourfold increase over the 1960 figure.[5] It was also found that, even after almost five years, dieldrin-cement briquettes remained larvicidally effective on Atafu. Fifteen of them were sent by WHO to the Woodstock Agricultural Research Centre (Sittingbourne, Kent, England) for detailed study. Analysis by total chlorine and gas-liquid chromatographic methods established that the briquettes from tree holes (which dry out from time to time) and those from (constantly replenished) domestic water drums had lost about 50% and 60% respectively of the available dieldrin. It was thus concluded that the briquettes still had an extremely long useful life, with the reservation that at some stage leaching of dieldrin might cease, owing to the build-up of a coating of impervious foreign matter, despite the continuing presence of a fairly high concentration of the insecticide.

[5] Professor Couch also reported that in some instances a second species of *Coelomomyces* and suspected hybrids between this species and the dominant *C. stegomyiae* were present. This second species proved identical to one recently found by Professor Couch when examining specimens of *C. stegomyiae*-positive *A. aegypti* and *A. albopictus* collected by Mr J. Muspratt in Rangoon, Burma, and it should be mentioned that such double infections are rather common with respect to *Coelomomyces*. It thus appears that two species of the genus instead of one were introduced into Nukunono in 1958, the new one having escaped detection earlier through an overwhelming dominance of the larger sporangia of *C. stegomyiae* in the material originally derived from *A. albopictus* at Singapore.

The public health risk of larvicides

In October and November 1963, a member of the New Zealand Department of Health visiting Atafu in another connexion made fat biopsies from two volunteers from each of six households that had relied completely on briquette-containing tanks for their water supplies over the preceding five years. No trace of dieldrin could be detected in any of these samples on analysis (sensitivity of method: 0.2 μg dieldrin) at the Wallaceville Animal Research Station of the New Zealand Department of Agriculture.

Finally, to profit from the latest refinements in relevant analytical techniques, arrangements were made for serum samples to be taken from 20 inhabitants of Atafu during a filariasis survey there in October 1965. Analysed (in the Communicable Disease Center, Atlanta, Ga., USA) by electron-capture gas chromatography, these samples exhibited an average dieldrin concentration of only 0.0010 ppm (range <0.0001-0.0047 ppm). The average concentration was actually little more than half that found in the general population of the USA. As the loss of dieldrin from the body is very slow, particularly at low levels of storage, it is believed that the blood levels for Atafuans may have been little higher on the occasion of the 1963 sampling, after which few if any of the briquettes manufactured in 1958 were still present in local drinking-water containers. The analyses yielded no evidence that any health hazard whatsoever had been created by the 1958 larvicidal experiment on Atafu, fully supporting the toxicological assurances that had been given at the outset of the project.

Gains resulting from the project

Besides demonstrating the feasibility of practical integrated mosquito-control methods, combining selective chemical procedures with novel biological measures, the Tokelau Islands project suggested a number of subjects for related research, and, perhaps most important of all, its encouraging results were one of the main factors in the decision of WHO to initiate a widespread programme of research on biological control in 1961.

All the specific recommendations for further research arising from the Tokelau Islands project have since been implemented in this broader programme. For example, the project drew attention to the need for a great deal more information on the life history, geographical distribution, and host range of *Coelomomyces* and for appropriate procedures for the mass cultivation of these fungal pathogens as prerequisites to future large-scale field trials. A WHO consultant afterwards made field studies of high natural mortalities in *Anopheles gambiae* resulting from heavy infection with a strain of *C. indicus* locally abundant in rainy-season pools near the Victoria Falls, Zambia. Since then, WHO has been supporting an intensive laboratory investigation of this strain at the University of Bristol, England. Throughout this period, too, in response to a request made by WHO, a great deal of *Coelomomyces* material has been made available by collaborating investigators in various parts of the world. Many new host and locality records have been obtained, and Professor Couch, who has been studying these collections on the Organization's behalf, is currently working on a comprehensive review that will raise the number of known species of *Coelomomyces* from the 1961 figure of 24 to about 38. In addition, WHO consultants have undertaken initial field studies of other possible biological control agents suitable for use in reducing the incidence of *A. polynesiensis* not only in the Tokelaus but elsewhere, for example on Aitutaki, Cook Islands, where preparatory baseline data on the local ecology of this mosquito have already been obtained. These other agents include Neotropical craneflies of the genus *Sigmatomera*, the aquatic larvae of which prey upon larval *Aedes (Stegomyia)* in tree-holes, and predators on rats—a possible means of reducing the availability of rat-gnawed coconuts as *A. polynesiensis* larval habitats on certain South Pacific islands.

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20 822 20 823

P.O. BOX 865 APIA
WESTERN SAMOA

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

3/18
GHB
GHB

5 March 1985

RSS

Richard S. Shomura
Director
National Marine Fisheries Service
Southwest Fisheries Centre
Honolulu Laboratory
P.O. Box 3830
Honolulu, Hawaii
76812

Dear Richard,

Accept my apology for the very late reply of your letter. I fully agree with the fact that I went through George Blaza's report and found it really interesting and very important for historical purposes. I understood that some useful information in the report have never been documented before.

The film on the Northwester Hawaiian Islands arrived in time for the first meeting of an organised Committee of the Agriculture and Fisheries Department. The area of conservation recieved some significance discussions.

I have mailed the film to your Office, and for your information I have been transfer to the Tokelau Office in Apia. This movement would speed up previous communication breakdown.

Best personnal regards.

Yours sincerely,

(Foua. Toloa)
Acting Director of Agriculture

ROBERT GILLETT
c/o SOUTH PACIFIC COMMISSION
B.P. D5 NOUMEA CEDEX
NEW CALEDONIA

5/20 Grant WSSC CHB

May 7, Apia

Richard,

I just finished reading an article by George Balazs on sea turtles in Tokelau and found it quite interesting. In about 4 days time I leave for FAKAOFO ATOLL, TOKELAU, where I will stay for about 6 weeks doing work on traditional tuna fishing similar to what I did in Satawal a few years ago.

As I might have some extra time while in Tokelau, I might be able to collect some turtle data for George Balazs. If he is interested, have him send a telegram to:

Adrian Macey
Official Secretary
Tokelau Affairs Office
P.O. Box 865 APIA
Western Samoa.

} He can relay message to me in Tokelau

I am scheduled to depart here May 14 and return July 2.

Regards,

Bob

November 18, 1985 F/SWC2:GHB

Mr. Luciano Perez
Nukunonu Atoll
Tokelau Islands
Box 865
Apia, Western Samoa

Dear Luciano,

Since it is "turtle season" now in Tokelau, I thought I would write and ask how many turtles the people of Nukunonu have caught this year. How many females? How many males? I would greatly appreciate receiving this information from you.

I have enclosed a recent copy of Hawaii Fishing News which I know you enjoy reading. If there are any hooks or other small specialty fishing items you need, please let me know.

Sincerely,

George H. Balazs
Zoologist

Enclosure

cc: Balazs
HL

NATIONAL MARINE FISHERIES SERVICE
HONOLULU LABORATORY
P. O. BOX 3830
HONOLULU, HAWAII 96812

November 18, 1985 F/SWC2:GHB

Mr. Robert Gillett
Fisheries Development Adviser
UNDP Private Mail Bag
Suva, Fiji

Dear Bob,

It was informative and a pleasure to meet with you the other day and discuss our mutual interest in Tokelau. I was delighted to learn that concern for sea turtles remains high, and that the report of my 1981 study visit is still a topic for discussion. As you will read in the enclosed copied letter, I have acted upon your suggestion to renew my offer to pursue a source of tortoiseshell to make traditional Tokelauan fish lures. I will contine to keep you informed as this effort progresses.

I have enclosed a copy of my 1977 consultancy report to SPC covering their former turtle farming project in Fiji and the Cook Islands. Please do not freely circulate this document, as SPC had requested that it only receive limited distribution. Under separate cover, I am also sending you a copy of the 500-page proceedings of the 1979 World Conference on Sea Turtle Conservation (published in 1981). The broad array of comprehensive papers contained here will serve as a good literature source for your office library.

Best regards--hopefully we will meet again before another 6 years have passed.

Sincerely,

George H. Balazs
Zoologist

Enclosure

cc: Balazs
HL

NATIONAL MARINE FISHERIES SERVICE
HONOLULU LABORATORY
P. O. BOX 3830
HONOLULU, HAWAII 96812

November 18, 1985 F/SWC2:GHB

Mr. Foua Toloa
Agriculture and Fisheries
Office for Tokelau Affairs
Box 865
Apia, Western Samoa

Dear Mr. Toloa:

I recently had the opportunity to meet with Mr. Bob Gillett of UNDP who was visiting here in Honolulu. Bob told me about his very successful 50-day study visit to Tokelau dealing with traditional tuna fishing. He also informed me that considerable interest exists in following up on my 1981 study of Tokelau sea turtles, and especially the statement in my published report (copy enclosed) that I would be willing to pursue a legal source of tortoiseshell in the U.S. for making traditional fish lures. Commercial dealing in tortoiseshell is illegal under the U.S. Endangered Species Act and the Convention on International Trade in Endangered Species (CITES). The hawksbill turtle, from which tortoiseshell is obtain, along with all other species of sea turtles, are covered under these precepts. When illegal shipments of derived products are found by enforcement agents, the items are confiscated and stored as evidence by the U.S. Fish and Wildlife Service. After the judicial process is completed, the material is donated to museums and other educational institutions, or if space permits, it is retained in storage. It was my thought that stocks of confiscated tortoiseshell might be made available at no cost in controlled quantitites for native Tokelauans living in Tokelau to make their traditional fishing lures.

The first step needed for me to actively pursue this idea would be for your official secretary, Mr. Adrian Macey, to write a formal letter asking for my assistance in this matter. The letter should be addressed to:

Mr. Richard S. Shomura
Director, Honolulu Laboratory
National Marine Fisheries Service, NOAA
P. O. Box 3830
Honolulu, HI 96812

The letter should refer to my report . It should also emphasize that the tortoiseshell will in no way enter into handicraft that will be offered for sale, and that it will be

given free to the Council of Elders on each island for equitable distribution. I am not certain how much tortoiseshell can be obtained, should permission be granted. However, it would be good to have some estimate of how much material would be needed by the fisherme n. I had originally thought that perhaps 20 kg, the scutes from 20 adult hawksbills, would be sufficient for an extended period--5 years or more. Please let me know if this is a realistic project. I am uncertain how often the hooks break or are lost while fishing.

I look forward to hearing from you at your earliest convenience.

Sincerely,

George H. Balaze
Zoologist

Enclosure

cc: Balazs
HL

FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

UNITED NATIONS
DEVELOPMENT PROGRAMME

PROJECT RAS/85/004

SOUTH PACIFIC REGIONAL FISHERIES DEVELOPMENT PROGRAMME

OFFICE OF THE RESIDENT REPRESENTATIVE FOR THE SOUTH PACIFIC

TELEPHONE: 22489
UNITED NATIONS DEVELOPMENT PROGRAMME
CABLE: UNDEVPRO SUVA

LETTER NO: 769
PRIVATE MAIL BAG
TELEX: 2228FJ

REFERENCE: TOK 1
RAS 1
SUVA, FIJI

Date: 27 November, 1985

Dear George,

Thanks for "Biology and Conservation of Sea Turtles" which arrived today. I believe it will be a very valuable reference and will partially compensate for my ignorance on such an important subject.

Enclosed is a partial copy of my Tokelau report on Tuna Fishing which touches on the subject of Hawksbill turtles. I'll send you a complete copy when it is published.

Later today I'll be writing to Tokelau Affairs Office and will attempt to relate what I learned from you.

Sorry I didn't get back to you on Firday - I guess I was trying to do too much in one day.

Thanks again,

Yours sincerely,

Bob

Robert Gillett
Fisheries Development Adviser

Mr. Geoge H. Balazs
Zoologist
National Marine Fisheries Service
P. O. Box 3830, 2570 Dole St.,
Honolulu
HAWAII 96812.

Encl (1)

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20 822 20 823

P.O. BOX 865 APIA
WESTERN SAMOA
5/3/1

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

29 November 1985

Mr George Balazs
National Marine Fisheries Service
Southwest Fisheries Centre
Honolulu Laboratory
P O Box 3830
HOnolulu, Hawaii 96812

Dear George,

Thank you for your letter of 18 November 1985.

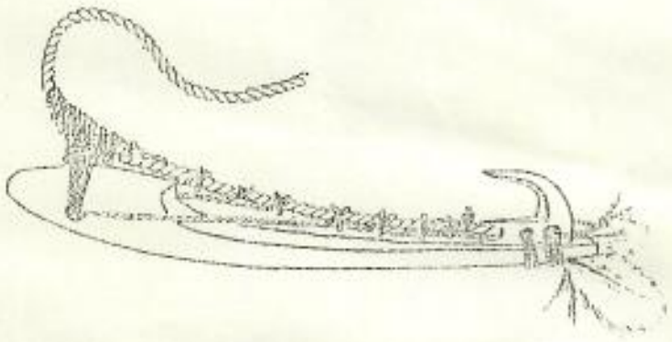
I have pursue the first step needed in order for you to assist us in obtaining tortoise shells. Your estimate of the amount needed would just be right and I suggest we start on that figure.

A letter to Richard S Shomura would be forthcoming and I will be coming back to you once we finalised things with UNDP on the Integrated Atoll Project in which we need assistance on the possibility of a turtle hatchery.

Yours sincerely,

(F Toloa)
Actg Director of Agr & Fisheries

TRADITIONAL TUNA FISHING IN TOKELAU



Robert Gillett

July 1985

The distinction between size categories of yellowfin and bigeye appears more subjective than for skipjack. On the basis of 83 yellowfin and bigeye fish measured during the visit the dividing point between a "kahikahi" (the smaller size) and "kakahi" appeared to be about 65 cm measured from the fork of the tail to the tip of the snout (LCF). "Takuo" and "lalavalu", large yellowfin and bigeye respectively, are distinguished from the smaller "kakahi" at about 150 to 160 cm LCF. A similar measurement was said to divide the categories of dogtooth tuna, "tavatava" and "valu".

The four names for yellowfin and bigeye imply that functional considerations are important in Tokelau tuna nomenclature. Fishermen are well aware that there are two types of "kakahi" but not until they reach the size where they become behaviourally different (and require a different fishing strategy) are separate names used.

Table 3 lists those fish used as bait for tuna fishing and fish that were stated as being important tuna diet items.

Canoes

Offshore fishing activities in Tokelau were traditionally carried out in outrigger canoes. The design of the typical canoe is distinctly a product of the atoll environment. The lack of ideal species of trees for boat building dictates that canoe hulls are laboriously constructed of several pieces of "kanava" (Cordia subcordata). The scarcity of this wood requires that those canoes constructed are long lasting, despite the punishment they may receive crossing directly over the reef en route to and from the ocean. A description of the canoes and their construction is given in MacGregor (1937). The major difference in the canoes of that account of half a century ago and those of today is the present use of monofilament line for lashing and the attachment of an outboard engine bracket onto the outrigger struts.

Information on the Fakaofo canoe fleet during June 1985 is given in Tables 4 and 5. Of the 44 canoes on Fakaofo with intact hulls, 12 are used occasionally for offshore fishing, the remainder of the activity being carried out in aluminium skiffs powered by outboard engines. "Tautai" believe that canoes are more appropriate for most types of tuna fishing than aluminium skiffs. Reasons cited for this include a reduced amount of noise and the ease of holding the bow into the wind, slowly paddling forward, and holding a tuna handline in the preferred position (pleasantly wrapped around one's big toe). Due to speed and manoeuvrability, an aluminium skiff is considered better for modern-type trolling for tuna in surface schools.

Pearl-Shell Lures

The most essential item of gear for skipjack fishing, the pearl shell lure ("pa"), is made from the black-lip pearl oyster ("tifa", Pinctada margaritifera). In addition to its use in fishing, pearl-shell is also used for body decoration, wedding and death gifts, and more recently, graduation presents. As diamonds are cherished in the cosmopolitan world for their ornamental, sentimental, and utilitarian value, so are pearl-shells in Tokelau.

A Tokelau pearl-shell lure (Figure 3) consists of a shank, hook, feathers, lashings, and leader line. The pearl-shell for the shank occurs in the lagoons of Tokelau but it apparently has never been very plentiful and is quite rare at present. MacGregor (1937) reported the supply of pearl-shell in Atafu "has grown less as succeeding generations comb the lagoon for the precious material". Van Pel (1958) stated that "one or two were found occasionally over a period of years". During the present study "tautai" reported that about 10 years has lapsed since the last pearl-shell was found in Fakaofo lagoon.

The distribution of pearl-shell in Fakaofo lagoon appears to be random. Residents state there were no particular areas where the shell was more prominent than others, although more were probably found in the lagoon area close to Fenua Loa due to the increased diving activity in that area in search of giant clam (Tridacna sp.). Pearl-shell was most often encountered inside small caves and underneath rock ledges. The older "tautai" interviewed said that during their youth diving was done without the aid of goggles; divers cupped one hand over the eye (Figure 1) trapping a small pocket of air in the palm which would enable underwater vision. As pressure increases with depth, this technique could only be used to a maximum depth of about eight metres, after which the air bubble would be too compressed to be of any use.[4]

Pearl-shell was also brought to Tokelau from other localities. Missionaries from Tokelau serving in New Guinea from the turn of the century to the early 1940s returned home with thick shell, probably the gold-lip variety (Pinctada maxima). "Tautai" cited other sources of shell as being Pukapuka, Nassau, and Penryhn in the northern Cook Islands, and finished lure shanks from Samoa.

The pearl-shell is cut into pieces to form one or more shanks for lures (Figure 4). The shank size, always as large as possible, is determined by the section of shell from which it is made. The largest comes from the centre cut ("pa matua") with adjacent cuts being progressively smaller. Lure shanks measured in this study ranged in size from 6 to 17 cm.

The hook portion of the lure is usually made from the shell of the hawksbill turtle ("fonu una", Eretmochelys imbricata). Although cow horns, coconut shell, whales's teeth, marlin spikes and plastic are occasionally used, turtle shell predominates despite the rarity of the animal. Most "tautai" interviewed on Fakaofo could not recall the local capture of a hawksbill turtle of a size with a shell of adequate thickness for hooks during their lives[5], however it is reported in Balazs (1982) that hawksbill are known to nest at Nukunonu atoll.

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4. I suspect the introduction of diving goggles to Fakaofo in the 1940s was a major factor contributing to the virtual absence of pearl-shell in the lagoon at present.
5. Navini, the oldest man alive on Fakaofo, stated that a suitable hawksbill was captured in the 1920s at Mulifenua. "Tautai" interviewed from Nukunonu and Atafu could not recall ever catching a large hawksbill.

Sources cited for turtle shell for lure manufacture were similar to that for pearl-shell, with the addition of Hull Island in the Phoenix group.

After European contact, metal replaced local materials in hooks for many types of fishing, but such was not the case for pearl shell lures. Ironically, turtle shell was regarded superior to metal due to its weakness; under a very heavy load a turtle hook would break before the extremely valuable pearl-shell shank. A turtle hook was also less likely to cause injury to a fisherman when rapidly poling tuna. Furthermore, the colour of the turtle hook, opaque-brown mixed with translucent amber, was thought to attract skipjack.

Bird feathers are attached to the distal portion of the shank. The white breast feathers of the red-tailed tropic bird ("tevake") are considered by most fishermen to be the best type, but due to the scarcity of this animal, feathers of two species of boobies, and occasionally chicken feathers or even plastic, are used.

Formerly, the line which attaches the lure to the pole and the more delicate lashings which attach the various lure components was three-stranded line made from "fau" (Pipturus argenteus). The strength of the line was given as about 50 kg and that for the lashings as about 12 kg. Although this line ("laufau") is thought to be superior to synthetic materials due to its durability and tendency not to kink, it had been replaced by nylon monofilament on all lure specimens examined during this study. The amount of effort required for its manufacture was given as the reason.

As rigged for a fishing expedition, from three to seven lures are attached by separate lines to a single pole. In the selection of these lures an attempt is made to include a wide range in colour, size, shape, and hook angle. Tokelau fishermen recognise five colours of pearl-shell[6], nine cuts of a large shell, two head (proximal end of the shank) shapes, and two classifications of hook angle. Table 6 lists these variations. Each of these factors is considered critically important by "tautai" in the functioning of the lure. Nordhoff (1930) stated "an accomplished fly fisherman in Europe or America does not carry in his head one half of the practical knowledge a bonito (skipjack) fisherman uses every day." A great deal of this practical knowledge concerns when to use the different variations of pearl-shell lures.

Pearl-shell lures are known in many areas of Polynesia, Micronesia, and Melanesia. Information in Hiroa (1932) and Anell (1955) helps clarify the relationship of the Tokelau-style lure to those of other areas. Lures from Tokelau are considered typically Polynesian due to the attachment of the leader line to both the head of the pearl-shell shank and to the base of the turtle shell hook. In Melanesia and areas of Micronesia the line is characteristically attached only to the shank head. Polynesian-type lures are subdivided into eastern and western

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6. Two of the four variations in colour of pearl-shell recognised by fishermen in Tuvalu, as given by Kennedy (1930), are similar to the Tokelauan names.

TABLE 6. VARIATION IN PEARL-SHELL LURES

Character	Variation	Description	Note
Colour of convex surface	Lau milo	Golden with some red and green	Used first in Takafakaoli-type school. Name also used in Samoa and Tuvalu for pearl-shell; also called lautiale; New Guinea lures are this colour. Other shell colours can be changed to hiku uli by additional grinding.
	Pa hina	White	Used first in Fakapula-type school. Other colour lures can be changed to hiku uli by additional grinding.
	Hiku uli	Blacktail	Some fishermen say works well when tuna feeding on goatfish.
	Fulu fakalupe	Shiny blacktail with some red/ green	Also called fakanununa.
	Lano faka pugapuga	Entire surface brownish	
Head shape	Ulu faka kalo	Sharp head	Lure tends to dive. Preferred for use when skipjack are feeding on goatfish.
	Ulu faka ula	Round head	Lure tends to stay on surface and wiggle; used in tahikupa-type school.
Hook angle	Tala fumu	Dull angle	Fish can be unhooked faster; turtle shell material for this type must be thick.
	Maga	Sharp angle	Less chance of fish falling off hook prematurely.
Shell cuts (20 cm diameter shell)	Ni ulu fenua	Edge cut	Smallest size; used on completely calm days, e.g. no wind or swell.
	Hoko ote kau pukupuku	Adjacent cuts	Decreasing size
	Kau pukupuku		
	Pa matua	Centre cut of shell	Biggest; never used first in school; good to use when fish biting fast. Usually pa hina or hiku uli; never use with yellowfin.
	Kau loa		
	Hoko ote kaulua	Adjacent cuts	Decreasing size
	Tafa tafa		
	Tafa kelekele	Edge cut	Smallest size
	Kau tifa	Cross cut	Only one possible from each shell; many colours present.

groups, the Tokelau lure being in the western group along with those from Samoa, Pukapuka, Tuvalu, Wallis, and Polynesian outliers in Melanesia, due to the hook base (the interface between the pearl-shell and turtle shell) extending towards the head of the shank rather than away from it. Tokelau lures have three holes in the base of the turtle shell hook; one for attaching the line and the other two for lashing the hook to the shank. Outside of Tokelau, the western Polynesian, three-hole lure is found only in Wallis[7] and Tuvalu.

The value of a pearl-shell lure to its owner should be stressed. An idea of the importance can be given by relating that in the speeches which accompany a funeral ceremony, it is common for the death of a family member to be compared to the loss of a well-known pearl-shell lure.

Other Gear

In traditional times the pole for skipjack fishing was made from the wood of "puka" (Hernandia sonora). Presently the stock is of imported bamboo attached to a butt of kanava wood. Five poles that were measured during the study ranged in length from 461 to 529 cm. When not in use the poles are stored on the overhead beams of houses and are a common sight in Tokelau.

Pearl-shell lures, spare lines, and hooks are stored in an oval container ("tuluma") made of kanava. These gear buckets, which measure from 20 to 40 cm at the base, have tight-fitting lids and will float in the ocean. If a canoe capsizes, the precious lures and other gear stored inside will not be lost. Because the containers are very buoyant, the larger ones have been used in the past as life preservers.

The hooks used in tuna handlining are presently made from metal in three different shapes: the barbed "U" shaped hook, the barbed tuna circle hook, and the traditional barbless "matatahi" (literally: "one eye") hook. Modern barbed hooks are called "matalua" or two eyes, the eyes referring to the point and tip of the barb. Older "tautai" claim that a "matatahi" hook (Figure 3) is best due to its ability to "hold a fish until it dies of hunger". Johannes (1981) has a good description of these barbless hooks.

Plants used in the manufacture of Tokelauan tuna fishing gear are listed in Table 7.

Tuna Fishing Methods

Fakaofo fishermen catch tuna and related species using a variety of techniques. Table 8 summarizes and compares the seven methods used during the last fifty years.

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7. I suspect that the 3-hole Wallisian lure has a Tokelau origin as Hinds (1969) reports that at the time of World War I tuna fishing in Wallis was carried out by Tokelauans.

TOKELAU FILE

MICRONESIAN MARITIME AUTHORITY
P.O. BOX D; KOLONIA, PONAPE
EASTERN CAROLINE ISLANDS, 96941

December 10, 1985

Mr. George Balazs
National Marine Fisheries Service
Box 3830
Honolulu, Hawaii
96812

Dear George:

Thanks for the letter and the Tokelau idea. Gillett stopped by here after Hawaii and described his meeting you. I have only a few comments. One is that I think you should be realistic about the uses of turtle shell that might be made available. If people in Tokelau are like other atoll-dwellers, they have other uses for the shell (rings, combs, etc). To restrict the use of the shell to only fish-hooks may not be prectical. I would recommend expanding the uses to which they put the shell to include other traditional items as noted above. In this way, someone is not in violation of an agreement if they find a shell unsuited to a fish-hook that could be used for some other useful implement. The fact that a turtle shell comb can be substituted with plascit goes for the fish-hooks as well (can be substituted with stainless, as in Tahiti). Of course the prohibitions against sale for handicraft, etc. would still remain.

No problem on the slides. As soon as I get them back I will send them. Or bring them when I am in Hawaii in January for tuna treaty negotiations. Yes, I received the Southeast Recover Plan. Its just a couple of documents down in the pile by the side of my desk, and I should get to it before long. Trust you understand the situation.

Sincerely,

Mike A. McCoy
Executive Director,
Micronesian Maritime Authority

cc: Bob Gillett, UNDP Fiji

TELEGRAMS: TOKALANI APIA
TELEPHONE: 20 822 20 823

P.O. BOX 865 APIA
WESTERN SAMOA

WGG
GHB
DO

5/3/1

OFIHA O NA MEA TAU TOKELAU
Office for Tokelau Affairs

12 December 1985

Mr Richard S Shomura
Director, Honolulu Laboratory
National Marine Fisheries Service NOAA
P O Box 3830
Honolulu, Hawaii 96812

Dear Sir,

We wish to acknowledge the good report on "Sea Turtle and their Traditional Usage in Tokelau" by George H Balazs who is one of your turtle scientists.

Several recommendations in the report have been followed up after the formation of an Agriculture and Fisheries Committee last year. This Committee strongly recommended to the Councils of Elders on each atoll the importance of pursuing these recommendations. Also, an agriculture and fisheries programme has been developed for the school in which special efforts will be made to strengthen any appropriate cultural aspects involving sea turtles.

On this same subject we wish to pursue the idea of obtaining raw scutes of the hawkskill turtle which we understand from George's report are held by the US Government in Hawaii. This material, which is extremely scarce in Tokelau, would be used for fishing hooks need in skipjack pearl shell lures. It would also be used for teaching the young people the skills of making these traditional fishhooks.

We guarantee that these materials will not be offered for sale in any form, and will be given free to the Council of Elders on each atoll for equal distribution.

We look forward to hearing from you.

Yours sincerely,

AHMacey

(A H Macey)
Official Secretary

GHV - [illegible]

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Fisheries Center
Honolulu Laboratory
P. O. Box 3830
Honolulu, Hawaii 96812

January 2, 1986 F/SWC2

Mr. A. H. Macey
Official Secretary
Office for Tokelau Affairs
P. O. Box 865
Apia, Western Samoa

Dear Mr. Macey:

Thank you for your letter of December 12, 1985 concerning George Balazs' research on sea turtles in Tokelau. We are pleased to learn that his report has been helpful to the people of Tokelau.

With regard to obtaining raw tortoiseshell for use in working traditional skipjack lures, I have asked George to inquire about the possibility of obtaining material from confiscated stocks held by the U.S. Government. A special exemption will very likely have to be issued which will undoubtedly involve several months to process. George will be in contact with you when he has determined exactly what procedure must be followed.

We appreciate having the opportunity to work with you on this matter.

Sincerely,

for Richard S. Shomura
Director, Honolulu Laboratory

January 21, 1986 F/SWC2:GHB

Mr. Robert Gillett
South Pacific Regional Fisheries
Development Programme
UNDP
Private Mail Bag
Suva, Fiji

Dear Bob,

I'm sure there is a very logical and straightforward answer to this question, but I prefer an authority such as yourself to supply the answer. I've been asked by Larry Ogren, Fishery Biologist at our Panama City (Florida) Laboratory, why the Tokelauans don't prefer to use modern steel and plastic lures. "Aren't the commercially available lures much more efficient than the home-made pearl-shell and tortoiseshell lures?"

A number of colleagues have already voiced solid support for donating the tortoiseshell to Tokelaui. Also, I've lined up 40 lbs that will be shipped to Honolulu in the near future. Progress is being made, but we still have a ways to go to obtain full approval.

Sincerely,

George H. Balazs
Zoologist

cc: Balazs
HL

Nukumanu
Takelau
26-5-87

Dear Balazs,

Thank you for the salt water fishing magazine I enjoyed looking at.

We badly hit by the tidal waves on the 28th February 87 lot of damages to the house and the trees and the School building too.

At the moment were busy tiding our place. Turtle season 1986 not much luck very little in my record only 5 turtles. In 1987 until ~~June~~ May, only 2 turtles.

No one in Nakunoma had a Ham Radio except Peter Moore, he is working to set up our Radio at the moment he used to talk to other Ham Radio Operators. I'll give him your

y call sign to contact you.
He's a good friend of mine
a he stayed with me for a
while.

Nice to hear from you again.

Love

Luciano Perez.

SPC/Fisheries 23/IP19
5 August 1991
ORIGINAL:ENGLISH

SOUTH PACIFIC COMMISSION

23RD REGIONAL TECHNICAL MEETING ON FISHERIES
(NOUMEA, NEW CALEDONIA, 5-9 AUGUST 1991)

TOKELAU COUNTRY STATEMENT

Tokelau is highly dependent on its marine resources. Though the harvesting of these resources were primarily to meet the local needs, recent studies and activities have been undertaken for commercial development.

Fisheries in Tokelau are still at the early stage of its development, and there are only a limited number of projects. Three projects, fish processing, trochus transplantation and fish aggregation devises are receiving top priority at present. These projects were developed in consultation with the traditional council of elders.

Fish Processing Project

A fish processing project based on Atafu has been operating for eight months with funding from the economic assistance component of the U.S. tuna treaty.

Although the original idea of the project was to improve the traditional sun dried fish prepared by the local community, a new improved product has been created with which has revenue earning possibilities.

A small market outlet has been established in New Zealand and some good market prospects for expansion now exist. Pending the completion of a market study currently underway by the South Pacific Trade office in Auckland, there might be a possibility of an expansion of the current production capacity.

There is also the possibility of developing other side products with assistance from the S.P.C. Fish Processing and Handling Officer.

The evaluation of the project is due in December and a clearer direction for the project is expected.

Technical assistance to the project was provided by the S.P.C. Fish Processing and Handling Officer.

Trochus Transplantation

A survey was done on Faleaofo in 1990 to judge the success of three previous transplant. The result showed an abundance of juvenile trochus, despite Tokelau being battered heavily by two cyclones after the first transplantation.

The result of the survey and some visual monitoring information suggest that the trochus has been established well in its' new environment. Surveys to determine the establishment of the trochus population on the other two atolls, Atafu and Nukunonu have been scheduled for September and December.

Future survey will indicate when a trial harvest should occur.

Fish Aggregation Devices

The F.A.D. programme although very productive, has not been utilized to it maximum potential capacity.

Presently there are three FADs in position with plans for more upon the arrival of the new inter-island vessel.

REPORT

ON THE

TOKELAU ISLANDS

MINISTRY OF FOREIGN AFFAIRS

FOR THE YEAR ENDED

31 MARCH 1976

Presented to the House of Representatives by Leave

BY AUTHORITY:
A. R. SHEARER, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1976

Price 15c Publication No. 519

Wellington.

SIR,

I have the honour to submit herewith a report on the administration of the Tokelau Islands for the year ended 31 March 1976.

It should be noted that the term "Tokelau Islands" as the group is officially designated in New Zealand legislation, is used throughout this report. The Tokelau people however customarily refer to their territory as "Tokelau" and it would be desirable for New Zealand terminology to be brought into line. The necessary amending legislation will accordingly be proposed.

This report is compiled both for the information of the House of Representatives and also for transmission to the United Nations in terms of Article 73E of the Charter, which relates to the provision of information on the development of non-self-governing territories.

I have the honour to be,
Sir,
Your obedient servant,
F. H. CORNER, Secretary of Foreign Affairs.

The Hon. B. E. TALBOYS, Minister of Foreign Affairs, Wellington.

PART I: GENERAL INFORMATION

1. Geography

a. *Location*

The Tokelau Islands, which are a New Zealand dependency, are bounded by the parallels 8 degrees and 10 degrees south and by the meridians 171 degrees and 173 degrees west. The group is situated about 483 kilometres to the north of Western Samoa and consists of the three atolls of Fakaofo, Nukunonu, and Atafu. Fakaofo is 64 kilometres from Nukunonu which is 92 kilometres from Atafu.

b. *Topography and Area*

Each atoll consists of a number of reef-bound islets encircling a lagoon. These islets which are also known as motus, vary in size from 90 metres to 6 kilometres in length and are from 3 metres to 4.5 metres above sea level.

Nukunonu is the largest atoll, being 546 hectares in area; Fakaofo and Atafu having 263 and 202 hectares respectively.

c. *Climate*

The average mean temperature is 20°c, July being the coolest month and May the warmest. The rainfall is heavy but inconsistent and a daily precipitation of 8 cm or more can be expected at any time of the year. Severe tropical storms are rare.

2. History

The three islands became a British protectorate in 1877, formal declarations being made at each atoll in 1889 by Commodore Oldham, R.N., of HMS *Egeria*. At the request of the inhabitants the British Government annexed the islands (then known as the Union Islands) in 1916 and included them within the boundaries of Gilbert and Ellice Islands colony. In 1925 the British Government transferred administrative control of the group to the Governor-General of New Zealand, who was authorised to delegate his powers to the Administrator of Western Samoa. As a result the Union Islands were separated from the Gilbert and Ellice Islands colony. In 1946 the Tokelau Nomenclature Ordinance officially designated the group as the Tokelau Islands and by the Tokelau Islands Act 1948, by which formal sovereignty was transferred to New Zealand, they were included within the territorial boundaries of New Zealand.

3. People

a. *Composition*

The Tokelau Islands are a border area between Micronesia and Polynesia. To some extent the inhabitants retain linguistic and cultural ties with Samoa which are fostered by contact with Samoans and Samoan literature, radio broadcasts, and church ties. The culture of the Tokelau Islands is, however, distinctly moulded by the atoll environment which has its closest parallel with Tuvalu (previously the Ellice Islands).

b. *Population*

The census held on 25 September 1975 showed the following population (1974 figures in brackets):

	Male		Female		Total	
Atafu	269	(263)	295	(286)	564	(549)
Fakaofo ..	316	(299)	349	(349)	665	(648)
Nukunonu ..	175	(176)	199	(201)	374	(377)
Totals	760	(738)	843	(836)	1 603	(1 574)

c. *Religion*

On Atafu all the inhabitants belong to the Congregational Christian Church of Samoa, while on Nukunonu all are Roman Catholics. On Fakaofo both faiths are represented, adherents of the Congregational Christian Church being the majority. The work of both missions is directed from Western Samoa.

4. Government

a. *Status*

The Tokelau Islands are included within the boundaries of New Zealand and are administered under the authority of the Tokelau Islands Act 1948 and its amendments.

Under the provisions of the British Nationality and New Zealand Citizenship Act 1948, Tokelauans are British subjects and New Zealand citizens.

The islands of Tokelau are classified by the United Nations organisation as a non-self-governing territory and having no strong economic base, remote and very small, they present special problems in respect of decolonisation. The policy of the New Zealand Government has been to disturb as little as possible the internal institutions which go to make up the Tokelauan way of life and as a result of this policy the islands today are in practical effect already self-governing. A delegation from the United Nations Committee on Decolonisation was scheduled to visit the Tokelaus in June 1976 to gather facts on the special problems as presented by the Tokelauans and to ascertain the true wishes and aspirations of the people.

b. *Administration*

The Secretary of Foreign Affairs is the Administrator of the Tokelau Islands and is responsible to the Minister of Foreign Affairs. Under the provisions of the Tokelau Islands Administration Regulations 1971 certain powers of the Administrator are delegated to a senior administrative officer in Apia and to senior officers of the Ministry of Foreign Affairs. By agreement with the Government of Western Samoa the Office for Tokelau Affairs continues to be based in Apia.

There is close administrative co-operation between the Government of Western Samoa and the Tokelau Islands Administration. Officers of the Western Samoan Government, particularly medical officers and radio technicians, visit the islands regularly.

The Tokelau Islands are included in the South Pacific Commission area and benefit from the results of work carried out by this organisation.

In September 1975 Tokelau was represented by three delegates at the fifteenth South Pacific Conference held in Nauru. A representative also attended the Independence Celebrations in Papua New Guinea.

In addition, over 70 participants performed at the second South Pacific Festival of Arts held in Rotorua, New Zealand, from 6–13 March 1976.

c. *Legislation*

The basis of the Tokelau Islands legislative, administrative, and judicial systems is the Tokelau Islands Act 1948 and its amendments. Under this Act, the laws of the Gilbert and Ellice Islands colony which were in force in the Tokelau Islands immediately before New Zealand assumed formal sovereignty of the group, were continued in force. These laws which, to a great extent, were out of date, have largely been replaced by laws suited to present conditions.

The law of England as existing in 1840 (being the year in which the colony of New Zealand was established) applies to the Tokelau Islands except so far as it is inconsistent with the Tokelau Islands Act 1948 or any other enactment in force in the Tokelau Islands. New Zealand statute law does not apply to the Tokelau Islands unless expressed to do so. The Governor-General of New Zealand may make all such regulations as he thinks necessary for the peace, order, and good government of the Tokelau Islands.

During the year the following legislation was enacted:

Tokelau Islands Amendment Act Commencement Order 1975.
Tokelau Islands Crimes Regulations 1975.
Tokelau Islands Divorce Regulations 1975.
Tokelau Islands (New Zealand Laws) Regulations 1975.

d. *Judiciary*

The Tokelau Islands Amendment Act 1970 gave the High Court of Niue civil and criminal jurisdiction in the Tokelau Islands as if that Court has been established as a separate Court of Justice in the Tokelau Islands, and the Supreme Court of New Zealand an original and appellate jurisdiction. The Act also provides for the appointment of a Tokelauan Commissioner for each of the three islands in the group with jurisdiction to deal with certain civil proceedings and criminal offences.

e. *Public Service*

Part I of the Tokelau Islands Amendment Act 1967, which came into force on 1 January 1969, established a separate Tokelau Islands Public Service under the control of the New Zealand State Services Commission. The enactment contains the usual provisions necessary for the control of a public service.

As at 31 March 1976 there were 19 expatriate staff and 204 locally appointed employees including 115 casual labourers. Tokelau public servants receive in-service training in Western Samoa under the Administration's training scheme and in New Zealand under the New Zealand Bilateral Aid Training Programme. Details are given in appendix II of this report.

f. *Local Government*

The most important body for local affairs is the Taupulega. It consists of the elderly men (Toeaina) together with the holders of the positions of

Faipule and Pulenuku. The Faipule is the chief representative of the Administrator and acts in a supervisory capacity over Government officers on the island. He administers the law and may preside over the Court. The Pulenuku is responsible for the administration of village affairs, such as the scheduling of work, cleanliness, sanitation, water supplies, and the inspection of plantations. A village clerk (Failautuhi) keeps a record of transactions arising from the discussions of the Taupulega and also a record of births, deaths, and marriages.

g. *Suffrage*

The Faipule and Pulenuku on each island are democratically elected for a term of 3 years.

PART II: ECONOMIC CONDITIONS

1. General

The physical characteristics of the atolls allow very little scope for economic development and the few natural resources are sufficient only to meet the needs of the simple pattern of life followed by the people. There has, until recent years, been little demand for the material standards of more developed countries, but increasing contacts with Western Samoa and New Zealand have stimulated a desire among the people for wider opportunities to advance their living standards.

The economy of the Tokelau Islands is based mainly on the resources of the sea and on the coconut and pandanus palms. Employment on the works programme has diverted much of the islands' labour force from food gathering and copra production although care is taken to limit such dislocation. Most families obtain part of their cash income from relatives working in New Zealand. Funds are also sent by the Tokelau communities in New Zealand for village and church projects.

Logistical problems, and difficulties in recruiting New Zealand overseers have caused delays in the works programme begun in 1966. The rate of progress is also partially determined by the use of unskilled labour and the need to ensure the minimum disruption in the routine life of the small communities.

Work has progressed well on three new hospitals. A public ceremony marked the opening of the Atafu Hospital in April 1976.

2. Land Tenure and Usage

a. *Utilisation*

The numerous uninhabited islets at each atoll are used as food plantations. Local timber is used for canoe making, house building, and domestic utensils, while woodwork and plaited ware are marketed on a small scale. The coconut palm, which is predominant in the atolls, provides a staple export in the form of copra.

b. *Ownership and Tenure*

Practically all land is held by customary title in accordance with the customs and usages of the inhabitants. The Tokelau Islands Amendment Act 1967 provides that the indigenous inhabitants may dispose of their

land among themselves according to their customs, but they may not alienate land by sale or gift to non-indigenous inhabitants other than to the Crown. Land holdings pass from generation to generation within the families, being held by the head of a closely related family group, although some land is held in common.

c. *Principal Crops*

Apart from the manufacture of copra, agricultural products are of a basic subsistence nature. Food crops consist of coconuts, pulaka, breadfruit, ta'amu, pawpaw, the fruit of the edible pandanus, and bananas.

d. *Livestock and Fisheries*

Livestock consists of pigs which, except in Fakaofo, are kept apart from the village areas, and fowls. Ocean and lagoon fish and shellfish are available in quantity and form a staple constituent of the diet, the most common species of fish caught being tuna, bonito, trevally, and mullet.

e. *Agriculture*

As a result of a visit by an agricultural officer from the South Pacific Commission, an agricultural extension officer is to be appointed at the request of the General Fono to help improve the returns from subsistence crops.

3. Transport and Communications

The Nauruan vessel the m.v. *Cenpac Rounder* was chartered for four voyages during the year. In addition the m.v. *Florida* was chartered from Rarotonga for two further voyages. A Polynesian Airlines Hawker Siddeley 748 was chartered to airdrop medical supplies urgently required on Fakaofo.

Radio stations at Atafu and Fakaofo work schedules for commercial traffic at 10 a.m. and 2 p.m. daily and for weather reports at 7 a.m. and 1 p.m. daily. Nukunonu radio transmits traffic and weather reports every 4 hours in addition to commercial schedules. Radiotelephone facilities are available at the three stations. Single sideband tele-radio equipment has been installed at all stations including Apia and the reception is much improved.

A special set of postage stamps featuring fish of the coral reef was issued in November.

4. Public Finance

All values are expressed in New Zealand currency. Revenue is derived principally from export duty on copra levied at the rate of 9½ percent *ad valorem* on the f.o.b. value at the port of Apia on all copra exported from the group. Revenue derived from copra tax is now paid to special village funds and the expenditure of these funds on village projects is decided wholly by the Island Fonos. Customs duty of 12½ percent *ad valorem* is levied on all goods entering the group. Other revenue is derived from trading profits, the sale of postage stamps, and radio and telegram services. Total revenue for the year was $63,817. Expenditure is mainly devoted to capital works development, the provision of social services, and the cost of administration.

After discussion with the Island Fonos especially in respect of the works programme, annual estimates of revenue are prepared by the Administrator and approved by the Minister of Foreign Affairs. Financial aid totalling $1,400,000 from New Zealand for the triennium 1974–75 to 1976–77 was announced in February 1974. Additional aid totalling $112,650 was announced in 1974, and a further $245,000 in 1975.

Expenditure for the year was $709,585, the items being administration $69,598; education $163,765; health $79,890; public works $43,620; capital works development $169,747; agriculture $39,261; communications and transport $143,704.

The balance in the Copra Stabilisation Fund as at 31 March 1976 was $22,447 which is invested in Government stock but is currently being drawn upon to subsidise a payment of 16.26c per kilogram to growers.

5. Banking and Credit

New Zealand currency is legal tender in the Tokelau Islands, but as a matter of convenience, Western Samoa currency is used. Post Office Savings Bank and commercial banking facilities in Apia are available to the Tokelau people.

6. Trade

Trading operations in the territory are carried out by Burns Philp (South Seas) Co. Ltd. on chartered vessels. Trade figures are shown in appendix I.

PART III: SOCIAL CONDITIONS

1. General

Society is centred on the family group (Kainga), village affairs being conducted by a Council of Elders (Taupulega), comprising representatives of the families.

2. Human Rights and Status of Women

As the Tokelau Islands are part of New Zealand, policies relating to human rights which obtain in the metropolitan country are similarly applicable. A restriction of the right to leave the islands was introduced by the Tokelau Islands Departure Regulations 1952, under which residents over the age of 12 years must obtain a permit from the Administration before departure. This measure was introduced to ensure that Tokelauans wishing to leave are adequately prepared, financially and otherwise, to enter the completely different environment which will face them overseas.

Reinforcing statute law, local custom and usage also guarantee the rights of the individual, no discrimination being made between men and women. It is the declared policy of the New Zealand Government that the general provisions of the Universal Declaration of Human Rights should be applied to the Tokelau Islands so far as is compatible with the needs of the people and the conditions peculiar to the small and separate atolls which constitute the Tokelau Islands.

Policies relating to the elimination of racial discrimination which obtain in metropolitan New Zealand are applicable in the Tokelau

Islands. In practice, racial discrimination is not a problem in Tokelau since all the inhabitants, except for a few expatriates, are of the same race.

3. Labour and Employment

Copra production and the manufacture of plaited ware and woodwork are the only industries and no supervision of employment conditions in these industries is necessary. Between trading calls the people devote their labour to procuring food from lagoon, ocean, or plantation, to village maintenance, and to the production of woven mats, fans, and curios. The men also work on building projects. Some Tokelauans have taken up work in Western Samoa, thereby experiencing a different style of living and participating in a much more advanced type of economy.

Unemployment, sweated labour, and exploitation are unknown in the Tokelau Islands where adequate security and safeguards against oppression are provided by the social structure.

As a result of the assisted resettlement scheme whereby families were offered the opportunity of settlement in New Zealand, overpopulation now is not a problem and the population is now in a better state of equilibrium with available resources.

With the decline in the number of people seeking assistance under the Tokelaus Resettlement Scheme and the threat of social distortion becoming apparent in the Tokelau Islands through the drain of able-bodied manpower to New Zealand, a proposal was put to the Tokelauan people that the scheme be suspended indefinitely. This was agreed to by the island leaders.

While in some islands resettlement has deprived them of manpower, its long-term effects are beginning to pay dividends. A number of Tokelauans, at present in New Zealand, who have been brought out under the scheme, have expressed interest in returning to the Tokelau Islands to employ in the islands the skills they have acquired in New Zealand.

4. Housing Conditions

Tokelau housing is constructed of kanava and pandanus timbers with walls and roofs of plaited pandanus. The style of house is well suited to the climate.

The villages are well laid out. The people of Atafu live in one village which occupies part of a motu (islet). At Nukunonu the village occupies about half of one motu which is connected by bridge to a neighbouring motu where some families have settled.

The village at Fakaofo is situated on a small but comparatively high and well-shaded motu. It is overcrowded although emigration to New Zealand has lessened this. A new village on a larger, nearby motu where the school, the hospital, and other facilities are located, has been established.

5. Welfare and Relief

The question of poor relief has not arisen in the Tokelau Islands and will not as long as there is sufficient land available. Respect for the aged is firmly embedded in the social system of the islanders and there is an accepted family responsibility to provide food and accommodation for the aged and indigent.

Village women's committees, constituted principally of married women, assist the nursing staff in matters relating to infant care and child welfare.

6. Crime Prevention

The police establishment comprises seven Tokelauan officers—three in Fakaofo and two each in Atafu and Nukunonu.

Apart from petty offences there is little crime in the group. There are no prisons. Punishment takes the form of fines or labour which is directed to assist with public work, but there is little restraint on personal conduct during a period of sentence.

7. Public Health

The Government of Western Samoa assists with the medical services of the territory and regular visits are made to the atolls by its medical staff. There are three Tokelau medical officers and also a medical officer from Tuvalu serving at Nukunonu.

Skin diseases resulting from the limited supply of fresh water available for personal hygiene are quite common but are kept fairly well under control. In an effort to improve the supply of fresh water, several large water tanks have been installed in association with the building programme. There is a certain amount of eye trouble, partly due to irritation caused by sand and water which enters the eyes during fishing and partly to the effects of sunshine glare from lagoon and ocean.

8. Community Development

The population of the Tokelau Islands is divided into three groups, each of which forms a single cohesive unit embracing all the people on each of the atolls. The need for formal organisation of community development does not exist as it has always been the normal way of life in the Tokelau Islands.

PART IV: EDUCATION

1. General

Primary education is available for all children. Scholarships are awarded for secondary and tertiary education in Western Samoa, Fiji, and New Zealand.

The New Zealand Department of Education provides advisory assistance. It also provides supplementary material and equipment for the schools and carries out periodic inspections.

Two qualified New Zealand teaching couples, 31 trained Tokelauan teachers, and 16 teacher-aides are in the education service. The duties of the expatriate couples are to assist the Tokelauan staff to improve teaching standards and to help prepare intending migrants for life in New Zealand.

The schools are equipped with radio sets and slide and movie projectors. They are supplied with electricity from diesel-powered generating plants. As well as powering the projectors, electricity allows the school buildings to be used at nights for such purposes as youth club activities and adult education courses. Attendance at schools is very close to 100 percent, parents being most enthusiastic in supporting the schools.

Fifteen children began secondary school in New Zealand on scholarships awarded under the New Zealand Bilateral Aid Training Programme. Details are given in appendix II of this report.

APPENDIX I: TRADE

Except where otherwise stated all values are expressed in New Zealand currency.

Table A: Exports—Copra Only

Financial Year	Quantity	Value (at the Tokelau Islands)
	tonnes	$
1971–72	156	12,961
1972–73	134	11,144
1973–74	51	4,813
1974–75	256	87,154
1975–76	108	22,658

Table B: Summary of Trading Results for the Year Ended 31 March 1976

Expenditure	$	*Income*	$
Copra purchases	22,658	Copra proceeds	19,465
Transport, labour	8,383	Freight	9,527
Advertising	60	Passages	4,191
Insurances	1,526	Loss for year	100,327
Wharfage and stevedoring ..	9,862		
Charter hire	71,741		
Pilot and harbour dues ..	1,339		
Copra sacks	800		
Crew overtime	3,416		
Administration travel expenses ..	310		
Miscellaneous charges ..	6,623		
Commission and overhead ..	4,739		
Copra tax	2,053		
	$133,510		$133,510

APPENDIX II: EDUCATION

Table A: New Zealand Bilateral Aid Training Programme

STUDENTS AND TRAINEES AT 31 MARCH 1976

	M	F	Total
New Zealand—			
Nurses	..	4	4
School pupils, primary	7	6	13
School pupils, secondary	28	20	48
Teacher trainees, primary	1	..	1
Tradesmen and technicians	11	..	11
University students	1	..	1
Total	48	30	78
Short-term in-service trainees in New Zealand, April 1975 to March 1976—			
Plumbers	3	..	3
Medical Officer	1	..	1
Total	4	0	4

Expenditure 1975–76 NZ$96,421

Table B: Other Tokelauans in Training Overseas and Sponsored by Tokelau Islands Administration as at 31 March 1976

	M	F	Total
Western Samoa—			
Avele Agriculture College	8	..	8
Alafua College	2	..	2
Chanel College	2	..	2
Maluafou College	..	7	7
Papauta College	..	3	3
St. Mary's College	..	3	3
Teachers' Training College	3	1	4
Apia Hospital — Nursing	..	1	1
Total	15	15	30

BY AUTHORITY:
A. R. SHEARER, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1976
80499 G—76 G

The Tokelau Rat Survey 2
Pac
SB 994
R2W6
1968

Watson - Smithsonian ?

Lobell - Mich.

THE TOKELAU RAT SURVEY 2. FOLLOW-UP REPORT, APRIL 18 - JUNE 13 1968

BY

KAZIMIERZ WODZICKI, Ph.D. (GR:20%) F.R.S.N.Z.

INTRODUCTION

The first report on rats and other vertebrates (Wodzicki 1968) recommended : (i) A further study of rat damage to coconuts with regard to its occurrence throughout the year and its assessment together with an attempt to assess the coconut palm productivity in various islets of the atolls: (ii) Further trials with poisons that were successfully used in the 1966/67 poison trials and with any other poisons that may be acceptable to rats in Tokelau Islands conditions: (iii) The training of two rat control operatives in each of the three atolls with the view that at a later stage when both the palm productivity and the amount of rat damage in terms of lost copra production will be known, they would carry out rat control, under the supervision of the doctors in each island: (iv) Autopsies of further rats to obtain information on taxonomy, biometric aspects, reproduction and parasites and further experiments on the estimation of Rattus exulans populations in Tokelau Islands.

The present report describes the work carried out by the writer between 18 April and 13 June 1968 on the above mentioned important aspects. In addition whenever there was an opportunity, further observations on birds and reptiles were carried out and collections of land invertebrates and plants were made. An itinerary accounting of our activities is given in Appendix I.

I. FURTHER STUDY OF RAT DAMAGE TO COCONUTS

INTRODUCTORY

A study of rat damage to coconuts was initiated during the first survey in 1966/67 (Wodzicki 1968). It was found that at Nukunonu and Atafu rat damage on some islets, particularly on the Long Motu, Nukunonu atoll, was severe but on others, such as the Church property on Vao or Village Motu, Nukunonu the damage was insignificant or even non-existent.

The data obtained during the 1966/67 survey were criticised: Firstly because the damage was expressed as the percentage of all nuts found on the forest floor, and thus a collection of copra nuts in the quadrat, that would have taken place prior to counting would obviously increase the percentage of rat-damaged nuts. Secondly because the quadrats were on the small side and may not have been sufficiently representative. Thirdly, when analysing the results of the 1966/67 quadrats it was found that there is no information available in the literature on coconut palm productivity on low islands. Most if not all, studies of coconut palms were devoted to groves on high islands where coconuts are economically much more important than on atolls. Finally, various authors (e.g. Strecker in Storer 1952) found much more rat damage to coconuts on atolls than on high islands but its occurrence throughout a whole year has not yet been investigated.

This lack of reliable information on coconut productivity and on the occurrence of rat damage throughout the year on atolls, prompted the writer to organize a research project that would run throughout a whole year and would provide sufficient information on these two aspects.

MATERIAL AND METHODS

In order to make the sample as representative as possible the Nukunonu atoll was divided into three parts, according to the rat damage observed during the first survey in 1966/67 : i. islets without rat damage - Church property on Vao or Village Motu (Fig.1). ii. with little or no damage - various islets south-east or north-east from Vao. and iii. islets showing considerable rat damage - the Long motu, on the opposite side of the lagoon from Vao.

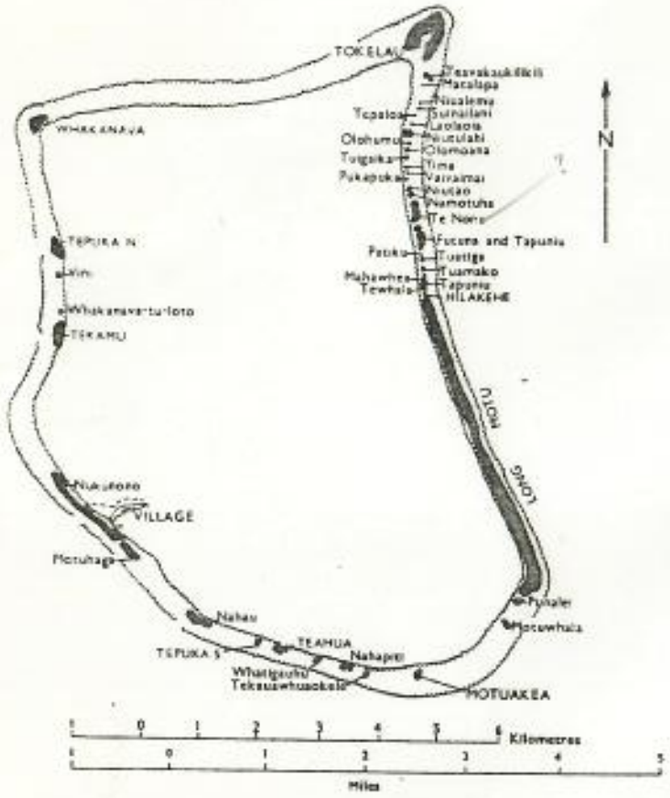

Fig. 1. Nukunonu atoll.

It is known that between the lagoon and ocean beaches there can be distinguished several vegetation zones (Parham 1960) and that there is a relationship between various vegetation zones and rat distribution (Wodzicki in press). To cover these vegetation zones three quadrats were established in each islet: one on the ocean side, one in the middle and one the lagoon side. Quadrats set in Vao or Village motu are an exception: the narrowness of the Vao islet made it difficult to have three separate quadrats and, larger quadrats were established there that would stretch from the lagoon to the ocean side.

A total of 42 quadrats was established on Nukunonu and 5 quadrats were established on Atafu atoll. Table I shows the location, size and number of quadrats on the various islets. The Table also shows on which of these quadrats regular observations will be carried out during 12 months ending in May 1969.

The procedure adopted in the establishment of the quadrats was as follows once the boundaries were marked with paint on the palms, all coconuts were collected into a couple of piles. In the following categories were counted: green and old rat-damaged, green and old undamaged nuts, copra and malformed nuts. Any nut carrying holes gnawed by rats are rat-damaged, copra nuts are matured or partly matured nuts, the contents of which are ready for cutting of copra, and malformed nuts are small nuts practically without "milk" or "meat". Upon the completion of counting all the nuts found on the quadrat's floor were removed from the quadrat.

In a representative sample of quadrats in a large number of islanders' properties, it was decided to count all the nuts on the ground throughout one year at 15 day intervals, with the view to obtain data on coconut productivity and on the occurrence of rat damage during the various seasons of one year.

Finally, it occurred to us that a record should be kept at regular monthly intervals, throughout one year, of the number of various kinds of immature coconuts on 3-4 palms in each quadrat.

The Tokelau language distinguishes eight kinds of growing nuts on a palm. Some are distinguishable by size, others by touch or tapping. This detailed knowledge of the various categories of coconuts is of great practical importance to the islanders as it allows them to distinguish nuts sufficiently grown to provide drink, others which are sufficiently mature to provide enough "meat" to eat, and the largest category which contains sufficient amount of "meat" to be cut for copra. The names of eight main categories from the smallest to mature copra nuts are as follows: 1. Puakoile; 2. Mokomoko-tawhawha; 3. Mokomoko; 4. Suamata tulua; 5. Suamata; 6. Niumata; 7. Agalele and 8. Popo. On the advice of Mr John W. Parham, Suva, Fiji, it was decided that these palms would be climbed by our assistants once a month, and all nuts in the bunches would be counted and at the same time any sign of rat damage or Rhinoceros beetle presence would be recorded.

In addition to these marked palms, all tall fruiting and low immature coconut palms, and all other trees from the pole stage onwards, growing within the boundaries of the quadrats were counted.

While on our voyage to and from Nukunonu some quadrats were established at Atafu atoll on Loulevalova and Fagamatuku islets and the results of coconut counts are included in the tables below.

RESULTS

Tables II - V show the results of the first coconut counts in ocean, middle and lagoon side quadrats on the Long Motu and on the adjacent small islets of Kelakene and Pumalei; on the small islets located between the Long Motu and Vao or Village islet,

TABLE I

GROUP AND LOCATION OF QUADRATS

All Group I, II and Atafu Quadrats 1024 m^2, Group III 4096 m^2

ATOLL	ISLET	PROPERTY	LOCATION	GROUP	REMARKS
FUNAFUTI	Te Whananava		Ocean side	I	One record only
	Helakaha		Ocean side	II	
	Long Motu	Teloha	Ocean side	II	
	Long Motu	Maniutepu	Ocean side	II	
	Long Motu	Natavlaga	Ocean side	II	
	Long Motu	Manihiki	Ocean side	II	
	Long Motu	Olopuka	Ocean side	II	
	Long Motu	Whakanaetino	Ocean side	II	
	Long Motu	Tekoko	Ocean side	II	
	Long Motu	Fiumahua	Ocean side	II	
	Long Motu	Avalau	Ocean side	II	
	Funalei		Ocean side	II	
	Motuakea		Middle	I	One record only
	Mahapiti		Middle	I	One record only
	Vini		Middle	I	One record only
	Te Whakanava		Middle	I	One record only
	Long Motu	Teloha	Middle	II	
	Long Motu	Maniutepu	Middle	II	
	Long Motu	Natavlaga	Middle	II	
	Long Motu	Manihiki	Middle	II	
	Long Motu	Olopuka	Middle	II	
	Long Motu	Whakanaetino	Middle	II	
	Long Motu	Tekoko	Middle	II	
	Long Motu	Fiumahua	Middle	II	
	Long Motu	Fogaliki	Middle	II	
	Long Motu	Tausunulua	Middle	II	
	Long Motu	Avalau	Middle	II	
	Long Motu	Tagiamako	Middle	II	
	Funalei		Middle	II	
	Te Whakanava		Lagoon side	I	One record only
	Long Motu	Teloha	Lagoon side	II	
	Long Motu	Manihiki	Lagoon side	II	
	Long Motu	Olopuka	Lagoon side	II	
	Long Motu	Whakanaetino	Lagoon side	II	
	Long Motu	Tekoko	Lagoon side	II	
NUKUNONU ATOLL	Long Motu	Fiumahua	Lagoon side	II	
	Long Motu	Fogaliki	Lagoon side	II	
	Long Motu	Tausunulua	Lagoon side	II	
	Long Motu	Avalau	Lagoon side	II	
	Long Motu	Tagiamako	Lagoon side	II	
	Long Motu	Vaitupu	Lagoon side	II	
	Funalei		Lagoon side	II	
	Vao Quadrat I		Ocean to lagoon	III	
	Vao Quadrat II		Ocean to lagoon	III	
	Vao Quadrat III		Ocean to lagoon	III	
ATAFU ATOLL	Laulavalava		Ocean		
	Laulavalava		Middle		
	Laulavalava		Lagoon		
	Fagamatuku		Ocean		
	Fagamatuku		Lagoon		

TABLE II

NUMBERS OF RAT-DAMAGED AND UNDAMAGED COCONUTS - OCEAN QUADRATS

Atoll and Name of Property	Date	Size of Quadrats M^2	No. Rat Damaged Nuts		No. Undamaged Nuts		Empty Nuts	Malformed Nuts	Total Nuts Counted	Remarks
			Fresh	Old	Fresh	Old				
ATAFU										
Laulavalava	19. 4.68	966	47	171	11	8	*	*	237	* Not counted
Fagamatuku	17. 6.68	1024	81	124	4	4	45	7	265	
Total			128	295	15	12	-	-	502	
NUKUNONU										
Te Whakanava	9. 5.68	1024	13	66						
Helakaha	16.12.67	243	12	229	5	29	54	7	172	
"	22.5 68	1024	83	355	4	13	*	*	258	
Total			108	648	17	60	328	36	819	
LONG MOTU							38	43	1249	
Teloha	15. 5.68	1024	48	28	17	104	88	38	315	
Maniutepu	"	"	39	50	16	44	109	11	269	
Natavlaga	"	"	9	49	1	55	189	11	309	
Manihiki	16. 5.68	"	56	62	8	28	79	7	240	
Olopuka	"	"	19	21	13	27	217	6	303	
Whakanaetino	"	"	135	384	14	33	232	0	858	
Te Koko	17. 5.68	"	61	143	0	27	54	3	288	
Fiumahua	"	"	27	293	2	27	0	0	349	
Avalau	24. 1.67	288	7	98		11	*	*	66	* Not counted
"	22. 5.68	1024	21	70	4	31	233	60	419	
Total			417	1148	75	422	1201	136	3416	
Funalei	16. 5.68	1023	19	93	0	25	146	2	285	

TABLE III

NUMBERS OF RAT-DAMAGED AND UNDAMAGED COCONUTS - MIDDLE QUADRATS

Name of Atoll and Property	Date	Size of Quadrat M^2	No. Rat Damaged Nuts		No. undamaged Nuts		Copra Nuts	Malformed Nuts	Total Nuts Counted	Remarks
			Fresh	Old	Fresh	Old				
ATAFU ATOLL										
Laulavalava	19. 4.68	1024	12	265	11	48	56		392	
NUKUNONU ATOLL										
Motunkea	7. 5.68	1024	Nil	Nil	6	38	74	18	136	
Mahengili	"	"	Nil	Nil	Nil	35	137	142	314	
"	"	"	Nil	Nil	Nil	22	43	46	111	
Vini	10. 5.68	"	Nil	3	Nil	17	36	18	74	
Te Whakanava	9. 5.68	"	9	20	Nil	28	44	18	121	
Nelukeke	15.12.66	243	10	229	?	-	-	-	248	Not included in total
LONG MOTU										
Toloke	15. 5.68	1024	52	114	5	35	179	0	387	
Manjutapu	"	"	22	61	22	5	189	11	310	
Motaulaga	"	"	4	49	1	55	189	11	309	
Manihiki	16. 5.68	"	30	32	19	22	137	32	252	
Olopuka	"	"	19	12	13	27	79	7	157	
Whakanactine	"	"	33	100	33	21	188	9	384	
Te Koth	17. 5.68	"	40	122	8	48	176	7	401	
Piumahua	"	"	187	171	44	45	142	23	612	
Fogaliki	21. 5.68	"	39	107	4	46	119	6	403	
Tonunuloa	7. 1.67	81	8	55	Nil	Nil	-	-	63	Not included in total
"	22. 5.68	1024	109	425	18	90	474	13	830	
Avalau	"	"	71	526	6	10	320	97	960	
Tuglauako	"	"	Nil	347	2	21	150	29	349	
Total			601	1926	173	448	1955	253	5358	
Funalei	16. 5.68	1024	82	43	10	23	183	8	269	

TABLE IV

NUMBERS OF RAT-DAMAGED AND UNDAMAGED COCONUTS - LAGOON QUADRATS

Name of Property and Islets	Date	Size of Quadrats m^2	No. Rat-Damaged Nuts		No. Undamaged Nuts		No.		Total Nuts Counted
			Fresh	Old	Fresh	Old	Copra Nuts	Malformed Nuts	
ATAFU ATOLL									
Laulavalava	68	1024	36	448	31	45	**	**	520
Fagamatuku			81	297	11	3	44	4	440
TOTAL			117	745	42	48	44	4	960
NUKUNONU ATOLL									
Te Whakanava	9.5.68	1024	1	16	Nil	15	28	53	113
Motunkea	19.12.66	324	2	6	70		-	-	78
LONG MOTU									
Toloke	15.5.68	1024	31	105	3	17	67	26	249
Manihiki	16.5.68	"	26	48	2	65	95	Nil	251
Olopuka	16.5.68	"	14	106	8	71	65	12	276
Whakanactine	16.5.68	"	56	99	6	102	241	102	606
Tokoko	17.5.68	"	38	227	11	59	128	34	497
Piumahua	17.5.68	"	160	485	4	64	135	142	988
Fogaliki	21.5.68	"	82	248	4	40	129	51	1054
Tonunuloa	21.5.68	"	87	370	Nil	81	106	26	670
Avalau	22.5.68	"	98	310	4	80	354	272	1118
Tuglauako	22.5.68	"	Nil	147	2	21	150	29	349
Vaitupu	15.5.68	"	75	120	17	38	82	15	335
TOTAL			665	2763	61	628	1549	709	6395
Funalei	16.5.68	1024	71	296	3	28	93	5	496

** Counted with rat-damaged and undamaged nuts

such as Te Shakenave, Pini, Katepiti and Motuakea; and finally on three quadrats on Church property, Vao or Village Motu.

A comparison of the 1966/67 counts (Woodroffe 1968) with those counted during the present survey shows that despite the small scatter size of the 1966/67 quadrats, the general picture was much the same. No rat damage was found on Church property, Vao. Little damage was recorded on the small islets between the Village and Long Motu but considerable rat damage to coconuts was noted in both years on the Long Motu and adjacent islets of Helnkebe and Punalei.

With regard to rat damage in the three zones (ocean, middle and lagoon side) on the properties of the Long Motu the following differences were recorded: the largest proportion of rat damaged nuts occurred in quadrats on the lagoon side (311 nuts per quadrat, 55% of the total number of nuts counted); followed by the middle quadrats (194, 47%); finally, the ocean side quadrats showed the least rat damage (175, 43%). This trend of rat damage increasing from the ocean beach towards the lagoon is of interest but as it is based on one set of observations only, it cannot, at least at present, be considered as significant. Further observations will be recorded by our assistants under the local doctor's supervision, approximately every 15 days during the next twelve calendar months.

Tables VI - IX contain observations carried out on 61 marked trees within the quadrats described in Tables II - V. These observations contain information on height of palms, clusters of coconuts and presence of rat and rhinoceros beetle sign.

Height of coconut palms

The height of palms is of some interest as it may be an indication of their age. It was found that the palm height of the Long Motu varies from 45.3 ft (ocean quadrats) to 52.5 ft (lagoon quadrats) and is 46.5 ft for palms in the Church property quadrats in Vao. It would appear that all these groves consist of mature, if not very old palms.

Coconut numbers

The main purpose of the monthly counts of various kinds of nuts on the marked palms is to obtain the productivity of the marked palms during one year.

Tables VI - IX show a considerable variability in the numbers of the eight kinds of coconuts and in the total of nuts from all palms in various quadrats. With one count of coconuts on the marked trees on hand, it may be premature to analyse in detail any relationships in the occurrence of the eight kinds of nuts on palms in various islets. However, it may be of interest to compare the means of nut totals on marked trees in various quadrats. Firstly, we find little difference between marked palms in ocean quadrats and those in middle quadrats - 35.2 and 39.5 respectively. On the other hand, marked palms in the lagoon side quadrats on Long Motu and in the Church property on Vao Motu, differ from the two previous groups and show means of 26.2 and 25.4 nuts per palm respectively. It will be interesting to follow up these and other differences in coconut productivity between the various islets during a one year period.

Rat and beetle sign

Rat and beetle sign in the crowns of the marked trees were noted and are shown in Tables VI - IX.

Rat sign comprised several rat nests (including one with two baby rats), and rat damaged nuts. With the exception of the Church property in Vao islet where only one tree in eleven marked palms showed rat sign, rat sign on palms in the Long Motu properties

TABLE V

NUMBER OF RAT-DAMAGED AND UNDAMAGED COCONUTS - VAO ON MEDIUMOOD WEST

Name of Property and Islets	Date	Size of Quadrats m²	No. Rat-Damaged Nuts		No. Undamaged Nuts		Total Nuts Counted
			Fresh	Old	Fresh	Old	
Church Property	4967	2n3	NIL	NIL	NIL	45	45
" " quadrat I	3.5.68	2048	NIL	NIL	NIL	5	5
quadrat II	8.5.68	"	NIL	NIL	4	190	511
quadrat III	3.5.68	"	NIL	2	NIL	8	121
Total			NIL	2	192		682
SECOND COUNTING							
quadrat I	20.5.68	2048	NIL	4	21	410	796
quadrat II	10.5.68	"	NIL	NIL	2	NIL	136
quadrat III	20.5.68	"	NIL	NIL	21	9	221
Total			NIL	4	44	419	1083

Name of Property and Islets	Date	Size of Quadrats m²	No. Rat-Damaged Nuts		No. Undamaged Nuts		Total Nuts Counted
			Fresh	Old	Fresh	Old	
Church Property	4967	2n3	NIL	NIL	NIL	45	45
" " quadrat I	3.5.68	2048	NIL	NIL	NIL	5	5
quadrat II	8.5.68	"	NIL	NIL	4	190	511
quadrat III	3.5.68	"	NIL	2	NIL	8	121
Total			NIL	2	192		682
SECOND COUNTING							
quadrat I	20.5.68	2048	NIL	4	21	410	796
quadrat II	10.5.68	"	NIL	NIL	2	NIL	136
quadrat III	20.5.68	"	NIL	NIL	21	9	221
Total			NIL	4	44	419	1083

No.		Total Nuts Counted
Copra Nuts	Malformed Nuts	
•	•	45
•	•	5
296	131	511
70	41	121
536	172	682
233	68	796
117	7	136
164	27	221
536	102	1083

• Not counted

TABLE VI

KINDS OF COCONUTS ON MARKED PALMS - OCEAN QUADRATS (10 x 10 M²)

Name of Property and Islet	Date	No. of Palm	Height of Tree	No. (1)	No. (2)	No. (3)	No. (4)	No. (5)	No. (6)	No. (7)	No. (8)	Spadix Closed	Spadix Open	Rat Sign	Beetle Damage	Total Nuts	Remark
NUKUNONU ATOLL			Ft														
Nalakaka	28.5.68	1	32	0	0	0	0	0	0	0	12	-	-	No	-	0	Not banded
"	28.5.68	2	54	5	3	2	2	3	0	0	4	2	2	Yes	No	15	"
"	28.5.68	3	42	0	0	0	0	0	0	4	9	2		Yes	No	13	"
Long Nuts																	
Tulehe	29.5.68	1	48	1	2	5	1	2	1	3	24	2	0	Yes	No	39	
"	29.5.68	2	54	0	0	0	0	4	9	10	90	2	0	No	Yes	113	
"	29.6.68	3	63	1	1	1	3	5	4	1	10	2	0	Yes	Yes	26	
Whakanaatino	28.5.68	1	50	1	5	11	5	2	2	4	2	0	0	No	No	32	
"	28.5.68	2	50	11	5	15	16	5	7	10	30	2	0	Yes	No	99	Banded
"	28.5.68	3	30	0	6	5	1	1	0	2	10	0	0	No	No	25	
Piumwhua	28.5.68	1	38	0	2	3	4	2	3	5	34	3	0	No	No	53	
"	28.5.68	2	42	0	0	0	0	0	0	0	14	3	0	No	No	14	Banded 5-6'
"	28.5.68	3	48	0	0	6	6	0	0	2	3	2	0	(Green Nuts	No	17	
Vaitupu-Pilipili	28.5.68	1	42	8	12	4	2	4	8	11	25	0	0	No	No	74	Banded 12'
"	29.5.68	2	30	3	2	2	2	2	3	1	15	1	0	Yes	No	30	Banded 14'
" "	29.5.68	3	42	3	3	2	1	1	2	1	31	2	0	Yes	No	44	Banded 14'
Funalei	29.5.68	1	48	6	1	1	1	1	0	3	8	2	0	No	No	21	
"	29.5.68	2	48	0	0	1	0	0	0	1	7	1	0	No	No	9	
"	28.5.68	3	54	2	4	0	0	0	0	2	1	2	0	No	No	9	
TOTALS		18		37	46	56	34	32	39	60	449	28	2			633	

(1) = Popo
(2) = Agalele
(3) = Niumata
(4) = Suamata
(5) = Suamata tulua
(6) = Mokomoko
(7) = Mokomoko-Tuahanha
(8) = Fuakoile

Av. Height = 45'

Total No. with Rat sign = 8
Total No. without Rat sign = 10
Total No. with Beetle Damage = 2
Total No. without Beetle Damage = 15

TABLE VII

KINDS OF COCONUTS ON MARKED PALMS - BEITOKE QUADRATS (10 x 10 M²)

Name of Property and Islet	Date	No. of Palm	Height of Tree	No.	No.	No.	No.	No.	No.	No.	No.	Spadix Closed	Spadix open	Rat Sign	Beetle Damage	Total Nuts	Remark
Long Nuts			Ft														
Tulehe	29.5.68	1	48	7	3	2	5	1	0	5	23	5	0	Yes	No	46	Banded 6'
"	29.5.68	2	48	3	2	1	0	0	0	0	12	3	0	No	No	18	
"	29.5.68	3	42	3	2	2	1	1	0	1	3	2	0	Yes	No	15	
Whakanaatino	28.5.68	1	49	3	3	2	1	0	0	4	30	3	0	No	No	45	
"	28.5.68	2	59	3	6	8	2	3	3	2	14	2	0	No	No	41	Unbanded
"	29.5.68	3	60	8	8	7	4	2	5	4	20	3	0	No	No	58	"
Piumwhua	28.5.68	1	42	1	2	3	0	3	1	2	14	2	0	Yes	No	26	"
"	28.5.68	2	45	8	22	7	6	4	3	4	5	2	3	No	No	59	Banded 4-6'
"	28.5.68	3	25	6	5	2	1	0	1	1	22	3	1	No	No	38	Unbanded
Vaitupu-Pilipili	29.5.68	1	49	0	0	1	0	0	0	1	4	2	1	No	No	6	"
" "	28.5.68	2	48	4	8	6	6	4	0	0	32		0	No	No	60	Banded 8'
" "	28.5.68	3	30	2	3	4	2	2	2	2	12		0	No	No	29	Banded 12'
Funalei	29.5.68	1	50	3	4	4	1	2	1	1	4	0	0	No	No	20	Unbanded
"	28.5.68	2	54	1	2	2	1	0	0	2	10	1	1	No	No	18	Banded 6'
"	29.5.68	3	56	0	0	0	0	3	7	16	87	2	0	(on 2 (Green (Nuts	No	113	Unbanded
TOTALS		15		52	70	54	30	25	23	47	292	30	6			490	

(1) = Popo
(2) = Agalele
(3) = Niumata
(4) = Suamata
(5) = Suamata tulua
(6) = Mokomoko
(7) = Mokomoko-Tuahanha
(8) = Fuakoile

Av. Height = 46.5'

Total No. with Rat Sign = 4
Total No. without Rat Sign = 11
Total No. with Beetle Damage = 0
Total No. without Beetle Damage = 15

TABLE VIII

KINDS OF COCONUTS ON MARKED PALMS - LAGOON QUADRATS (1024 M^2)

Name of Property and Islet	Date	No.of Palm	Height of Tree	No.	No.	No.	No.	No.	No.	No.	No.	Spadix		Rat Sign	Beetle Damage	Total Nuts	Remark
												Closed	Open				
			ft														
NUKUNONU ATOLL																	
Helakaha	28.5.68	1	51	0	0	5	0	1	0	0	5	0	0	Yes	No	11	Unbanded
"	28.5.68	2	43	0	0	3	0	2	0	4	8	0	0	No	No	17	"
"	28.5.68	3	72	0	0	0	0	0	1	0	5	0	0	No	No	6	"
Long Hole																	
Tolohe	29.5.68	1	42	0	0	0	0	4	2	3	16	1	3	No	No	25	"
"	29.5.68	2	56	1	2	0	1	0	0	4	10	3	0	Yes	No	18	"
"	29.5.68	3	50	1	1	2	1	0	1	0	5	1	1	No	No	11	"
Whakanaetino	28.5.68	1	60	7	8	4	3	8	2	4	4	1	0	No	No	40	"
"	28.5.68	2	66	0	3	6	3	2	4	3	14	0	1	No	No	35	Banded 6'
"	28.5.68	3	54	0	1	7	5	2	1	4	6	1	2	Nest	No	24	Unbanded
Piumawhua	29.5.68	2	60	0	0	0	0	0	0	0	11	2	1	Nest	No	11	"
"	29.5.68	3	36	2	9	6	6	1	3	4	3	2	0	Nest	No	34	"
Veitapu-Pilipili	29.5.68	1	42	10	6	5	4	7	7	7	22	2	1	No	No	61	"
" "	29.5.68	2	54	0	0	0	0	0	0	0	8	2	1	Yes	No	8	Banded Low
" "	29.5.68	3	56	0	1	1	0	1	1	2	16	2	1	No	No	22	" "
Funafoli	29.5.68	1	63	5	7	8	6	6	9	7	9	2	0	No	No	57	Banded 10'
"	29.5.68	2	36	1	3	0	1	0	0	4	10	0	1	No	No	45	Unbanded
"	29.5.68	3	60	20	0	0	0	0	0	0	0	2	0	No	No	20	"
TOTAL		17		47	40	47	28	34	31	46	152	21	12			445	

(1) = Fapo
(2) = Agalele
(3) = Niumata
(4) = Daamata
(5) = Diamata tulua
(6) = Makomoko
(7) = Makomoko-Tamaamia Av. Height = 52'
(8) = Puakoila

Total No. with Rat Sign = 6
Total No. without Rat Sign = 11
Total No. with Beetle Damage = 0
Total No. without Beetle Damage = 17

TABLE IX

KINDS OF COCONUTS ON MARKED PALMS - VAO OR NUKUNONU WEST QUADRATS (2048 M^2)

Name of Property and Islet	Date	No.of Palm	Height of Tree	No.	No.	No.	No.	No.	No.	No.	No.	Spadix		Rat Sign	Beetle Damage	Total Nuts	Remark
												Closed	Open				
			ft														
VAO or NUKUNONU WEST																	
Quadrat I	25.5.68	1	60	2	7	5	2	4	5	6	2	0	0	No	No	31	
"	25.5.68	2	60	3	4	3	1	4	7	7	7	0	0	Yes	Yes	26	banded 6'
"	25.5.68	3		0	3	4	4	5	1	1	5	0	0	No	Yes	23	
Quadrat II	31.5.68	1	42	1	4	3	1	2	0	0	4	0	4	No	Yes	15	Unbanded
"	31.5.68	2	50	0	8	7	8	0	4	4	20	3	1	No	Yes	51	"
"	31.5.68	3	42	6	0	0	0	0	0	0	0	2	1	No	Yes	6	"
"	31.5.68	4	56	4	0	0	3	2	0	0	17	1	0	No	Yes	21	"
Quadrat III	27.5.68	1	40	5	3	3	2	3	1	3	5	0	0	No	No	25	"
"	27.5.68	2	50	9	3	3	4	2	1	7	7	0	0	No	Yes	36	Banded 14-15'
"	27.5.68	3	70	10	4	7	0	0	0	0	0	0	0	No	Yes	21	Banded 16'
"	27.5.68	4	54	4	3	4	1	1	1	5	5	0	0	No	No	23	Unbanded
TOTALS		11		44	39	39	26	23	15	33	67	6	6			280	

(1) = Fapo
(2) = Agalele
(3) = Niumata
(4) = Daamata
(5) = Diamata tulua
(6) = Makomoko
(7) = Makomoko-Tamaamia Av. Height = 47'
(8) = Puakoila

Total No. with Rat Sign = 1
Total No. without Rat Sign = 10
Total No. with Beetle Damage = 6
Total No. without Beetle Damage = 2

was common : in 32 palms marked on Long Motu, Helakeha and Funalei islets 18 showed rat sign.

The climbing of the marked palms for the counting of nuts provided an opportunity for recording beetle damage. As expected the Church property, Village Motu had the largest occurrence of beetle damage: in 17 marked palms only three were without sign of beetle damage; and the presence of two dead palms on quadrat 1 was noted. The accidentally introduced beetle was first noted in the village and in the Church property and this may explain its heavy incidence in this region.

Among the 17 palms marked on lagoon quadrats and 15 palms on middle quadrats in Long Motu no beetle damage was noted but two palms on the ocean quadrats were showing evidence of beetle presence.

Our sample of marked trees is unfortunately small but nevertheless it indicates the seriousness of the beetle's invasion and the strength of its impact on Vao. It also confirms Dr A.D. Hinkley's statement about the beetle's presence on the Long Motu in 1967. It will be of interest to follow-up the marked palms for sign of the rhinoceros beetle during the remaining 11 months.

Coconut palm density

The relationship between palm density and rat damage was discussed in the first report on the rat problem in the Tokelau Islands (Wodzicki 1966). The idea was advanced that proper management of coconut groves leads either to a reduction of the rat population or to a development of new foods for the rats to the effect that they do not gnaw green coconuts. This suggestion found support in Mr M.N. Sproat (in litt. 1966) experiments in the Mariana Islands and in our observations on N.Z.E.S.T.E.C. plantations on Upolu Island Western Samoa.

Tables X - XIII show the numbers of tall, i.e. mature and low, i.e. immature coconut palms and of other tree species in the quarter of an acre (874 m^2) quadrats in the ocean, middle and lagoon side of Long Motu, the Helakeha and Funalei islets and in the small islets of Motunkea, Nahapiti, Vini and Te Nhakanava. Table XIV records the same information on Church property, Vao islet, on one acre (4097 m^2) quadrats. Similar observations were recorded for the Lualavalava islet, Atafu atoll.

Pressure of other work prevented a detailed analysis of the data contained in Tables X - XIV, except working out the mean numbers of tall and low coconut palms and of other trees. All data are calculated to 874 m^2 (one quarter of an acre) quadrats.

TABLE X

Coconut and Other Trees Density - Ocean Quadrats
All quadrats 874 m^2 * - not counted

Islet and Property Name	Date	No. Coconuts Tall	No. Coconuts Low	No. Other Trees	Total Palms	Total Palms and other Trees
ATAFU ATOLL						
Laulavalava	19.4.68	25	6	28	31	59
NUKUNONU ATOLL						
Te Nhakanava	9.5.68	25	6	*	31	
FAKAOFO	22.5.68	36	25	24	61	85
LONG MOTU						
Tolehe	15.5.68	40	9	70	49	119
Maniutapu	15.5.68	36	10	41	46	87
Mataulaga	15.5.68	22	17	8	39	47
Manihiki	16.5.68	21	8	4	29	33
Olopuka	16.5.68	18	9	7	27	34
Nhakanaetino	16.5.68	16	10	8	26	34
Tekoko	17.5.68	32	10	3	42	45
Piumahua	17.5.68	18	4	3	22	25
Ivalau	22.5.68	24	6	19	30	49
Total		227	85	105	312	417
Mean		25.2	9.2	9.2	34.4	43.6
FUNALEI	16.5.68	26	4	12	30	42
Total Long Motu, Helakeha and Funalei		278	95	119	371	490
Mean		25.3	8.4	10.8	36.4	47.2

TABLE XI

Coconut and Other Trees Density - Middle Quadrats
All quadrats 874 m^2

Islet and Property Name	Date	No. Coconuts Tall	No. Coconuts Low	No. Other Trees	Total Palms	Total Palms and other Trees
ATAFU ATOLL						
Laulavalava	19.4.68	16	4	*		
NUKUNONU ATOLL						
Motumkea	7.5.68	58	8	12	66	78
Nahapiti	7.5.68	114	25	28	139	167
Nahapiti	7.5.68	52	15	30	67	97
Vini	7.5.68	20	6	9	26	35
Totals		Dan	54	69	298	367
Mean		61.0	13.5	19.2	74.5	91.7
LONG MOTU						
Tolehe	15.5.68	10	11	27	21	48
Maniutapu	15.5.68	14	13	34	27	41
Mataulaga	15.5.68	32	16	4	48	52
Manihiki	16.5.68	34	10	3	44	47
Olopuka	16.5.68	18	9	7	27	34
Nhakanaetino	16.5.68	36	9	7	45	52
Tekoko	17.5.68	28	9	8	37	45
Piumahua	17.5.68	33	4	10	37	47
Fogaliki	21.5.68	32	4	*	36	36

Table XI (Continued)

Tausunulea	22.5.68	22	5	5	25	30
Avalau	22.5.68	25	5	21	28	49
Total		280	101	110	381	491
Mean		25.4	9.2	11.0	34.6	45.5
PUNALEI	16.5.68	26	10	6	36	40

TABLE XII

Coconut and Other Trees Density - Lagoon Quadrats

All quadrats 974 m^2 not counted

Islet and Property Name	Date	No. Coconuts Tall	No. Coconuts Low	No. Other Trees	Total Palms	Total Palms and other Trees
ADAFU ATOLL						
Laulevalava	19.4.68	19	9	9	28	28
NUKUNONU ATOLL						
Te Whakanava	9.5.68	26	12	6	38	44
LONG MOTU						
Tolehe	15.5.68	32	33	9	65	65
Manihiki	16.5.68	19	8	11	27	38
Olopuka	16.5.68	22	13	25	35	60
Whakanaetino	16.5.68	44	15	2	59	61
Tekoko	17.5.68	20	10	14	30	44
Piumahua	17.5.68	36	7	2	43	45
Pogaliki	21.5.68	20	12	6	32	38
Tausunulea	21.5.68	36	6	6	42	48
Avalau	22.5.68	23	5	14	28	42
Tagiamako	22.5.68	15	7	7	22	29
Vaitupu	15.5.68	21	8	12	29	41
Total		288	134	99	412	511
Mean		26.1	12.3	9.9	34.7	44.6
PUNALEI	16.5.68	22	13	3	35	38
Total Long Motu and Punalei		310	137	102	382	484
Mean		25.8	11.4	9.3	34.7	44.0

TABLE XIII

Coconut and Other Trees Density - Church Property, Vao

All three quadrats 4097 m^2 (one acre)

Islet and Property Name	Date	No. Coconuts Tall	No. Coconuts Low	No. Other Trees	Total Palms	Total Palms & other Trees
NUKUNONU ATOLL						
Vao Church Property						
Quadrat I	3.5.68	98	49	31	147	178
Quadrat II	31.5.68	51	20	11	51	62
Quadrat III	1.5.68		91	95	91	186
Total			289	137	289	426
Mean			96.3	45.6	96.3	142

TABLE XIV

Comparison of palm and other trees density on Long Motu and Church Property, Vao

	Mean Numbers of Coconut Palms	Mean Numbers of Other Trees	Total No. of Palms and Other Trees
Ocean side quadrats	39.8	9.2	43.6
Middle quadrats	34.6	11.2	45.5
Lagoon side quadrats	34.7	9.9	44.6
Vao			
Quadrats I-III	24.0	11.4	35.5

It would appear from the above Table that there is little difference in numbers of palms and other trees between the three aspects of the Long Motu. On the other hand, in the Vao quadrats both palm density and that of other trees appear to be significantly lower than it is in the Long Motu. In fact, Quadrats I and II have even fewer other trees than the much more overgrown Quadrat III. Sample from the small islets between Long Motu and Vao (Tables X, XI and XII) is to small - all one can say is that the density of palms and other trees varies a good deal between one islet and another.

Before concluding this brief description of the coconut groves at Nukunonu, it may be of interest to compare briefly the density of palms at Nukunonu with that of the W.E.S.T.E.C. plantations on Upolu Island, Western Samoa. The W.E.S.T.E.C. plantations are reported to have 40 to 100 palms per acre on volcanic soils while at Nukunonu we find (Table XIV) between 101 to 182 palms per acre on coral sand soil with little humus. No other trees than coconut palms grow on W.E.S.T.E.C. plantations, but at Nukunonu, we find a substantial number of trees other than palms. If these trees are included we obtain a density from 142 to 182 trees/acre.

Finally it should be mentioned that the W.E.S.T.E.C. plantations have no undergrowth except grass between the palms. In the Tokelau Islands the forest floor is covered by a luxuriant growth of ferns (lausasile Phytomatodes scolopendria, lausea Asplenium nidus), seedlings of various trees and shrubs (puapua Guettarda speciosa, nonu Morinda citrifolia, gasu Scaevola taccada, whetai Tournefortia filiformis) and of some other plant species. There is usually plenty of thrash formed by decaying coconut leaves, old logs etc.

II. RAT CONTROL TRIALS

INTRODUCTION

Although no final recommendations for rat control in the Tokelau Islands can be made before the completion of observations on coconut palm productivity and rat damage during a twelve month period, it was important to obtain further information on rat control methods suitable for the Tokelau Islands conditions. Trials of poison and other rat control methods were also of practical importance for the training of the members of the "workshop", described in a later section of this report.

The rat control trials comprised the following tests:

1. Anti-coagulant poisons; 2. Zinc phosphide; 3. "Rat houses" and 4. "Operation Village".

1. Anticoagulant Poisons

Cage experiments and some field trials carried out during the 1966/67 survey (Tolnicki 1968) showed that biotrol wheat and cake(1), sorexa(2) and prolin(3) appeared suitable for rat control in Tokelau Islands conditions. The following experiments were carried out during our second visit to Nukunonu.

(a) Copra Store

Mr Bryan Drew, the works overseer, reported large numbers of rats in the copra store. At the time of our arrival there was no copra left in the store but it was decided to wipe out any rats that may have remained in the store, after the shipment of copra. On 24 April biotrol cake was set out in 15 places inside the copra store and another 9 poison stations were established in the adjacent public works part of the store. The store was daily visited during the next month and the remaining cake was weighed. Very little bait was eaten daily but four dead rats were collected four days and another four a month later.

(b) Church Property

On this site about 150 m from the village, a square 70 x 70

(1) Biotrol, a product of Bentokill Laboratories Ltd, Auckland, contains 0.05% Warfarin in whole wheat.

(2) Sorexa Master Mix contains 2% of 3 (1-Phenyl 2-Acetyl-Ethyl) 4-Hydroxy Coumarin + Hydroxy - 3-1-Phenyl Butane 3 - ON - 1 - YL - Coumarin and 98% of inerts and a blue soluble tracer;

(3) Prolin, a rodenticide recently developed by the Wisconsin Alumni Research Foundation contains: 3 (α - acetonylbenzyl) - 4 hydroxy-coumarin (warfarin) 0.025% p1-2 quinoxalylsulfanilamide (- sulfaquinoxaline) 0.025% and inert ingredients 99.950%.

yds (about 4,100 m^2), 146 snap-traps, two at each station, were set on 25 April in eight lines and baited with bread, fish, grated coconut, coconut cubes and with crab meat. Table XV shows the results:

TABLE XV

Results of trapping with various baits on Church property, Vao

No. of poison lines	Kind of bait	No. of Bait stations	No. of rats caught
1 - 3	bread	14	4
3 - 4	fish	13	5
4 - 5	grated coconut	13	6
5 - 6	coconut cubes	17	7
7 - 8	crab meat	16	6
	Total	73	34

It would appear that all above kinds of baits used attracted rats, though coconut baits were more attractive than the others. The trap-night index of 21.2/100 traps for an one acre area appears to be high.

At this stage traps were removed and replaced on 26 April by bamboo tubes, each with 8 ozs (about 225g.) of biotrol wheat. The tubes were inspected at various intervals and the biotrol wheat weighed. Table XVI shows the intake of biotrol wheat during the following 36 days. On 31 May 1968 the bamboo tubes were replaced by traps and inspected next day. No rats were caught.

TABLE XVI

Biotrol intake by rats, Church property, Vao

Date	Total No. of tubes	No. of Tubes Untouched	No. of Tubes Biotrol taken	Weight of biotrol taken gms	Interval days	Intake grams/ day
				grams		
29.4.68	81	68	13	1219	3	406
30.4.68	79	68	10	184	1	184
1.5.68	79	70	9	170	1	170
2.5.68	78	74	4	99	1	99
3.5.68	79	66	13	233	1	233
4.5.68	79	66	13	163	1	163
7.5.68	78	32	46	943	4	236
11.5.68	77	58	19	255	4	64
20.5.68	78	59	19	262	9	29
31.5.68	70	2	68	2934	11	265
Total		563	294	6462	36	849

(c) Nailed Cardga

It was suggested that hard coral soil prevents burrowing by rats and thus perhaps allows predation by crabs on baby rats. Cover may therefore be an important factor in rat distribution in the Tokelau atolls. This would particularly apply to the Church property in Vao where there is little trash that would provide rats with shelter. An instance of a substantial local rat population connected with favourable and ample cover was provided by trapping a small (about 12 x 12 m) garden surrounded by a one metre high wall of coral rubble. This garden was at the entrance to Church property. As the Sisters could not grow vegetables because rats were taking flowers of pumpkin (Cucurbita spp.) twelve snap-traps were set for three days. They yielded 15 rats and within a week there was a marked change in the growth of pumpkins and other vegetables.

2. Acute Poison - Zinc Phosphide

The results of several trials with sodium fluoroacetate (1080) during the first survey were unsatisfactory (Kodzicki 1968), and no further trials were undertaken during the present survey. In the meantime, information from the Gilbert and Ellice Islands Colony (Mr J.J. Smith in litt.) suggested that another acute poison - zinc phosphide may be suitable for rodent control in atoll conditions. Among its advantages are: its smell which is unpleasant to humans but attractive to rats, a fairly swift action of the poison allowing to find poisoned rats, and finally its low price in comparison to anticoagulants. Zinc phosphide was among the supply of poisons provided for us by the Vector Biology and Control Division, World Health Organization, Geneva, but was unfortunately not delivered when we sailed from Apia in the M.V. Aoniu on 10 April 1968. The poison with other supplies, arrived on H.M.N.Z.S. Endeavour two days before our departure from Nukunonu. The zinc phosphide was given to the three Doctors supervising rat work in the Tokelaus with an instruction to test its efficacy on some of the islets of the three atolls showing considerable rat damage to coconuts. It was decided to follow Mr Smith's procedure by prebaiting with an ounce of grated coconut under every third tree for three days, followed by poison baits, again one ounce of poison bait under every third tree, left for three days.

Detailed reports of poisoning with zinc phosphide have not arrived at the time of the compilation of this report. However, letters briefly describing the poisoning are to hand and will be briefly quoted: on Atafu atoll Dr Lutu Elia reported that although "no rats have been seen on the ground, foul smell on the third day may indicate dead rats" and "fewer rats have been seen on the islet". Grated coconut and boiled fish were used as bait. Dr Hopati Logologo, Nukunonu atoll, made the following comments: "We have carried out poisoning with zinc phosphide at Helakeke and Punalei, the results were marvellous. As shown by the reduction of rat damage to green nuts - nil after 4 and 6 weeks." Finally, Dr Iona Tiniela, Fakaofo reports that he plans to poison four islets, but at the time of writing (31 August 1968) only Teoki islet was poisoned "and it was a very successful trial, we did at that island, there are any more rats on this island. We put up some baits and rat traps" ... "but no sign of rats, we are hoping to visit again Teoki to make sure there are no more rats alive on this island".

Pending detailed reports it would appear from the above comments on zinc phosphide poisoning that this poison in grated coconut bait is as acceptable to rats in the Tokelaus as it is in the Gilbert and Ellice Islands.

3. "Rat Houses"

"Rat houses" or fale kimos were originally devised and widely used in rat control by islanders in the British Solomon Island

Protectorate. Essentially they are composed of two parts. A box 50-70 cm square, standing on 15-20 cm stilts, with a floor of coconut fronds stems and walls mainly made of Pandanus leaves. The box has an entrance, say of 12-18 cm square on one side. A detachable roof made of sticks and Pandanus leaves may have an apex of tin. With the materials available in the Solomon Islands a skilled worker may build a couple of fale kimos a day and it is reported that "rat houses" last about a year in the humid climate of the Solomon Islands.

Half a dozen fale kimos were built by our ratcatcher students during the present survey and some experimenting was done. It was confirmed that "rat houses" are attractive to rats which seem to congregate from larger distances than for baited snap-traps. "Rat houses" were also useful for controlling rats by the use of tracking powders laid between the bait and the "door". There is also little, if any, disturbance by crabs and lizards. It is regretted that pressure of other work prevented us from a detailed study of this device, new to rat control on atolls. Its main use may be replacement of snap-trap lines and it is possible that a dozen of fale kimos would replace two lines of two dozen snap-traps.

4. Operation Village

Since the beginning of the "workshop" at Nukunonu, complaints about rat nuisance were reaching the writer from the village. We were told of bags of food being attacked and spoiled by rats, clothing being damaged and rats being often seen running during the day along the beams of the fales. It was felt that as the poisons for the workshop were donated by the World Health Organization in Geneva, we should make an attempt to clear the village of rats. Also, it was thought that conducting such a large rat control operation would be a useful experience for the six ratcatcher students.

The method of rat control used was simple: four, in larger fales more, snap-traps were nailed in the middle of the beams and set for several days until at a morning inspection there were no more rats caught. At this stage, aluminium tubes about 30 cm (20 inch) long and 8-9 cm (3-4 inch) replaced the traps and were also nailed. The middle of each tube contained a sample of biotrol cake or biotrol wheat, and on both ends of tubes there was a small quantity of Sorexa Master Mix, an anticoagulant in the form of powder. It was thought that any "trap-shy" rats still living in or visiting the fale would be poisoned by either eating biotrol or by grooming their feet upon walking upon Sorexa, used here as a tracking powder.

Initially six fale were trapped between May 2 and 14, each of the houses being the responsibility of one ratcatcher student. Soon it was found that the work was proceeding smoothly and Teomi Basileo was appointed leader of a team of 3-4 men and 30 or more snap-traps were operated daily. The catch in each fale was recorded separately and the traps were inspected and reset daily in the morning.

The Nukunonu Village is situated on the south-east side of the church and consists of two separate parts: the main village and Motusaga (Fig. 2). The first is the densely populated main village with fales on both sides of four main streets running from the church to the sea arm separating Vao or the Village islet from Motusaga. A few houses, the hospital and some of the cook houses are irregularly set outside the main block of houses on the edge of the lagoon. As the result of the prevailing easterlies, the majority of the cook houses, the copra store and the meeting house are on the seaside of the main village. There are 144 houses in the main village including 29 cook houses. Motusaga is a small islet connected by a bridge over a shallow sea arm with the main village. There are 23 fales and 10 cooking house in Motusaga, the majority of the dwellings being situated on the lagoon side of the islet. The main difference between the main village and Motusaga consists in the scattering of the 23 houses on Motusaga among coconuts and scrub in comparison to the neat and close setting of the houses along the streets of the main village.

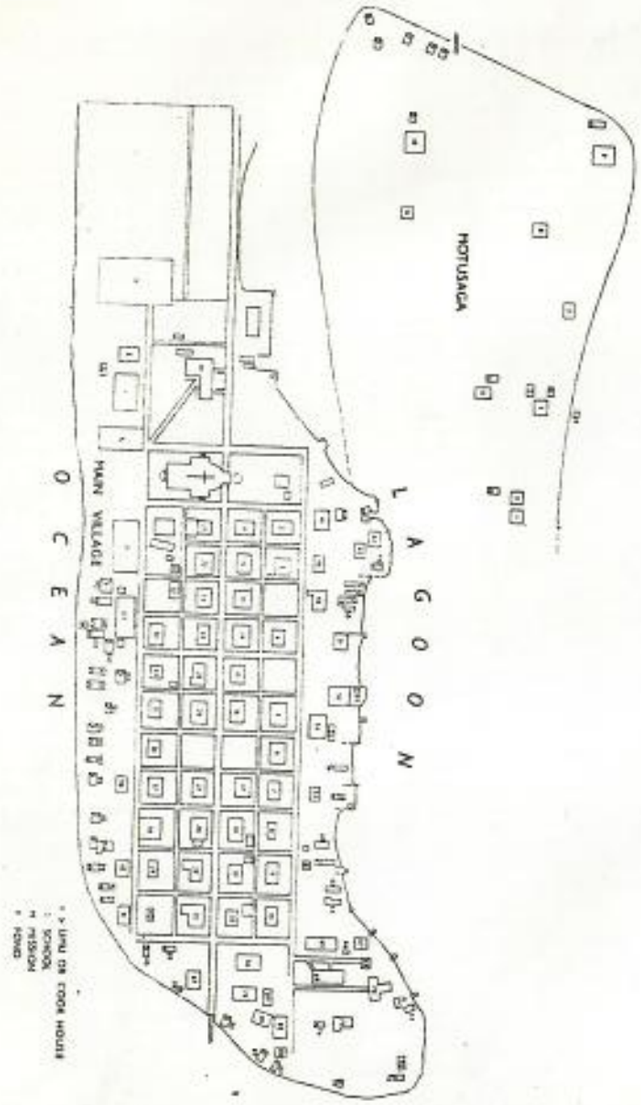

Fig.2 The main village and Motusaga, Nukunonu atoll.

The trapping of Nukunonu Village took place between 2 May and 11 June 1968 and Table XVII shows the sequence of trap setting and the results obtained.

TABLE XVII

Results of trapping in Nukunonu Village

Date	No. of Houses Trapped	No. of Traps Used	Days of Trapping 1	2	3	4	5	6	Total Rats Trapped	Rats/ House
Main Village										
2-5 May	6	41	25	25	14	0			64	10.7
14-19 May	6	36	24	17	3	5	2	1	52	8.7
18-23 May	31	159	61	30	18	14	15	6	144	4.6
24-28 May	73	365	73	27	39	15	29		193	2.6
Total Main Village		597	183	109	74	34	46	7	453	4.0
Motusaga										
6-10 June	23	115	37	30	22	18	16		123	5.3
Grand Total		682	220	139	96	52	62	7	576	4.1

As can be seen from Table XVII the shortage of time we had for rat trapping of the village prevented us from continuing the setting of traps until such time when no more rats would be trapped. The grand total of 576 rats trapped in both parts of the Nukunonu Village would be probably nearer or would probably exceed 600 if more time was available. However, the total of actually trapped rats is more than one rat per head of the Nukunonu Village population.

The difference between the number of rats trapped per dwelling in the main village and that in Motusaga is probably significant because the dwellings nearer the coconut grove of the Church property in Yeo also provided larger numbers of rats; in fact, one fale outside the main village and close to the Church plantation yielded a record number of 34 rats. Motusaga has, as already mentioned a fair amount of scrub and it is likely that the dwellings there will be sooner re-infested than in the main village.

It would be of considerable interest to know when Nukunonu Village will become rat-infested again. A report from Dr Ropati Logologo of 31 August 1968, i.e. about 3 months after the completion of "Operation Village" states: "Rat infestation in the village remains scarce".

5. Biological Control

The problem of biological control of rats in Pacific Islands in the light of recent proposals to introduce the Japanese weasel (Mustela sibirica itatsi Temminck and Schlegel) was discussed in some detail in the first report (Wodzicki 1968). It was concluded that a thorough investigation should precede the liberation of this carnivore.

From observation of rat sign and reports of the islanders it was found that there was no change in numbers of feral cats on Long Motu since 1955/62. There were also no changes in the numbers of rat-damaged coconuts that would indicate a decrease in rat numbers.

The cats in the village appeared as before emaciated and in poor condition. Judging by the results of "Operation Village" described above, they had little effect on the rat population in the village.

III. TRAINING OF RAT CONTROL OPERATIVES

It is the writer's considered opinion that, if the results of current research on coconut palm productivity and rat damage (see p. 9) would recommend rat control this would have to be carried out more or less permanently. Also, whether direct or indirect control methods would be recommended, control would have to be performed by sufficiently skilled trained personnel. The coconut palm banding on Nukunonu atoll which, as already stated (Wodzicki 1968), was applied without expert advice and in fact does not prevent rat damage to nuts, strengthens the case for fully trained personnel.

I am indebted to the Tokelau Islands Administration for bringing Messrs M. Foliga and Vaopuka from Fakaofo, Tepine and Kili Basilee from Nukunonu formed the workshop's rat operatives class. from Atafu to Nukunonu. These men with Alomoa Isaia and Teoni The workshop consisted of twelve lectures on rat biology and control and most of the days were filled with practical work during which the participants gradually learned the application of all more important rodent control methods that could be applied in the Tokelau Islands. On 4 June 1968, a one-hour examination with half a dozen questions on rat biology and control in Tokelau language was prepared for the workshop's participants. All members of the class passed in the following order: Tepine, Teoni, Foliga, Vaopuka, Isaia and Kili. It would not have been possible to complete the course successfully without the kind assistance of Dr Ropati Logologo, both in interpreting during the course and also helping in various ways in the field.

The follow-up scheme described in the report and submitted to the Tokelau Islands Administration would not have been possible without the assistance of Dr Iona Tiniela, Fakaofo, Dr Ropati Logologo, Nukunonu and Dr Iuta Elia, Atafu, who kindly agreed to supervise the rat control and survey work on their respective atolls during the remaining 11 months.

IV. RAT AUTOPSIES AND ESTIMATION OF RAT POPULATIONS

RAT AUTOPSIES

As already reported (Wodzicki 1968) the knowledge of the reproductive cycle and fecundity, ecto- and endoparasites and the age structure of rat populations, apart of its intrinsic value for basic research, is also directly relevant to planning of rat control.

The 534 rats dissected during the first expedition were obtained between the end of November 1966 and the end of February 1967. During the second expedition additional 260 rats, killed between the end of April and the first week of June 1968 bring the total number of autopsies to 794. As expected, all rats collected this year are Polynesian rats (Rattus exulans).

The Tokelau Islands Administration, realising the importance of the knowledge of the whole annual, reproductive cycle agreed to have a collection of 50 rats a month made on each of the three atolls betw. June 1968 and April 1969. It is hoped that this

this representative material will allow to obtain a good picture of the annual reproductivity cycle and also will portray any differences in reproduction and other aspects of rat ecology that may exist between the three atolls.

Since the publication of the first report, it was possible to discover five stages in molar teeth wear which are attributed to age. At the first stage molar wear is insignificant and body weight indicates very young animals. The significance of the other stages of molar teeth wear will remain unknown until we will obtain sufficient rats of known age.

Information on taxonomy, reproduction, parasites and age of the 794 rats autopsied so far, was placed on punched cards. It is proposed that next year a computer programme will be prepared (with the assistance of the Applied Mathematics Division, D.S.I.R.) to study the results statistically.

A brief visit to Faleolupo, Savai'i, Western Samoa at Rev. Father Peter Kmuga's, S.M. invitation (Appendix I) enabled the collection of a sample of the three rat species (Rattus exulans, R. rattus and R. norvegicus) in one locality. This material, together with the parasitological material collected this year at Nukunonu was handed to the Department of Zoology, Victoria University of Wellington for a study of Tokelau Islands rat parasites. This study is the object of an Honours' thesis and the comparison of the parasite burden of R. exulans in the Tokelaus with that of Faleolupo where the Polynesian rat may be carrying additional parasites acquired from the two other, world-wide rat species, will be of great interest.

RAT POPULATION STUDY

Other commitments during our seven and a half weeks sojourn at Nukunonu allowed for only one short-term population study.

Description of the site

Our experiment was based on the same one acre region as the Nukunonu West population study in February 1967 (Wodzicki 1968). This site is situated on Church property, near the north-west tip of Vao or Village Motu. It also coincided with our Quadrat III and Table IX compares the vegetation of this region with that of the two other quadrats, set on Vao. The mean density of trees and shrubs in this region is higher than on the remaining quadrats, south-east from this site. The 95 trees growing among 91 tall and low palms include 24 fala (Pandanus spp.), 24 puapua (Guetteria speciosa), 30 pukavaka (Hernandia peltata) and 17 kanava (Cordia subcordata). This gives a density of approximately 181 trees per acre or about 450 per ha. The forest floor contains ferns leu maile (Thymatodes scolopendria) and leu mea (Asplenium nidus) in addition to seedlings of puapua, gasu (Scaevola taccada) and nonu (Boerhavia tetrandra).

This part of Vao is about 1.2 km from Nukunonu Village and is only rarely visited. It serves as roosting and probably nesting place of akiaki (Gygis alba) and gogo (Anous stolidus). Some pigs belonging to the Convent, roam through this part of Vao because a wire fence prevents them from moving towards the village. Pigs were occasionally a nuisance as they upset live-traps from time to time.

Live rats were frequently observed singly or in pairs, particularly in the afternoon. On one occasion, in the middle of the afternoon at least a dozen rats were observed moving across the experimental area at one time. It would appear from these observations that more rats were being seen during our present stay than in January-February 1967.

Table V shows the numbers of coconuts counted on Quadrat III which coincided with the live-trapping area: the number of rat-damaged nuts on the floor of the forest is equally insignificant as on Quadrats I and II, set on Vao islet between Quadrat III and the village.

Experimental Procedure

The experimental procedure in catching and marking rats was similar to that used in 1967 (Wodzicki 1968). Chauvancy traps (Petter 1963) were used, baited with fresh coconut cubes and usually visited twice a day. However, instead of the ten traps in five rows used in the first experiment, in February 1967, sixteen traps were placed in four rows of four traps each; except on the 17th day of trapping, when only 14 traps were operated. The 1968 experiment lasted 17 days instead of the 15 days in 1967.

Results

Table XVIII records the numbers of unmarked and marked rats caught and released during the 17 days between 26 April and 16 May 1968. Other urgent work done outside the village area prevented us from setting and visiting the traps on 5 and 12 May.

Figure 3 compares the numbers of rats caught and marked for the first time and numbers of recaptures on each of the 15 days in the 1967 and 17 days in the 1968 experiment.

In 1967 large numbers of rats were caught and marked in the first three days of the experiment, averaging 10.7 rats per day. During the next five days an average of 4.2 rats were caught and marked but during the last 8 days of this experiment only four new rats were caught and marked altogether and the average number of recaptures in this period was 1.4 rats per day.

The capture-mark-recapture experiment repeated in 1968 under essentially identical conditions gave a markedly different capture and recapture pattern: during the first 8 days an average of 8.1 rats were caught and marked and, contrary to the 1967 experiment, new rats continued to be caught until the last day at a rate of 3.1 rats a day. With regard to recaptures only relatively few marked rats were recaptured during the first seven days - an average of 2.6 rats a day but from the 8th day to the end of the experiment there was a steady number of recaptures of 6.5 per day. The population estimate obtained from the 1968 experiment was, however, acceptably consistent with that obtained in the 1967 experiment in view of expected population growth.

TABLE XVIII

SUMMARY OF THE CAPTURE-RECAPTURE TRIAL ON NUKUNONU WEST, 1968

DAY	1			2			3			4			5			6			7			8			9		
DATE AND	APRIL 26th			27th			28th			29th			30th			MAY 1st			2nd			3rd			4th		
TIME	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T
RATS MARKED	-	15	15	2	3	5	-	5	5	-	7	7	5	7	12	0	3	3	10	-	10	4	4	8	3	-	3
MARKED RATS RETRAPPED		Nil		1	3	4	-	2	2	-	1	1	3	2	5	3	2	5	1	-	1	6	2	8	5	-	5
TOTAL	-	15	15	3	6	9	-	7	7	-	8	8	8	9	17	3	5	8	11	-	11	10	6	16	8	-	8
REMARKS				3 unmarked rats escaped, 1 died while being marked			1 rat escaped unmarked			1 rat escaped by chewing a hole																	

DAY	10			11			12			13			14			15			16			17			Grand Total		
DATE AND	MAY 6th			7th			8th			9th			11th			13th			14th			15th					
TIME	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T	M	AFT	T
RATS MARKED	-	4	4	1	4	5	4	0	4	3	-	3	1	-	1	2	-	2	1	4	5	1	-	1	37	56	93
MARKED RATS RETRAPPED	-	5	5	4	4	8	4	3	7	7	-	7	5	-	5	5	-	5	4	5	9	6	-	6	54	29	83
TOTAL	-	9	9	5	8	13	8	3	11	10	-	10	6	-	6	7	-	7	5	9	14	7	-	7	91	85	176
REMARKS																			1 rat escaped during marking			Only 14 traps operated					

M - Morning, AFT - Afternoon, T. - Total

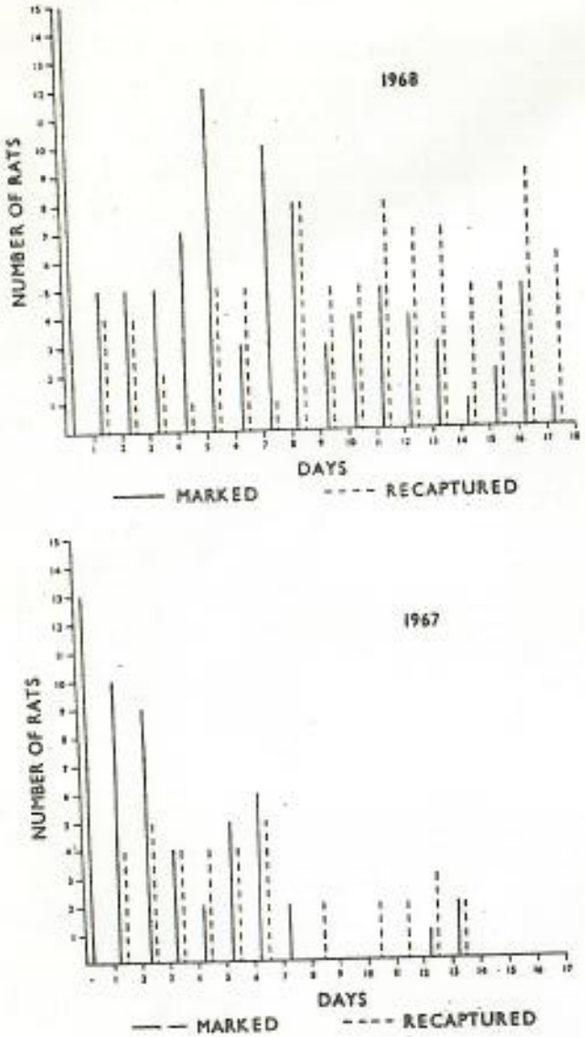

Fig. 3. Graphs showing the numbers of rats marked and recaptured in 1967 and 1968 on the same one acre region, Church property, Vao islet, Nukunonu atoll. Missing columns indicate that no rat was marked or recaptured on that day.

One could argue that in the 1967 experiment the majority of the rat population had been caught and marked at least once by the 9th day and perhaps subsequently displayed a certain trap-shyness. In the 1968 experiment, however, the opposite took place: new rats were caught and marked until the last day of the experiment and recaptures actually began to increase in the latter half of this experiment. It is possible that some of the rats may by then have become "addicted" to traps. One thing seems certain: the 1968 rat population exceeded the 1967 fairly considerably.

The above data were analysed by Mr Theo J. Smit, Applied Mathematics Division, D.S.I.R. Table XIX summarises the results of Mr Smit's analysis and also includes population estimates obtained with the same capture-mark-recapture method for comparison. Three sampling regions, Motuakea, Tepuka North and Fogalaki-Matagi are islets, but Nukunonu West, Vao and Avalau, Long Motu are parts of larger islets.

TABLE XIX

Rat Population Estimates in Five Sampling Regions in 1967 and 1968

	Nukunonu Atoll					Atafu Atoll
Name of Sampling Region	Avalau Long Motu 1967	Tepuka North 1967	Motuakea 1967	Nukunonu West Vao 1967	Nukunonu West Vao 1968	Fogalaki Matagi 1967
Population Estimate N	17.2	25.3	36	73.9	116.5	31.9
Standard Error SE (N)	1.0	4.1	7.4	7.7	7.3	2.4

The results of the analysis as shown in Table XIX confirm the 1967 findings (Wodzicki 1968) and lead to the following conclusions: i. As the areas of the five sampling regions were roughly the same there is a considerable diversity in the density of rat populations in various islets of Nukunonu and probably in the remaining two atolls. In 1967 the differences in the density of rat populations were in the order of a ratio of 1:5. ii. The rat populations on Nukunonu are far from being stable as shown by a nearly 50% increase of the Vao population in 14 months between February 1967 and April-May 1968.

PLANT AND INVERTEBRATES COLLECTIONS

The willing assistance of the six ratcatcher students and particularly the help of Alowha Iasia largely contributed to further extensive collections of plants and invertebrates.

The plant collection was presented to the National Herbarium maintained by the Botany Division, Department of Scientific and Industrial Research at Lincoln. Mr B.E.V. Parham, O.B.E., of the Botany Division, examined the collection and supplied (in litt. 2.9.1968) the following comment: "The second collection (1968) has brought to record 7 additional plant species: fungi 3, dicotyledons 3 and monocotyledons 1, and includes two species not previously listed for the Group." The vegetation of the Tokelaus

comprises now with the above additions 167 vascular plant species including 45 adventive weeds and grasses and 75 cultivated plants, with an, as yet, unknown number of non-vascular plants".

The invertebrate collection, mainly insects, was donated to the Dominion Museum in Wellington. At the time of the compilation of the present report, it is being curated by Mr Ron Orlish, Entomologist, Dominion Museum. It is likely that this collection will also contain a few species not previously listed for the Tokelaus.

DISCUSSION

The follow-up survey rat survey of the Tokelaus primarily aimed at obtaining a more accurate assessment of the economic relationships between man and rat, further testing of control methods suitable for rodents in atoll conditions and training of rat control operatives. Any remaining time during the seven odd weeks in the Tokelaus was devoted to the collection of information and specimens of other biota and to an experiment on estimation of rat population in Nukunonu atoll conditions.

Rat Damage and Coconut Productivity

There is little factual information on rat damage to coconuts in the Pacific. The PIRATE workers (Strecker in Storer 1962) were the first to point out the difference between high and low islands and stated that rat damage occurs much more commonly on atolls than on volcanic islands. Smith (1967) reviewed the occurrence of rat damage in the Pacific, Indian Ocean islands and in the West Indies. Like other workers including the writer (Wodzicki 1965), Smith calculated the loss of copra due to rats as percentage of rat-damaged nuts found on the forest floor. This procedure, as it was pointed out to the writer by some critically minded readers of his report, may not be justified as some green coconuts may be among those nuts that may be shed by the palm anyway.

In the Tokelaus the estimation of rat damage is further complicated by the lack of information on the average palm productivity on coral sand soils with little if any, humus, in atoll conditions. Theoretically, the situation may arise that with a very low palm productivity, any control scheme may be as expensive as the revenue from a very low yield of the annual coconut crop.

The 21 quadrats established by the writer during his second visit, together with records of coconuts on over sixty marked trees, should provide during twelve months sufficient information for a reasonably accurate estimate of coconut productivity and the occurrence of rat damage throughout a year. With the approval of the Tokelau Islands Administration similar numbers of quadrats and of marked trees were later established on Fakaofo and Atafu atolls. These quadrats and marked trees should provide in twelve months time information not only on palm productivity and rat damage, but also additional information on any differences in palm productivity and rat damage between the three atolls.

While we have to wait several months until a twelve months period of observations on coconut productivity and occurrence of rat damage is completed, a few interesting facts already emerged from the first nut counts obtained during the present survey.

Observations carried out during the second survey confirmed those obtained in 1966/67 (Wodzicki 1968) that all rat damage to coconuts occurs on the palm and not on the ground. Smith and Romney (1963) simulating rat damage by piercing the husk of the nut with a cork-borer, showed "that all such damaged nuts fell from the palm in four to twelve days".

The most striking feature of our follow-up survey was the occurrence of rat damage of a similar intensity in the same groups of islets as during the 1966/67 survey. Similarly, the Church property plantation in Nac was equally devoid of rat damage as it was in 1966/67.

The present survey also revealed some differences between the various zones and in the yield of coconuts in various parts of the Nukunonu atoll. More observations which are now being carried out are necessary for a better understanding of these and other developments.

The first observations carried out on marked trees in the quadrats showed that coconut palms on all islets are old and that there are probably differences in coconut productivity between the various groups of islets. However, most striking are the results of a comparison of the density of mature and immature coconut palms and of other trees in the Nukunonu groves with the palm density in the well-kept W.S.S.T.E.C. plantations in Western Samoa. Apart from the crowding of palms we find on the coral sand soil of Nukunonu substantial numbers of other trees and an abundant and varied undergrowth on the groves' floor, which must influence coconut productivity.

Other observations carried out on the marked palms showed that contrary to opinions expressed by various authors (e.g. by Strecker in Storer 1962) Rattus exulans is building nests and is damaging green coconuts in the palm crowns. Observations on the incidence of Oryctes rhinoceros at Nukunonu, as shown in the marked palms will, after 12 months be compared with those in other islands infested by the beetle.

Rat Control Trials

Trials of anticoagulant and acute poisons carried out during the present survey were compared with those carried out during the first survey (Wodzicki 1965) and experiments of Smith (1968) in the Gilbert and Ellice Islands. The efficacy of anticoagulants (bictrol, sorexa master mix and prolin) in Nukunonu atoll conditions was confirmed. Trials with 2% zinc phosphide were, for reasons independent of the writer, carried out after his departure from the Tokelau Islands. The preliminary reports received since from the three atolls seem to confirm Mr Smith's findings that zinc phosphide together with the anticoagulants are rat poisons suitable for atolls in the Central Pacific. The much cheaper cost of zinc phosphide (according to Mr Smith 1/- per acre as against £1.16.0 for coagulants) would favour the use of zinc phosphide in coconut plantations and of anticoagulants in inhabited areas.

Rats are known to abound in villages in the Pacific. The PIRATE workers (Marshall in Storer 1962) found rodents in large numbers in villages on Ponape Island, Eastern Caroline Islands. Presence or absence of cats made no significant difference in trap success. In trapping two villages with 405 and 195 trap-nights indices of 20.2/100 and 20.5/100 were achieved. Smith (1968) reported that in five villages in the Gilbert and Ellice Islands Colony rats (R. rattus more common than R. exulans) can reach a serious level; and clothing, food and soap are attacked.

At Nukunonu 682 trap-nights gave a trap-night index of 119.4/100. Judging by reports reaching the writer nearly three months later, rats were still reported scarce, perhaps owing to the systematical procedure applied in clearing the village of rats and to the successful follow-up with anti-coagulant poisons.

Nukunonu "Workshop"

The Nukunonu "workshop" is the second course of that kind conducted in the Pacific - the first "workshop" was carried out in 1965 by F.A. Bianchi in Saipan, Mariana Islands, American Trust Territory. The great advantage of our workshop was due to the factual disappearance of the language barrier owing to the help given by Dr Hopati Logologo. It was found that towards the end of the six weeks course, each of the three two men teams were sufficiently well trained to carry out rat control and survey work with very little supervision.

Estimation of the Rat Population

Stroecker (in Storer 1962) using first-day captures and removal trapping found that on Ponape, Caroline Islands certain rat populations (e.g. those in the rain forest and coconut plantations) were stable, while populations in the grassland showed "evidence of some fluctuation" ... "for causes not apparent".

As used in our first rat survey the capture-recapture method modified by Mr Theo J. Smit, Applied Mathematics Division, D.S.I.R. and found that rat populations on Nukunonu atoll varied greatly from islet to islet. We were able to repeat one of those experiments on the same one acre region of the Church property, two islet fourteen months later. The results indicate a rat density about 50% higher than that in February 1967. However, despite these significantly higher changes in population density, there was on this islet, like in 1966/67 no damage to coconuts by rats.

CONCLUSIONS AND RECOMMENDATIONS

i. The follow-up survey confirmed that the Polynesian rat is the only rodent present in the Tokelau Islands. The importance of quarantine measures preventing other rodents from getting ashore is reiterated. It was reliably reported to the author that a mouse was recently seen in one of the prefabricated houses when it was assembled ashore. These measures should be combined with those preventing the dynastid beetle from spreading to the two other atolls. At present very little attention is being devoted to these two very important matters.

ii. The study of rat damage and coconut palm productivity, although based on one set of observations only, supplied valuable information on these two ecological aspects. For example, it was confirmed that at Nukunonu rat damage is local, i.e. rat damage is significant on some islets but not on others. It was also confirmed that rats nest on the palms and gnaw nuts on palms, not on the ground. It is, therefore, imperative that the fortnightly and monthly observations of quadrats and marked palms initiated by the author, be continued to obtain a twelve months set of observations.

iii. Considerable progress was made in screening control methods suitable for Tokelau atolls conditions. Zinc phosphide appears to be particularly suitable for coconut groves, and certain anticoagulants with or without snap-traps are recommended for villages and their vicinity, where acute poisons are not indicated. Pending the receipt of the reports on the zinc phosphide trials from the three Doctors supervising rat survey and control in the three atolls, a complete rat eradication of certain, particularly infested islets could be considered. However, such trials will have to be preceded by, and will depend on, the results of the studies mentioned in ii. above.

iv. It is hoped that on the termination of the survey work described in ii. above, there will be sufficient research material available for studies of rat reproduction, parasites and other important aspects of Tokelau rats bionomics. Such information, apart of its intrinsic interest would be important for long-term planning of rat control.

v. Work carried out during the present follow-up survey supports an important recommendation made on the completion of the 1966/67 survey (Wodzicki 1968) namely, that proper management of coconut palm groves may be the long-term answer to rat damage to coconuts.

ACKNOWLEDGEMENTS

This follow-up survey of the rat problem in the Tokelau Islands would not have been possible without the whole-hearted support the author received from Mr John R. Springford, Controlling Officer, Islands Division, Maori and Island Affairs Department, Mr Ian L. Baumgart, Assistant Director-General, D.S.I.R., Mr O.P. Gabites, former High Commissioner for New Zealand in Western Samoa and Administrator, Tokelau Islands and his successor Mr R.S. Taylor. Both Mr Gabites and Mr Taylor showed a continuous interest in the project and Mr Taylor approved the twelve months survey of coconut productivity and rat damage to be carried out in all three atolls; this survey should provide information that should help controlling rodents not only in the Tokelaus but also on other atolls. Mr H.L. Webber, Administration and Mr D.J. Clarke, Islands Division, Maori and Island Affairs Department were very helpful.

Mr Edwin H. Bryan Jr., Manager, Scientific Information Centre, Bernice P. Bishop Museum, Honolulu supplied important bibliographical information; he also personally attended to supplies and equipment to be loaded on H.M.N.Z.S. Endeavour at Pearl Harbour and brought to Nukunonu.

The interest and assistance in the follow-up survey given by the Vector Biology and Control Division, World Health Organisation in Geneva and by Dr Normal G. Gratz from above Division in supplying various rodenticides is gratefully acknowledged.

My thanks are due to Doctors Ioma Tinielu, Fakaofo, Ropati Logologo, Nukunonu and Iuta Elia, Atafu, for their interest and for taking over the supervision of the follow-up work during the next 11-12 months. Without Dr Ropati's help it would not have been possible to carry out the "workshop". Dr Ropati also placed his extensive local knowledge of Nukunonu and its traditions unreservedly at my disposal. Particular thanks are due to the participants of the "workshop" M. Poliga and Vaopuka, Tepine and Eili and Alowha Isaia and Teoni Basileo

for their enthusiasm and thoroughness shown in attending to their tasks during the whole "workshop" and for working long hours and on weekends, most of them far from their home and families.

The hospitality provided by Father Hansell, S.M., Sister M. Alfret and the other Missionary Sisters of the Society of Mary is gratefully acknowledged. Father Hansell was most obliging in the matter of transportating the members of the "workshop" to other islets in his "San Josefo". Thanks are also due to the Faipule and Elders in Nukunonu for their interest in the survey and for agreeing to certain restrictions in harvesting coconuts on the properties where quadrats were established.

The hospitality offered by Dr Ian Prior and the members of his unit allowed some work to be done on Atafu atoll on our return voyage and the Captain, the First lieutenant, Officers, Petty Officers and crew of H.N.Z.M.S. Endeavour were most obliging in the matter of returning the two Fakaofo members of the "workshop" to their homes and in transporting our gear and equipment to Apia, Niue Island and Auckland.

Last but not least liaison with E.J. Wilson, Rat Control Expert, South Pacific Commission, Noumea and F.J. Smith, Rodent Research Officer, Gilbert and Ellice Islands Colony, Tarawa, proved very useful. The author's attendance at the Asian-Pacific Rodent Control Interchange East-West Center, University of Hawaii, Honolulu, provided an opportunity of meeting many leading rodent research workers from the Pacific area.

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NOTES ON THE MOSQUITOS OF THE GILBERT, ELLICE AND TOKELAU ISLANDS, AND ON FILARIASIS IN THE LATTER GROUP.

BY

Marshall LAIRD

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NOTES ON THE MOSQUITOS OF THE GILBERT, ELLICE AND TOKELAU ISLANDS, AND ON FILARIASIS IN THE LATTER GROUP.[1]

By Marshall Laird.[2]

There are 25 islands, many of them atolls composed of a number of islets, in the Gilbert and Ellice Islands Colony—a Crown Colony under the administrative control of the High Commissioner for the Western Pacific. These islands lie between the parallels of 03°15′N. and 10°45′S. and the meridians of 172°30′E. and 179°52′E. The 16 northernmost ones, the Gilberts, form an arc across the Equator. They are, in effect, a bridge between Polynesia and Micronesia, the affinities of the Gilbertese themselves being largely Micronesian. The people of the nine southern islands, the Ellice Group, are Polynesians.

New Zealand administers the Tokelau Group, which is made up of three atolls inhabited by Polynesians. Lying out to the east of the Ellice Islands, these atolls are bounded by the latitudes of 08°30′S. and 09°28′S. and the longitudes of 171°12′W. and 172°32′W.

Filariasis occurs throughout the area in question, being of the non-periodic type in the Polynesian islands. There is a certain amount of evidence to suggest that in the Gilberts the nocturnally periodic type is present as well (Backhouse & Heydon, 1950). Elephantiasis is particularly prevalent in the northern Ellice Islands (O'Connor, 1923), but is rare elsewhere.

Only one species of mosquito, *Aëdes* (*Stegomyia*) *pseudoscutellaris* (Theo.), has been reported from the Tokelau Group (O'Connor, 1923). O'Connor also found this mosquito to be widespread in the Ellice Islands, and demonstrated it to be the vector of *Wuchereria* both there and in the Tokelau Group. Buxton recorded "*Aëdes variegatus* var. *pseudoscutellaris*" from all the islands of the Tokelau Group and from all those of the Ellice Group with the exception of Nurakita, which he did not visit; he thus felt, considering both the wide distribution and the limited flight-range of the species, that it was not a recent introduction (Buxton & Hopkins, 1927). Stating that "the eggs of this insect are resistant to drying, and that they are sometimes laid in canoes" Buxton thought it likely that Polynesians sailing up from Samoa had been responsible for the initial introduction, and that subsequent inter-island canoe voyagers had broadcast *pseudoscutellaris* within the two Groups. Davis (1949) suggested that the aquatic stages of this mosquito could have been carried in the drinking-water containers with which the former ocean-going canoes were equipped. It is worth noting that such hollowed-out wooden containers are still manufactured—although mostly for the tourist trade—by Ellice and Tokelau natives.

Young (1927) reported the prevalence of "*Stegomyia pseudoscutellaris*" in the Gilbert and Ellice Islands Colony. His record seems to have been intended to apply specifically to the Gilberts, as he had at that time visited all the Gilbert Islands although he had not been to the Ellice Group. Bohart & Ingram (1946) indicated that the representative of the *scutellaris* group occurring in the Gilberts is *Aëdes* (*Stegomyia*) *marshallensis* Stone & Bohart, 1944, basing this conclusion on material from the atolls of Tarawa and Abemama.

[1] These studies form part of a project initiated by the Royal New Zealand Air Force and supported by a grant from the N.Z. Department of Scientific and Industrial Research. Their publication is authorised by the Chief of Air Staff, RNZAF.

[2] Medical Branch, RNZAF. Now at Department of Parasitology, University of Malaya.

It was demonstrated by Marks (1951) that Theobald's *Aëdes pseudoscutellaris* is actually confined to Fiji. She described the widely distributed vector of *Wuchereria* in Polynesia as a new species, *A.* (*Stegomyia*) *polynesiensis*. However, having no material from the Ellice and Tokelau Islands, she was unable to state definitely that the representative of the *scutellaris* group found there is in fact *A. polynesiensis*.

O'Connor (1923) found only one other species of mosquito in the Ellice Group. This, which he referred to as "*Culex jepsoni*", was subsequently recognised as *C.* (*Culex*) *annulirostris* Skuse by Edwards (1924). Although O'Connor reported this species from five of the Ellice Islands, Buxton found it at Funafuti only. The latter author was of the opinion that drought was the probable cause of his not securing *C. annulirostris* on other islands of the Group (Buxton & Hopkins, 1927).

Culex (*Culex*) *pipiens fatigans* Wied. was collected by the District Officer, Tarawa, in 1925 (Buxton & Hopkins, 1927). These authors also identified examples of *Aëdes* (*Stegomyia*) *aegypti* (L.) from Tarawa. Both domestic species were listed from the Gilberts by Young (1927) and in subsequent Annual Medical and Sanitary Reports of the Colony. Buxton & Hopkins considered that at the time of their researches both *C. p. fatigans* and *A. aegypti* were still absent from all the islands of the Ellice and Tokelau Groups. Twenty years later, however, the latter species had become established at Nanumea, the most northerly atoll of the Ellice Islands (Venner, 1944). Brygoo (1953) indicated the occurrence of *C. p. fatigans* as well as *A. aegypti* in the Ellice Group (his Tables "A" and "C"), but quoted no authority for his information. As he omitted to list "*pseudoscutellaris*" from the Ellice Group in his Table "A", and his paper contains other inaccuracies such as the statements that *C. annulirostris* is absent from New Caledonia (where this species is common—Perry, 1950; Laird, 1954) and that *Aëdes* (*Stegomyia*) *tongae* Edw. is restricted to Tonga (it has been known from Sikaiana, Solomon Islands, for more than a quarter of a century—Edwards, 1926) Brygoo's record should be treated with reservation.

Finally, Buxton collected *Aëdes* (*Aëdimorphus*) *vexans* (Mg.) on the islands of Nui and Niutao in the Ellice Group (Buxton & Hopkins, 1927). It should be noted that Brygoo (1953) overlooked this record also. I cannot trace any record of *A. vexans* from the Gilberts, although Bohart & Ingram (1946) reported it from Ebon Atoll (Marshall Islands) to the north-west of the former Group.

It was stated in a U.S. Army Air Force wartime manual on tropical diseases (unpublished, 1944) that "*Aëdes kochi* is not found in the Fiji, Ellice, Cook and Phoenix Islands. In the Gilbert (Tarawa), Tokelau and Society Islands it breeds in coconut husks and other small collections of water". This is inaccurate. Apart from the fact that a representative of the *kochi* group does occur in Fiji—*Aëdes* (*Finlaya*) *fijiensis* Marks—*Finlaya* is unknown in the area under consideration (Stone & Bohart, 1944; Marks, 1947). The most easterly species of the *kochi* group is *A.* (*Finlaya*) *samoanus* (Grünb.), which occurs in Samoa and Tonga (Buxton & Hopkins, 1927). Larvae of *A. samoanus* are most frequently found in the water which collects in the leaf axils of certain species of taro (*Colocasia* and *Alocasia* spp.). Buxton & Hopkins drew particular attention to the absence of this species from the Ellice Islands, putting forward in explanation the facts that the brackish subsoil of these islands does not lend itself to the cultivation of the better types of taro and that the round-stem taro grown there does not hold water.

Discarding unsubstantiated records, then, the picture of mosquito distribution in the Gilbert, Ellice and Tokelau Islands presented by the literature is shown in Table I.

From time to time, flying boats of No. 5 Squadron, RNZAF, visit the Tokelau Group, Tarawa and Funafuti from Lauthala Bay, Fiji. The opportunity thus

presented itself to collect material at each of these places in the course of routine flights. Although all the calls were brief ones, only a day being spent at Nukunono (Tokelau Group) and a similar period at Tarawa and at Funafuti, it is considered that the results achieved warrant publication.

TABLE I.

Species	Occurrence		
	Gilbert Is.	Ellice Is.	Tokelau Is.
A. aegypti	×	×	—
A. polynesiensis	—	×	×
A. marshallensis	×	—	—
A. vexans	—	×	—
C. annulirostris	—	×	—
C. pipiens fatigans	×	—	—

TOKELAU GROUP.

A landing was made at Atafu on the afternoon of 15th June 1953, and a brief visit was paid to the village islet. Two collections of *scutellaris*-group larvae were made there, both of them from 44-gallon drums filled with rain-water of pH 7·0 and pH 6·4 at a temperature of 28°C. Ill-fitting wooden covers were present in both cases, and the drums were in the immediate vicinity of houses.

The aircraft reached Nukunono (09°10′S., 171°47′W.) later that afternoon. The population of this atoll at the last census was 452—226 males and 226 females. Thanks to the good offices of Father A. MacDonald and Sister Kasarina, who are stationed at Nukunono, 97 of these people, their ages ranging from 5 to 78, presented themselves for blood sampling. A single thick film was taken from the tip of the index finger of each individual, the survey being made between 1910 hr. and 2025 hr. on the evening of 15th June. The films were subsequently dehaemoglobinised and stained with Giemsa in the usual fashion. All those concerned had dwelt on the atoll for all, or for the greater part of, their lives.

The data obtained were inadequate for the estimation of any relationship between age and microfilaria concentration. Ten or more microfilariae were counted in the thick films from six individuals whose ages were 22, 25, 32, 34, 39 and 42 years. The heaviest concentration was noted for a man 34 years old, 30 microfilariae being present in his film.

In 1920, O'Connor examined 27 males, all over 16 years of age, at Nukunono. Four of these had microfilariae without clinical filariasis, one had both clinical filariasis and microfilariae and one had clinical filariasis alone. The microfilaria rate for this group was thus 18·5 per cent., while the overall percentage of infection was 22·2 per cent.

During the present survey, 28 males of over 16 years of age were examined (no notes on clinical filariasis being taken). Twelve of these exhibited microfilariae, the microfilaria rate thus being 42·9 per cent. The rates for 10-year age groups ranged from 28·6 per cent. for the 20–29 group to a maximum of

66·7 per cent. for the 50–59 group (Table II). In this connection, it is worth noting that Murray (1948) recorded the maximum percentage of microfilaria carriers in the 50–54 age group in American Samoa.

The total number of males above 16 years of age was only one more than that dealt with by O'Connor, but the microfilaria rates for each 10-year age group, as

TABLE II.

Microfilaria rate, Nukunono.

Age of persons (years)	Males			Females		
	Number examined	Positive		Number examined	Positive	
		No.	%		No.	%
1 — 9	7	0	0	5	0	0
10 — 19	8	0	0	11	0	0
20 — 29	7	2	28·6	14	2	14·3
30 — 39	6	2	33·3	7	1	14·3
40 — 49	5	2	40·0	10	1	10·0
50 — 59	6	4	66·7	5	1	20·0
60 plus	4	2	50·0	2	0	0
Total	43	12	27·9	54	5	9·3

well as the overall rate, materially exceed the figure of 18·5 per cent. computed from the latter author's data. This might be due, at least in part, to a difference in techniques, for O'Connor based his conclusions on the examination of 20 cu. mm. of blood from each subject, and the volume of blood in the average thick drop is in excess of 20 cu. mm. Six of those examined in the present instance had relatively light infections, only one or two parasites being present in their films. Some or all of these infections might well have been overlooked had a smaller sample of blood been taken. Four of those concerned being men, the resultant microfilaria rate for males above 16 years of age could thus have been computed at 18·6 per cent.—a figure almost exactly comparable with O'Connor's. It cannot, therefore, be claimed that the microfilaria rate at Nukunono has increased since 1920, although the evidence now available indicates that this rate is higher than O'Connor estimated it to be.

Dr. J. S. Armstrong (Acting Director of Medical Services for Western Samoa at the time of this survey) informed me that two or three years ago he took 50 thick smears in the Tokelau Group, but that these, the only ones taken since O'Connor's visit, so deteriorated before staining as to be unsuitable for examination.

O'Connor examined more people at the other two atolls, Fakaofu and Atafu, than he did at Nukunono. Of a total of 330 individuals from all three atolls, 12 (of 85) under 16 years old and 90 (of 245) above that age showed evidence of infection. Only seven of those under 16 had microfilariae in their blood, the other five being what O'Connor called "doubtful cases of clinical filariasis". Of

the 90 above that age who showed signs of infection, 52 (of 145) were male and 38 (of 120) were female. However, 13 of the former and 22 of the latter were recorded as positive for filariasis on clinical grounds alone. Microfilariae were demonstrated for only 39 (26·9 per cent.) of the males and 16 (13·3 per cent.) of the females.

The microfilaria rate among Tokelau males is thus much higher than that among females, O'Connor's figures indicating a ratio of 2:1 and mine (Table II) one of 3:1. This is in accord with data available from American Samoa, where Murray (1948) found microfilariae in the blood of twice as many men as women above 20 years of age. It seems likely that this state of affairs is related, as previous authors have suggested, to the much greater amount of time which men spend working in the coconut plantations where the population of vector mosquitos of the *scutellaris* group is usually much greater than in the cleared ground about the villages where the women spend most of their time. Tokelau boys go regularly to the plantations (which are located on other islets than the village ones) from an early age. MacGregor (1937) stated: " Every family has a plantation of coconut trees on the atoll and usually some trees near the village. It is part of the young boys' work to keep the household supplied from these trees and to go with their fathers to the plantations two or three times a week and pick nuts."

Twelve larval habitats of mosquitos of the *scutellaris* group were located on 16th June. Seven of these were at Motusanga, a small islet covered with coconut palms at the southern end of the village islet, to which it is connected by a footbridge. The other five were on the village islet itself, this islet bearing the name of the atoll, Nukunono. Nine collections, five on Motusanga and four on Nukunono, were made at small reservoirs hollowed into the trunks of growing coconut palms (see O'Connor, 1923, Pl. IV, fig. 10; Buxton & Hopkins, 1927, Pl. XII, fig. A). Such tree reservoirs were formerly used to obtain drinking water, most of which is now stored in large concrete tanks. Thus the water in these cavities—at all events in those of them handy to the villages—is often allowed to lie untouched or is used by men returning from the lagoon, who dash it over themselves to wash away the salt. While six of the reservoirs examined teemed with larvae, three others, located near to the beach and thus in constant use, contained fewer larvae and many dead adults. Some of the latter were not fully free from the pupal pelt, and had apparently been knocked over in the act of emergence by mechanical disturbance of the water.

Two of the larval collections were made from rot-holes in a Puka tree (*Hernandia ovigera*) on Motusanga, while the remaining one was from water in the bottom of a beached canoe in the heart of Nukunono village. Adult males and females of the *scutellaris* group were found resting in the shaded upper parts of two of the tree reservoirs. A few females also emerged from some of the pupae collected. All the larvae collected at the atoll were typical of the *scutellaris* group, while the adults corresponded with the description of *Aëdes* (*Stegomyia*) *polynesiensis* Marks. Specimens were duly forwarded to Dr. Marks who confirmed my tentative identification (private communication, 1953).

The only other aquatic arthropods present in any of the mosquito breeding places were Ostracoda, discounting a crab, found at the bottom of one of the holes in the Puka tree, and identified as *Sesarma* sp., probably *rotundata* Hess, by Dr. C. H. Edmondson of the Bernice P. Bishop Museum, Honolulu. There were also a few Collembola on the surface film of some of the palm reservoirs. The hydrogen-ion content of the water in the last-named larval habitats ranged from 6·0 to 7·6 pH (av., 7·1), while that of the water in the Puka rot-holes was 6·8. In all cases the water temperature was much the same, varying from 26·25°C. to 27°C. The water in the beached canoe being very murky and of a deep yellow colour, a pH reading could not be taken by the only means

available, a Lovibond comparator. All the breeding places were shaded from sunlight, the tree cavities by the part of the trunk above them and the canoe by a pile of palm fronds.

Two hours were spent in a fruitless search for mosquito larvae along the rubbish-strewn edges of a seepage pond some 50 yards in length and 20 yards in width, on Motusanga (fig. 1). The water there was brackish to the taste, with a pH content of 8·4. It is considered that this pond could support such

Fig. 1.—Brackish seepage pond, Motusanga.

a brackish-water breeder as *Culex* (*Culex*) *sitiens* Wied. should an introduction ever take place—as well it might, *C. sitiens* being common in Samoa, whence comes most of the (sporadic) shipping which visits the Tokelau Group.

No coconut shells holding water and suitable as breeding places could be found on Nukunono, a tribute to the state of cleanliness in which the village and its surroundings are maintained. No larvae of *A. polynesiensis* were found in 44-gallon drums as at Atafu, and an examination of the water held in 50 leaf axils of *Pandanus* disclosed no aquatic arthropods whatsoever. Night-biting mosquitos were conspicuous by their absence, although *A. polynesiensis* was troublesome in shady places both at Motusanga and on the village islet during the day.

Tarawa, Gilbert Islands.

Mosquito collections were made at this atoll (01°30′N., 173°00′E.) on 27th January 1954. It was not practicable to undertake a blood-smear survey during the visit.

The domestic mosquitos, *Aëdes aegypti* and *Culex pipiens fatigans*, having already been recorded from Tarawa (p. 293), these were not searched for. Particular attention was paid to accumulations of surface water on the islets of Bairiki, Teaoraereke and Eita. The deep pits which the Gilbertese dig down to intersect the water table for the cultivation of their coarse taro or "babai" (*Cyrtosperma chamissonis*) proved of particular interest as larval habitats.

Larvae of *C. annulirostris* were found to be abundant on all three islets, being particularly common in the "babai" pits on Eita. There are some extensive pits on the latter islet, one of those examined measuring about 150 yd. by 100 yd.

and appearing to be an adapted natural swamp. During times of drought the seepage water in the "babai" pits is more or less brackish, but in the wet season—which was at its height at the time of this visit—so much rain-water is stored up that the resultant pools are all but fresh. The pH content of the water was found to vary between 7·2 and 8·0 (av., 7·4) at a temperature of 28°C. Larval Chironomids (identified by Dr. W. W. Wirth of the U.S. National Museum as *Tendipes* sp.) were usually present together with *C. annulirostris*, and the nymphs of Odonata (Anisoptera and Zygoptera) were always common. Great numbers of Collembola were noticed on the surface film of some small marginal pools. Other aquatic arthropods, notably Coleoptera and Hemiptera, appeared to be altogether lacking.

A brackish pond (pH 8·0 at 28°C.) near the beach at the eastern end of Teaoraereke supported huge numbers of the developmental stages of *C. annulirostris*. The entire surface of this pond, which measured 20 ft. by 15 ft., was literally black with larvae, despite the presence of large numbers of predators (dragonfly and damselfly nymphs). The species was also collected from flooded crab burrows. Adults of *C. annulirostris* were troublesome by night in the European houses on Bairiki.

One of the shallow pools in a rather dry "babai" pit on Bairiki proved to contain a few fully developed larvae of *Aëdes* (*Aëdimorphus*) *vexans nocturnus* (Theo.). Bohart & Ingram (1946) stated that larvae of the typical *A. vexans* (Mg.) have head hair B with two branches and C with three to five branches, whereas larvae from Australasia and the Philippines have B single and C single or double. On these grounds the Pacific representative of *A. vexans* was distinguished as *A. vexans nocturnus*. All the Tarawa examples seen have head hairs B and C both single, and are thus referred to this subspecies. No adults were collected.

A. marshallensis was common everywhere. Larvae abounded in the husks which littered the plantations, and imagines were a pest during the day-time in any shady patches of vegetation, particularly on Teaoraereke. The small pockets of water in 20 leaf axils of *Pandanus* were carefully searched for mosquito larvae, but as at Nukunono no arthropods of any kind were found.

Funafuti, Ellice Islands.

The afternoon of 29th January and the morning of the 30th were spent at Funafuti (08°28′S., 179°08′E.) on the way back to Fiji from Tarawa. As in the case of the latter atoll no blood-smears were made.

Collecting was confined to the largest islet, which bears the name of the atoll. The sandy soil of Funafuti is of much better quality than that of Tarawa. Pits, similar to those of the Gilbertese, are dug through the water table to make sunken gardens, some of which are of considerable size. The true taro (*Colocasia antiquorum* var. *esculenta*) is grown in addition to *Cyrtosperma chamissonis*. The Funafuti gardens were found to be much drier than those of Tarawa. Shallow pools in most of those examined held the aquatic stages of *A. vexans nocturnus* in association with larval Tipulids and Anisoptera, and amphipods, ostracods and freshwater snails. The pH content of the pools, like that of those at Tarawa, averaged 7·4 (range, 7·0 to 8·2). Water temperatures were higher than those recorded at the latter atoll, and in one instance that of a pool supporting a very heavy population of *A. vexans nocturnus* (up to 300–400 second-instar larvae per dip with a 200 cc. dipper) was as high as 37°C. (pH 8·2). Adults of this species were very troublesome at night-time.

A few adults of *C. annulirostris* were found resting in dark corners of a bedroom on the morning of the 30th. The only other record of this species at Funafuti was from the last-mentioned pool, and concerned an egg raft, from which larvae were just beginning to hatch.

Larvae and adults of a *Stegomyia* of the *scutellaris* group were common everywhere. Coconut husks lying about in the underbrush of the plantations often teemed with aquatic stages of this mosquito, which were also found in a small pool in a hollow on top of a knob of coral deeply shaded by overhanging vegetation. The pH content of the water in this larval habitat was 7·6 at 27·5°C. (the shade air temperature at the time was 28·5°C., while nearby pools in taro pits exposed to full sunlight averaged 33°C.; members of the *scutellaris* group are seldom found in water subject to marked temperature fluctuations, and the temperature of their larval habitats at the height of the day is usually less than the shade air temperature). Other larvae were found in a 44-gallon drum positioned so as to catch rain-water directed into it by means of a spout from the trunk of a coconut palm (pH 6·6 at 30°C.).

Imagines were extremely troublesome in the shade of the plantations. At one stage as many as 40 were present on my arms, and it was not possible to continue working without applying repellent. This is in marked contrast to the experience of O'Connor (1923), who declared that "I found only four or five specimens of *Stegomyia pseudoscutellaris* on this islet [*i.e.*, Funafuti.—M.L.], though *Culex jepsoni* [= *C. annulirostris*, see p. 292], which is absent from the other islets, is common". Perhaps the underlying reason is seasonal—O'Connor spent the driest months of the year (April–June) at Funafuti, and at that time a minimum of suitable mosquito breeding places would be available. As at Nukunono, the *scutellaris*-group mosquitos proved in every way comparable with the description of *A. polynesiensis*. Dr. Marks was sent material for checking, and once again she confirmed the identification (private communication, 1954).

The 44-gallon drum already mentioned contained numerous larvae of *A. aegypti* in addition to those of *A. polynesiensis*. No adults of *A. aegypti* were seen at Funafuti.

Many leaf axils of *Colocasia* and *Pandanus* were searched for mosquito larvae, once again with complete lack of success. Two to three hours were also spent in searching for mosquitos at the margins of two extensive brackish swamps (connected with the sea by underground channels, and thus subject to tidal action). Small pools in waterlogged ground at the edge of these swamps had a pH content of 10·0 at 32·5°C. Although outwardly suited to such brackish-water mosquitos as *C. sitiens*, these were quite without larvae.

Discussion.

The incidence of filariasis at Nukunono, as judged from the microfilaria rate, is appreciably higher than is apparent from O'Connor's (1923) results, and a much higher percentage of men than women exhibit *Wuchereria* there. Otherwise, the picture is substantially unchanged since 1920, no new mosquitos having made their appearance, although potential larval habitats for two Samoan species, *A. samoanus* and *C. sitiens*, are available at the atoll.

Tarawa and Funafuti have been the ports of entry to their respective Groups for many years. They are consequently the atolls most likely to be initially overrun by introduced mosquitos. On the available evidence it would seem that both *A. vexans nocturnus* and *C. annulirostris* have become established at Tarawa over the last quarter of a century. These species might well be very recent introductions, for in view of the military activity at Tarawa during World War II it is surprising that no mention of their presence was made in official survey reports. Both mosquitos could have been brought by sea or air from the Ellice Group, if not from further afield. *C. annulirostris* had become widely distributed in that Group by 1920 (O'Connor, 1923), while *A. vexans nocturnus* was present on at least two of the islands in 1924 (Buxton & Hopkins, 1927, as *A. vexans*). Although neither O'Connor nor Buxton found the latter insect on Funafuti it would have been an easy matter for them to have overlooked it, as

their visits both took place during the dry season. *A. vexans nocturnus* is of sporadic occurrence throughout its area of distribution, typically appearing in huge numbers (often to the temporary exclusion of *C. annulirostris*) in temporary surface pools formed as a result of heavy rains. Finally, it is highly unlikely that the two authors in question, interested as they were in mosquitos utilising small natural and artificial containers as larval habitats, would have overlooked the presence of so important a domestic mosquito as *A. aegypti* at Funafuti.

Certain ecological niches suitable as mosquito larval habitats, although not as yet utilised by these insects, are available in the Gilbert and Ellice Islands. Conspicuous among these are the brackish swamps of Funafuti and leaf axils of *Pandanus* and *Colocasia*. As the lack of water-retaining taros in the Ellice Group was proposed by Buxton as a reason for the absence of *A. samoanus*, it can only be concluded that crop changes in recent years have laid the Group open to the possibility of a successful introduction of this annoying pest species.

Granted a suitable means of transportation, it is felt that the possibility of such an Anopheline as *Anopheles* (*Myzomyia*) *farauti* Lav. being introduced should not be overlooked. There is no reason why this dangerous mosquito should not be able to establish itself in the taro gardens of either Group.

Representative adults of *Aëdes polynesiensis* from Nukunono and Funafuti and of *A. marshallensis* from Tarawa have been deposited in the collection of the University of Queensland.

Summary.

It is confirmed that the *scutellaris*-group mosquito of the Tokelau and Ellice Islands is *Aëdes* (*Stegomyia*) *polynesiensis* Marks. No other mosquitos are known from the former Group, but *Culex* (*Culex*) *annulirostris* Skuse, *A.* (*Aëdimorphus*) *vexans nocturnus* (Theo.) and *A.* (*Stegomyia*) *aegypti* (L.) are also recorded from Funafuti, Ellice Islands. *C. annulirostris* and *A. vexans nocturnus* are listed—apparently for the first time—from Tarawa, Gilbert Islands. Reference is made to the microfilaria rate at Nukunono in the Tokelau Group, and to some potential mosquito larval habitats, as yet unutilised, in all three Groups.

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BIRDS AND BIRD LORE IN THE TOKELAU ISLANDS

By

KAZIMIERZ WODZICKI

and

MARSHALL LAIRD

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BIRDS AND BIRD LORE IN THE TOKELAU ISLANDS[1]

By KAZIMIERZ WODZICKI[2] and MARSHALL LAIRD[3]

ABSTRACT

The avifauna of the Tokelau Islands and the surrounding ocean consists of at least 26 species (15 sea birds, eight shore birds and three land birds). Seven of the species are now recorded from the Group for the first time. Of the 15 sea birds, seven are known to breed in the Tokelaus or to have done so until recently. At least three of the others may do so, the remainder probably being random visitors. All but one of the shore birds are migrants, as are two of the land birds. The affinities of this avifauna with those of other Central Pacific islands are briefly described, as is the status of birds breeding in the Group. Conservation issues are touched upon, and some notes on Tokelauan bird lore are presented.

INTRODUCTION

The findings reported herein resulted from five extended visits to New Zealand's northernmost dependency — 1958 and 1960 (M.L.) and 1966/67, 1968 and 1970 (K.W.). These successive expeditions had the primary purposes of research towards mosquito control (Laird, 1963, 1967, 1969) and rat control (Wodzicki, 1968a, 1968b, 1969, 1970), but during them long canoe trips and field work on most islets of Atafu, Fakaofo, and Nukunonu[4] provided excellent opportunities for bird watching. Additionally, information on the past and present status of the avifauna, also on relevant island lore, was gathered from many Tokelauans. The resultant material substantially augments that published by Thompson and Hackman (1968) on the basis of a seven-day stay in the three atolls in 1965. It is submitted that we now have a reasonably complete picture of the avifauna of the Tokelaus, and of its relationships with that of other Central Pacific islands.

MATERIALS AND METHODS

The geography and history of the Tokelau Islands were briefly described by Thompson and Hackman (1968). Further details may be found in the Annual Reports of the New Zealand Island Territories Department for the years 1966/67 and 1967/68, and in Macgregor (1937) and Huntsman (1969).

Research into the ecology and integrated control of mosquitoes carried out in 1958 and 1960 (Laird, 1967) necessitated extensive visits to many islets — " motus " — of all three Tokelau atolls (all those of Atafu and Nukunonu: a selection of those of Fakaofo) and provided excellent opportunities for bird observations. Work on rat ecology and control in 1966/67 at Nukunonu and Atafu, in 1968 at Nukunonu only, and in 1970 at Fakaofo (Wodzicki, 1968a, 1968b, 1969, 1970) was similarly conducive to observations of bird ecology. Figs. 1 - 3 show the three atolls and the place names mentioned in the text.

1 Studies in Biology from Memorial University of Newfoundland, No. 21.

2 Department of Scientific and Industrial Research, Wellington, New Zealand.

3 Head, Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

4 Cartographers (e.g. " The Times Atlas of the World " 1968 Edition) generally accept Nukunono, which is a misspelling by early European voyagers of the true name " Nukunonu " (" Nuku," island; " nonu," a shrubby tree, **Morinda citrifolia** Linn., commoner here than elsewhere in the Tokelau Islands). The New Zealand Statutes have adopted the spelling Nukunonu (see the Tokelau Islands Amendment Act 1969, s. 2), and this spelling is being used throughout this paper.

Ten birds representing eight species were collected during the 1960 visit to confirm subspecific identifications, and deposited (as alcohol-preserved specimens) at the American Museum of Natural History, New York. Measurements of these birds taken by Dr. Charles E. O'Brien are given hereunder in the species descriptions in the following order: American Museum of Natural History (AMNH) number, locality, date, bill, tarsus, wing and tail-length (cm.). Thirty-seven bird skins were obtained during the 1966/67 visit. These are deposited at the Dominion Museum, Wellington. Relevant data are itemized in our species synopses, where applicable, in the following order: Dominion Museum (DM) number, locality, date, sex, bill, tarsus, toe, wing and tail-length (cm.) and weight (gm.) if available.

Thompson and Hackman (1968) collected and sexed 99 bird specimens belonging to 20 species during their seven-day visit to the Tokelau Islands in 1965. Unfortunately, the lack of standardization of their evaluation of the size and condition of the gonads, and of

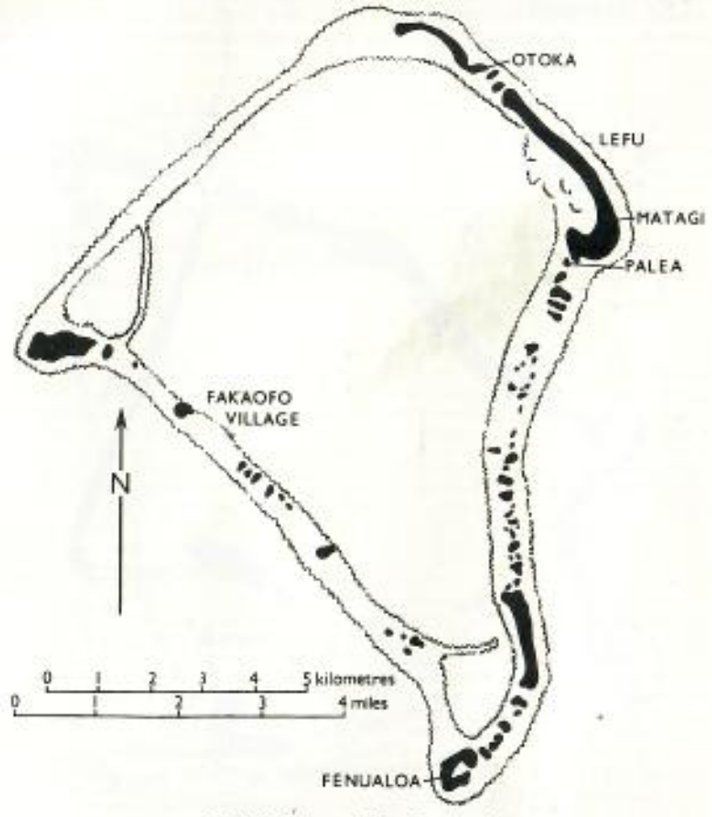

FIGURE 1 — Fakaofo Atoll

the amount of body fat, reduced the value of their results for an assessment of breeding condition.

The nomenclature and systematic arrangement of the birds enumerated in the present paper follow Kinsky (1970). An accurate knowledge of Tokelauan bird names is of basic importance to local folklore and ethno-avian studies. These vernacular names have been variously spelt between their first mention by Edwin H. Bryan, Jr. (1924) and the most recent publication (Thompson and Hackman, 1968). During the latter part of these studies, the presence in the

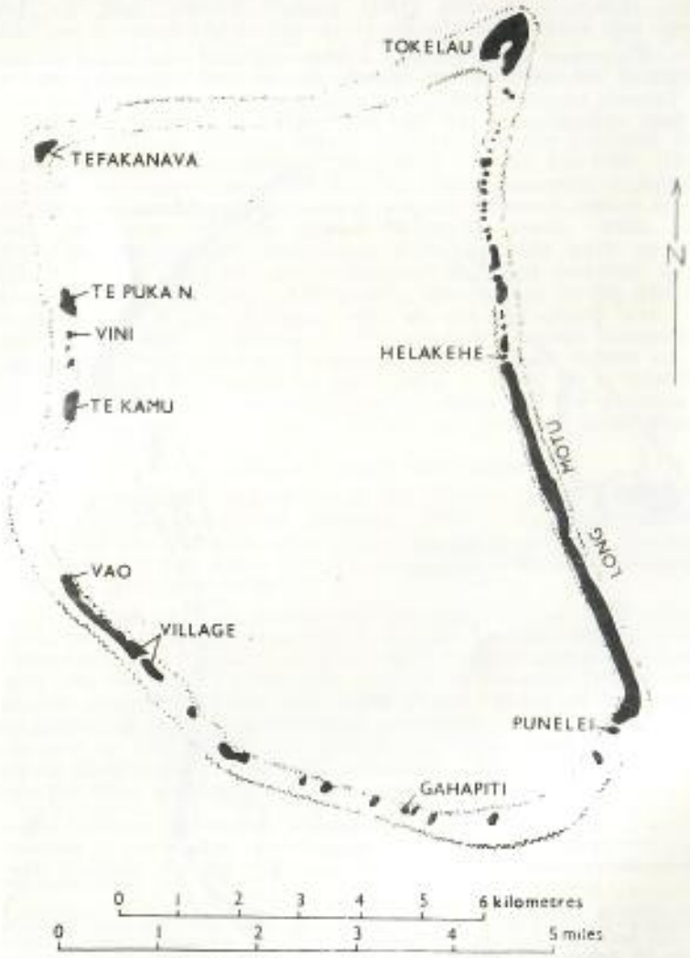

FIGURE 2 — Nukunonu Atoll

Tokelaus of two social anthropologists (Dr Antony Hooper, University of Auckland, and Dr Judith W. Huntsman, Bryn Mawr College, Pennsylvania)), made it possible to draw up the revised list presented herein.

The following brief note furnished by Dr Hooper explains the orthography adopted for the Tokelau names of birds in the present paper. "There is no 'official' orthography of Tokelauan, but linguistic analysis of the language is under way at the University at Auckland. The orthography used here is that agreed upon by linguists at Auckland, and used by Dr Hooper and Dr Huntsman in their ethnographic studies of the Tokelau group.

In Tokelauan, as in other Polynesian languages, vowel length is phonemic. The phonemically distinct long vowels are written as double vowels, *f* is a voiceless bilabial fricative and *h* is a glottal fricative which occurs palatalised before back vowels." According to Dr Hooper "the whole question of the *wh* versus the *f* is simple. True, it sounds like '*wh*' but the *f* is simpler to write and neater." Similarly, as in Samoan, the sound "*ng*" is rendered by "*g*" to avoid confusion.

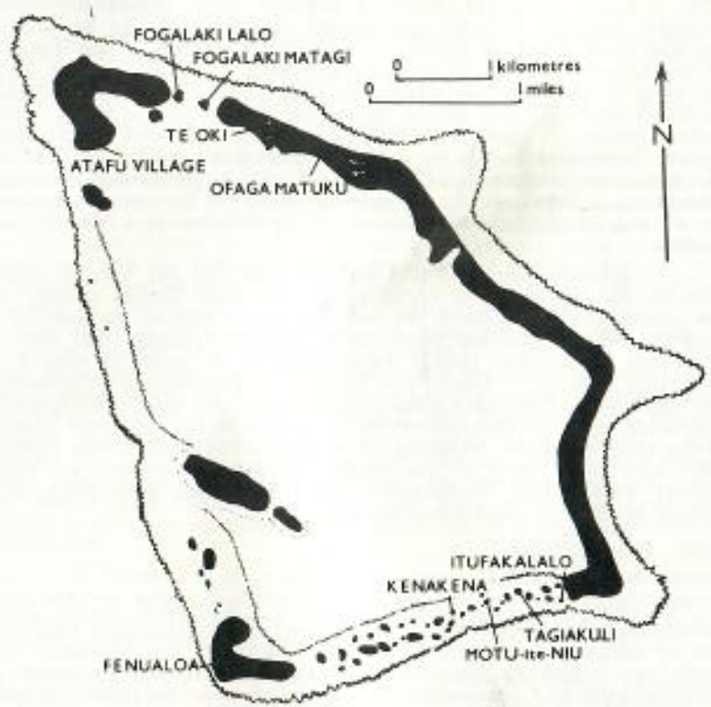

FIGURE 3 — Atafu Atoll

RESULTS

Introductory

The following account provides the scientific and vernacular (English and Tokelauan) names; the status of the birds (" na manu "); the dates of our observations, and information on specimens collected. The birds listed are broadly classified as sea birds, shore birds and land birds. Those not previously recorded from the Tokelau Islands are marked with an asterisk.

Disagreeing with Thompson and Hackman (1968) that subspecific names should await taxonomic revision, we have given subspecific names wherever sufficient taxonomic information is available.

Annotated Checklist

Order Procellariiformes

Family Procellariidae

*1. *Puffinus pacificus* (Gmelin, 1789) (subsp. *chlororhynchus* Lesson?). Wedge-tailed Shearwater, Takatai[5]. Non-resident. At 07.00 on 29/4/60, seven shearwaters were sighted (M.L.) some 300 metres from the M.S. " Aoniu," 170 km south of Fakaofo while bound for Apia, Western Samoa. A Tokelauan aboard declared these to be a bird we had often heard of, but never seen, in the Group — the Takatai (" wanderer of the sea "; " taka " wander, " tai " sea). One soon cut close to the ship, the binoculars then clearly revealing a longish wedge-shaped tail, dark-brown upperparts (black in the case of the rather similar *P. carneipes*), a brownish-grey face and throat, and brown underparts [white in the case of a smaller representative of the genus well-known from adjacent water, *P. lherminieri dichrous* (the Samoan Taio or Taiko, Armstrong, 1932)]. The strongly hooked tip of the bluish-black bill (pale flesh in *P. carneipes*) was clearly evident.

We had earlier been told at Nukunonu that the Takatai, while rare in the Tokelaus, is occasionally seen from fishing canoes on the open sea. The hooked bill was then mentioned as an identifying feature, and the size was stated to be somewhat larger than that of the Gogo or Common Noddy *Anous stolidus*. A petrel of some sort was thus indicated. Lastly, the feet were light-coloured, eliminating the black-footed Christmas Shearwater *P. nativitatis* from consideration. The wide range of this subspecies — which breeds on many islands in the tropical Pacific, including the Phoenix Group and Tonga (Baker, 1951, and King, 1967) — also supports our contention that the birds sighted were indeed Wedge-tailed Shearwaters, the most likely subspecies being *P. p. chlororhynchus* Lesson.

Order Pelecaniformes

Family Phaethontidae

2. *Phaethon rubricauda* Boddaert, 1783. Red-tailed Tropic Bird. Tavake-ulu-gahu. Resident. Well-known to the islanders, who said that it occasionally breeds on all three atolls of the Tokelaus. Its single egg is laid on the ground, beneath gasu *Scaevola frutescens*, a shrubby saltbush. According to our informants, the rarity of this species in the Tokelaus contrasts with its abundance at Hull Island (some four degrees north of Atafu) and several other of the Phoenix and Line Islands (Child, 1960). A bird in flight was recorded off the coast of Fenualoa islet, Atafu, on 8/4/60. Thompson and Hackman (1968) reported another (1/3/65). A group of six *rubricauda* flying on the lagoon side of Fenualoa islet, Fakaofo, were seen on 22/8/70 (K.W.). David Gravatt (pers. comm., Feb. 1967) stated that in some years they nest on Atafu.

3. *Phaethon lepturus* Daudin, 1802. White-tailed Tropic Bird. Tavake-ulu-puka. Non-resident. Two White-tailed Tropic Birds were seen at 11.00 on 29 April 1960, 136 miles south of Fakaofo and approximately half way back to Apia. Thompson and Hackman quoted P. W. Woodward for a sighting at Fakaofo on 27/2/65. Isaia, a Nukunonu elder, declared that the Tavake-ulu-puka used to nest at this atoll in his father's time. Mitchell (1909) gave Tava'e as the Samoan name for both Red- and White-tailed Tropic Birds, Armstrong (1932) following Pratt (extensively quoted throughout his book) in applying this name to the latter species and *P. aethereus* too, and using both Tava'e'ula and Tava'etoto for the former.

Family Sulidae

*4. *Sula dactylatra* (Gould, 1846). Masked or Blue-faced Booby. Hakea. Non-resident. Included here because several Tokelauans volunteered a good description of the species to each of us individually, claiming that this third Booby, " larger than the Talaga or Takupu," visits the Group rather rarely.

5. *Sula sula sula* (Linnaeus, 1766). Red-footed Booby. Talaga (young), Takupu (mature). Resident. There were numerous occupied nests in a grove of pukakakai *Pisonia grandis* at Palea islet, Fakaofo, on 27/4/60. A fledgling from this colony was being kept as a pet by the head teacher at the village on Fakaofo islet, who stated that eggs are laid in February, hatching taking place in March. The subspecific identification was confirmed by Drs. Charles O'Brien and Robert C. Murphy, from a colour slide of this young bird. Two adults had already been seen off the coast of the village islet of Atafu in October 1958, an islander (with M.L. at the time) remarking that although large flights sometimes visit the atoll breeding never takes place there. The same apparently holds good for Nukunonu. Such flights could originate equally well from Fakaofo or the Phoenix Group, most islands of which have colonies (Child 1960). This species was reported by Thompson and Hackman (1968) near Matagi islet, Fakaofo, on 28/2/65, but was not observed by the senior author in 1966/67 and 1968. Single birds and pairs of Takupu were seen diving from a low altitude in the Fakaofo lagoon in August-September 1970 (K.W.).

" Takupu " is given by Child (1960) as the Ellice name for this species, with " Talaga " as a queried alternative. The Tokelau name is close to the Maori " Takapu," which applies to the Australian Gannet (*Sula bassana serrator* Gray, 1843) (see Kinsky, 1970).

6. *Sula leucogaster* (Boddaert, 1783). Brown Booby. Fuakoo[6]. Probably resident. Sighted by both authors on several occasions; for

5 According to Dr Judith W. Huntsman [pers. comm., 22/4/1969], the Takatai is also known as Manutagilua [lit. 'bird with the double cry'] and so the saying goes — if one hears the cry of the Manutagilua during a storm, it indicates that the storm is almost over.

6 Interestingly enough, a name very close to this (Fusi'o) is applied to a very different bird, the Common Noddy, **Anous s. stolidus**, in Samoa (Armstrong, 1932; Mitchell, 1909), where according to the former author the Brown Booby is termed Ta'i'o.

example, two close inshore near Tefakanava, Nukunonu, at midday, 6 September 1958; another resting on a metal drum topping a metal tripod marker in the lagoon off Vao islet, Nukunonu, 18.00 hrs. same afternoon. D. Gravatt reported that the Brown Booby is only occasionally observed and is not known to breed on Atafu. On the other hand Vaopuka (pers. comm. to K.W., 19/9/70) stated that a few pairs of these boobies nest on Palea motu, but do not have a definite nesting season. These and other field records were supplemented by observations on captive birds. Thus an immature example, with a broken wing, was examined on the Village islet, Atafu, on 30 September 1958. The plumage of this was dark chocolate-brown, the line of demarcation between the dark breast and white abdomen being sharply drawn. The face and gular pouch were yellowish, as were the feet and legs, the bill being pale bluish. Another captive Brown Booby was seen at Atafu on 12/6/68. This bird (Plate XXX) had been

(The Late D. Robinson

Plate XXX — **Sula leucogaster** (Boddaert, 1783). Atafu, 12.6.68.

banded (No. 757-67076). The band proved to have been placed upon a Brown Booby at Jarvis Island by members of the Pacific Programme, Smithsonian Institution, in November 1964. According to the owner, a Brown Booby wearing this band was caught and kept as a pet for some time. On its death, the band was removed and placed on the bird actually seen.

Family Fregatidae

*7. *Fregata minor* Gmelin, 1788. Greater Frigate-Bird. Katafa Gogo or Katafa-ua-Leuleu (the Samoan name is Atafa — Armstrong, 1952; Mitchell, 1909). Resident. Uncommon, not noted by Thompson and Hackman (1968). A large black frigate bird was observed over the lagoon at Nukunonu at 11.15 on 6/9/58. Just after midday, two more were seen (off the islet of Tefakanava) harassing a White-capped Noddy *Anous minutus* which made its escape by flying off landwards just above the water. The junior author's identification was based on the evident size and general blackness of colouring of these birds, none of which had white flank patches. Tokelauans in the canoe volunteered the information that this was the larger kind of Katafa seen in the Group, and that at times it exhibits an inflated red throat pouch — the designation Ua-Leuleu then being applied to it.

It is interesting to note that similarly distinctive but quite different names are applied to males in this state in the Ellice Islands — Talakula or Katokula (Child 1960).

On Atafu David Gravatt reported that katafas were "quite often seen soaring over the lagoon. Twelve and twenty were observed on two occasions." They were "gliding in circles using very few wingbeats" and "they were issuing their characteristic rather plaintive cry and occasionally swooping on an *Anous* or other small bird."

During the 1968 survey (end of April to mid-June), six Greater Frigate Birds were seen on the morning of 6 May and three on the following day circling at a considerable altitude. They also roost in places on very windy nights, and are then collected (see below).

Vaopuka reported that Katafa-ua-Leuleu nests regularly on Fakaofo atoll, the Palea islet being its only nesting place. As this islet is communal property permission from the Elders is necessary for collecting the birds: about 20 - 40 birds are taken annually.

8. *Fregata ariel* (G. R. Gray, 1845). Lesser Frigate Bird. Katafa-koti. Possibly resident. Most of the frigate birds observed in 1958 and 1960 had an extension of the white breast (females) or a distinct white patch (males) on the lower flank beneath each wing, and were thus considered referable to this species. Recorded at Nukunonu on three occasions in 1960; Tokelau islet, 8 September; Vao or Village islet, 14 April; over lagoon, evening, 22 April (two groups numbering eight and 23, forming ascending spirals mounting to some 200 metres). At Fakaofo large numbers were circling above Palea islet on 25/9/58 and 27/4/60. Sibley and Clapp (1967) reported Lesser Frigate Birds as common visitors to all three atolls. Thompson and Hackman (1968) collected eight specimens at Fakaofo and Atafu between 27 February and 4 March 1965. They also recorded large flocks roosting at Fakaofo, and flocks flying northwards at Nukunonu. The eight specimens collected were all males with testes from 11 by 5 mm. to 17 by 8 mm. Fat condition was recorded in six specimens, one with medium and five with heavy fat (including one bird showing a substantial body moult).

Palea islet (Fakaofo), noted as "a nesting place for frigates" by E. H. Bryan, Jr. (1924), is the outstanding bird island of the Tokelaus. Red-footed Boobies, White-capped and Common Noddies and White Terns breed there. According to some islanders, Lesser Frigate Birds nest, or at all events, nested at Palea. Others reported that these birds simply roost in the islet's grove of pukakakai *Pisonia grandis*. The guano-spattered brownish-black humus beneath the *Pisonia* is characteristic of the heavily phosphatic Jemo series (Wiens, 1962). One very obvious consequence of the organic richness of Palea's soil is the darker green colour of the crowns of palms there by comparison with those of the adjacent sandy islet of Olokalaga.

On very dark and windy nights, visits are sometimes made to Palea islet for the purpose of clubbing Katafa. Climbing into the

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On very dark and windy nights, visits are sometimes made to Palea islet for the purpose of clubbing Katafa. Climbing into the

pukakakai trees, men strike them down with long poles, hitting them across the base of the beak to fell them without disturbing others roosting nearby. At Nukunonu, too, we were told (in 1958, 1960, and 1968) that frigate birds are similarly taken on dark nights following westerly gales, when the fronds of coconut palms on certain western reef islets from Te Kamu to Vini (especially the latter) may be black with them. Under these circumstances one man has been known to kill as many as 50 Katafa. In 1968, however, Isaia declared that no more than 20 - 30 birds are nowadays caught annually at Nukunonu.

Order Ciconiiformes

Family Ardeidae

9. *Egretta sacra sacra* (Gmelin, 1789). Reef Heron. Matuku [the name used in the Marquesas according to Jardine, quoted by Finsch and Hartlaub, 1867. Matuku-moana is the Maori name for the Blue Reef Heron (Oliver, 1955). Armstrong (1932) and Mitchell (1909) give Matu'u as the Samoan name]. Resident.

[J. Morgan Williams

Plate XXXI — **Egretta s. sacra** (Gmelin 1789) dark morph. Nukunonu, 1966.

DM 15,342, Village islet, Nukunonu, 19/12/66. 75.1, 72.4, 66.2, 280 and 93 (in moult, two control tail feathers short and in sheath). DM 15,341, Vaitupu, Long islet, Nukunonu, 6/2/67, female, 88.8, 70.9, 66.2, 277, 93 (six small fish in stomach). DM 15,340, Vao, Nukunonu, non-flying chick; Tepuka N., Nukunonu on 12/1/67, male, 82.8, 78.8, 67.6, 290 and 100.

Common throughout the Group, and the only wader breeding there. According to Mayr and Amadon (1941), Reef Herons from the Tokelaus are referable to *D. s. sacra*. There are three colour phases, grey-blue (Plate XXXI), pure white and mottled. These morphs are well-known to the islanders: grey phase (Matuku uliuli), white phase (Matuku hina or paepae) and mottled phase (Matuku tavai).

Thompson and Hackman (1968) recorded " white, intermediate and dark morphs." David Gravatt found in February 1967 (Atafu atoll) that the grey and white phases were common and present in roughly equal numbers. Intermediate birds were also observed, but less commonly. Of ten birds observed at Nukunonu in September 1958, six were grey, two were white and two were mottled (M.L.). During the 1966/67 and 1968 visits to Nukunonu and the 1970 visit to Fakaofo, every bird seen was noted, together with its colour phase (Table 1). It is of course realized that the numbers reported simply represent birds seen. Clearly, some of them could have been recorded more than once.

According to Mayr and Amadon (1941), the North-west and Central Pacific (including the Marshall Islands, Fiji and the Solomons) is inhabited by Matuku populations with mottled adults. Intermediate morphs have neither been reported from the Northern Cook Islands (Suwarrow), nor from Tonga and Samoa. Table 1 shows that Mayr and Amadon's range should be extended by including the Tokelau Islands. It is proposed (K.W.) to publish a fuller account elsewhere of the distribution of the three colour morphs and their genetic basis in *Egretta s. sacra*.

Thompson and Hackman (1968) collected 10 specimens between 26 February and 5 March 1965. The three males all had large testes. Three of the seven females exhibited granular, minute and small

TABLE 1 — Numbers and Percentages of the 3 Colour Phases of *Egretta sacra*

ISLAND OR GROUP OF ISLANDS	COLOUR PHASE: GRAY No.	GRAY %	WHITE No.	WHITE %	MOTTLED No.	MOTTLED %	NO. OF BIRDS IN SAMPLE	AUTHORITY
TOKELAU IS.: NUKUNONU	5		2		3		10	M.L., This paper, September 1958
NUKUNONU	50		10		4		64	K.W., This paper, November 1966 - February 1967
NUKUNONU	16		8		4		28	K.W., This paper, April-June 1968
FAKAOFO	10		16		2		28	K.W., This paper, August-September 1970
TOTAL TOKELAU IS	82	63.1	36	27.7	12	9.2	130	
FIJI	24	62	9	23	6	15	39	Mayr & Amadon (1941)
SOLOMON IS.	36	69	13	25	3.11	6	52	Mayr & Amadon (1941)
MARSHALL, CAROLINE, MARIANAS AND PALAU IS.	27	54	20	40	3.11	6	50	Mayr & Amadon (1941)
TOTAL FIJI, SOLOMON, MARSHALL, MARIANAS AND PALAU IS.	87	61.7	42	29.8	12	8.5	141	

ovaries, the remainder having large ovaries. From this evidence, Thompson and Hackman thought that " breeding occurs on the islands in February, March and possibly April." Fledglings were observed by us at Nukunonu in the last week of November 1966 and early in May 1968. Vaopuka found a white-phase heron incubating eggs at Otoka, Fakaofo, on 3/9/70. This would extend the breeding season considerably — from late August to late April. According to Isaia and others at Nukunonu, Matuku nest in coconut palm crowns but prefer fala (*Pandanus* spp.) trees. They lay up to six eggs. A former major nesting place on the western arm of Te Oki islet, Atafu, is still known as Ofaga Matuku (ofaga, nest).

Usually one sees single birds but occasionally they were observed feeding in pairs. Some of the birds seem to stick to a territory: at Fakaofo during the August - September 1970 visit (K.W.) a matuku uliuli was frequently seen on the reef south of the falee; and a matuku hina frequented the tidal flats between the village and the hospital.

At Nukunonu Reef Herons appear to be the only birds not taken for food, their meat being unpalatable; but at Fakaofo, according to Vaopuka they are occasionally eaten. They are, however, occasionally kept as pets, to chase poultry out of the houses.

Order Anatiformes

Family Anatidae

10. Duck (sp?). Toloa. Occasional visitors. Although no specimens or confirmed identifications of ducks are available for the Tokelau Islands, and no sightings took place during our five visits, ducks are nevertheless well-known to inhabitants of Fakaofo and Nukunonu. The birds are easily caught when resting on the lagoon by islanders who swim out with upturned baskets over their heads; when they are close enough they dive deeply, head directly up to the birds and grab. Tokelauans assured us that flocks of up to about 100 may appear at Fakaofo in September or October, keeping together on the lagoon and leaving in November. Thompson and Hackman (1968) quoted Father Goldfinch for the information that ducks are seen " nearly every year " at Nukunonu in February and March, and that one of the Sisters had identified them as Grey Ducks. They are also reported to feed in the marshes of Fenualoa islet, Fakaofo (the only significant body of fresh water in the three atolls), putting their heads down and feeding in the mud. Opeta asserted that the bird concerned is the same one found on Upolu, Western Samoa. This is the Grey Duck *Anas superciliosa* Gmelin, the Samoan name for which is also Toloa, according to Armstrong (1932); Doloa, Finsch and Hartlaub (1867). Amadon (1943) records *A. superciliosa pelewensis* Hartlaub and Finsch from Samoa, but not from the Tokelaus.

Order Charadriiformes

Family Charadriidae

11. *Pluvialis dominica fulva* Gmelin 1789. Pacific Golden Plover. Tuli[7] [a name casually applied to waders in general, both in the Tokelaus and Samoa (Armstrong, 1932)]. Non-resident, migrant.

7 Thompson and Hackman gave " Kiakiao." This is very close to the Gilbertese name for the Black-naped Tern, " Kiakia " (Child, 1960).

AMNH 2248, Punelei, southern end of Long islet, Nukunonu, 20/4/60, 24, 42, 163, and 65. DM 15,352, Village islet, Nukunonu, 24/12/66, female, 21.8, 44.1, 29.4, 154 and 58. DM 15,332, Tokelau islet, Nukunonu, 12/1/67, 24.5, 44.9, 31.3, 172 and 63.

Plovers were among tame birds seen in the village of Atafu (formerly Duke of York's Island) on the occasion of the visit of USS " Peacock " and " Flying Fish " on 25 January 1841 (Wilkes, 1845). However, the " York Island " from which Gray (1859) listed " *Charadrius fulvus* " was presumably Eimeo, Society Islands. Stickney (1943) published April records for Fakaofo and Nukunonu, estimating the total population on all three atolls at 70 birds. They were uncommon during the 1958 and 1960 visits.

This species was frequently observed during all four visits, usually along the shore but also in other places clear of tall vegetation, e.g. the cemetery at Nukunonu. Up to four were seen at a time during spring and summer, markedly fewer birds being noticed during the southern autumn and winter. In this period, most Pacific Golden Plovers would of course be breeding in the Subarctic. This is supported by data from the 14 examples collected by Thompson and Hackman (1968), and those obtained by the Whitney Expedition in April 1924.

Family Scolopacidae

*12. *Numenius phaeopus variegatus* (Scopoli 1786). Asiatic Whimbrel. Non-resident, migrant.

DM 15,354, Avelau, Long islet, Nukunonu, 30/1/67, 82.8, 57.2, 36.8, 22 and 82 (tail moult observed).

New record for the Tokelau Islands, based on a specimen by K.W. Mitchell (1909), in mentioning that a " wimbrel " was shot in Samoa in 1902, noted that " Being so rare the Samoans have no native name for them."

13. *Numenius tahitiensis* (Gmelin 1789). Bristle-thighed Curlew. Tiafee. The alternative Tokelauan name for this species comes much nearer to the loud alarm cry " tee-ar-fay " than Mayr's (1945) " aweu-wit." Neither of the Samoan names quoted by Armstrong (1932), Tuliolovalu and Tuliisutele, resembles either of these. Non-resident, migrant.

AMNH 2250, lagoon side of northern arm, Tokelau islet, Nukunonu, 21/4/60, 82, 50, 239, 113.

Quite common (usually in pairs) on all three atolls, in 1958, 1960, 1968 and 1970. Thompson and Hackman (1968) reported that two female specimens had heavy fat, obviously in preparation for the (northern) spring migration.

The Tiafee proved more numerous between November 1966 and February 1967 than from April to June 1968, when only two birds were seen. Curlews fed both among the coral fragments of the ocean beach and on the lagoon shore but were more common on the latter. Interestingly enough, on the evening of sighting the first Tiafee on Nukunonu in 1958, the junior author sketched the bird from memory for a young man who'd never left the atoll; who said,

when the drawing was almost completed but before the downcurved bill was emphasized, " Kuaka ! " — the Maori name for the following bird, the Eastern Bar-tailed Godwit.

*14. *Limosa lapponica baueri* Naumann 1836. Eastern Bar-tailed Godwit. Tulipala. Non-resident, migrant. Stickney (1943) referred to Samoan records as the most easterly for this species, which she did not list from the Tokelaus. The only godwit we observed in the Group was at Itufakalalo, near the south-eastern extremity of Atafu, on the afternoon of 7/10/58 (M.L.). Presumably a recent arrival from the north (this species reaches the Gilbert and Ellice Group about mid-October according to Child, 1960), it was easily recognizable from a recollection of large numbers of Eastern Bar-tailed Godwits seen ten years previously at Parengarenga Harbour, North Auckland. The bird was digging its bill deeply into the coral sand, possibly in search of ghost-crabs as described by Child. At all events, just like the one he watched, it ran to the edge of the sea from time to time to clean its bill. No Tuli-pala were observed during the later visits, nor by Thompson and Hackman (1968). However, this species was evidently well-known to Isaia and other Tokelauans.

15. *Tringa incana* (Gmelin, 1789). Wandering Tattler. Kolili (Thompson and Hackman, 1968, wrongly applied this name to the Ruddy Turnstone). Non-resident, migrant. The Tokelauan name is not unlike the Gilbertese " Kiriri " (Child, 1960), and well describes the Wandering Tattler's alarm cry.

AMNH 2243, Vao or Village islet, Nukunonu, 19/4/60, 42, 33, 171 and 79. AMNH 2244, same locality as last, 22/4/60, 40, 32, 167, 77. DM 15.333, Tepuka north islet, Nukunonu, 12/1/67, sex ?, 39.2, 34.1, 30.3, 171 and 74. DM 15,334, Tokelau islet, Nukunonu, 11/1/67, 39.2, 35.2, 30.6, 168 and 70 (primaries moulting).

Reported by Stickney (1943), this species was seen from time to time on each of the atolls during the 1958 and 1960 visits. Nine specimens were examined by Thompson and Hackman (1968). Two had enlarged gonads and heavy fat, the remainder having little to medium fat and small gonads. Although Thompson and Hackman considered the Wandering Tattler to be fairly common, it was not recorded during the April-June 1968 visit. We found this greyish wader, when motionless, very hard to distinguish among small fragments of coral along the shore. It often hurries along, skirting the foam line, head hunched down between the shoulders. Of special interest in view of Child's (1960) observation of an American Wandering Tattler perching on crowns of coconut palms, one was seen to fly up onto the roof of an Atafu hut, where it remained a minute or so, as the light was failing during the crescentic stage of the solar eclipse (approximately half-way between the beginning and totality) on the morning of 12 October 1958. Immediately after totality, it might be mentioned, the village cocks began to crow.

16. *Arenaria interpres* (Linnaeus, 1758). Ruddy Turnstone. Vahavaha (Thompson and Hackman, 1968, wrongly applied this name to the Wandering Tattler). Non-resident, migrant.

AMNH 2245, Vao or Village islet, Nukunonu, 19/4/60 (as of March 1970 on loan to Dr. Michael K. Rylander, Texas Technological College, Lubbock, Texas 79409, who kindly supplied the following measurements, 19.8, 29.5, 130). DM 15,350, Vao islet, Nukunonu, 24/12/66, female, 23.7 24.4, 22.4, 159 and 63. DM 15,351, same locality as last, 9/2/67, female, 22.0, 26.1, 29.4, 154 and 66 (this bird was still in winter plumage).

First recorded at Fakaofo on April 3 and 4 by Whitney South Sea Expedition [Stickney (1943)]. Several were seen at the northern end of the Long islet, Lalo Land Division, Nukunonu, at 11.35 on 20/9/58, 12 at Fenua Fala, Fakaofa, on the late afternoon of 26/9/58. A flock of five at Te Vaipapa, a sand area with scattered shrubs and low coconut palms, just south of Tekamu (on the western side of Nukunonu reef) in the late afternoon of 16/4/60, two flocks of six and fourteen on Vao on the following morning. Scattered pairs and individuals were seen on all three atolls on various occasions in both 1958 and 1960.

Fifteen specimens were collected by the Whitney South Sea Expedition (Stickney 1943) and by Thompson and Hackman (1968). These were in various stages of moult. Among them, only one male had large testes, while three females had granular ovaries. The remaining 11 had underdeveloped gonads. With one exception, the remaining ten shot between 26/2/65 and 3/3/65 all had a heavy fat deposit. A bird collected in 1960 proved to have the rectum heavily infested by a flagellate protozoan that one of us (M.L.) had recorded from the same host in the spring of the previous year at a subarctic breeding site — False River, near Fort Chimo, Ungava Bay, Canada (58° 10′ N; 68° 15′ W).

Ruddy Turnstones were less numerous during the November 1966 - February 1967 visit, when they were only seen five times on the lagoon beaches of Nukunonu (single birds, pairs, and once a flock of eight). Pairs of Vahavaha were observed at Fakaofo in Aug. - Sept. 1970 (K.W.).

17. *Calidris alba* (Pallas 1764). Sanderling, Lefulefu. Non-resident, migrant. First recorded on 2/4/24 at Fakaofo by the Whitney Expedition (Stickney 1943) and later by Mayr (1945). This species was twice observed by us (M.L.). Both sightings were at Vao or Village islet, Nukunonu atoll. The first was made while swimming — it proved possible to approach to within a few metres, while the bird was feeding on a sandspit in the lagoon on the evening of 4/9/58. The second Sanderling was observed on the ocean shore on the morning of 17/4/60. Smallness (substantially smaller than any of the other waders discussed herein), very pale grey upperparts, the habit of running busily back and forth along the foam-line, and the conspicuous whitish wing stripe in flight, sufficiently substantiate the identification.

Two specimens with small gonads were collected by Thompson and Hackman (1968) at Fakaofo. These authors mention an observation from Fakaofo made by Huber, on 26/2/65. Not seen during the 1966/67 and 1968 visits, but well-known to the elders at Nukunonu.

*18. *Sterna bergii* (Stephens 1826). Crested Tern. Visitor. The single example seen (Village islet, Nukunonu, evening of 4/9/58)

was confidently identified by M.L. from its very large size (appreciably larger than the Common Noddy), generally white colour, black crown and crest and yellowish bill.

19. *Sterna sumatrana sumatrana* Raffles, 1822. Black-naped Tern. Tovivi. Resident.

AMNH 2251, off Vaitupu, Long islet, Nukunonu, 22/4/60, 39, 19.5, 227, 152. A non-flying chick (DM 15,349) was collected on the reef between the Village and Te Kamu islets, Nukunonu, on 18/12/66.

Recorded from the Tokelaus (Union Islands) by Mayr (1945). The Black-naped Tern was recorded from all three atolls on the 1958 and 1960 visits, being most plentiful on Atafu (M.L.). The one shot in the lagoon off Vaitupu perched on a branch protruding about a metre from the water, some 75 metres offshore. Another specimen, also from Nukunonu, was predominantly white, except for the pale greyish upper wings and mantle. It had a white-crowned head, a black nape, and a black band above the eyes. The white feathers of the underparts of the second specimen, when still fresh, were suffused with a very faint pinkish hue.

Thompson and Hackman (1968) shot 16 (all three atolls) in 1965. They considered "This tern . . . . fairly common in the Tokelau Islands." estimating that "the Black-naped Tern population on each atoll was about 40±." Observations made during the 1966/67, 1968 and 1970 visits confirmed the status of this species. It was reported to us (1958 and 1960) to nest in depressions in the sand over the greater part of the year. At Palea islet, Fakaofo, our attention was drawn to several large upended coral slabs, emerging two metres or more from the lagoon about 300 metres offshore. Relics of the disastrous 1914 hurricane, these are honeycombed with holes which, we were informed, are used as nesting sites by Tovivi. Of the 16 specimens shot by Thompson and Hackman (between 26 February and 4 March 1965) three were immature, one had small testes, while the remaining seven males and five females had large gonads. The presence of fledglings would indicate that the breeding season had been going on for some time. A very small chick, not yet fledged, was seen on 29 May 1968 at Punelei islet, Nukunonu (K.W.). All the above observations confirm Isaia's statement that the Tovivi nesting period at Nukunonu extends from November to the end of April.

20. *Sterna fuscata* (Linn. 1766). Sooty Tern. Talagogo. Resident, probably breeding. Not seen in 1958 and 1960 (M.L.) nor in 1966/67 and 1968 (K.W.), but noted by David Gravatt at Atafu. Five specimens collected between 26 February and 4 March 1965 by Thompson and Hackman (1968) — on Fakaofo (one), Nukunonu (one), and Atafu (three). Uncommon around Nukunonu and Atafu, but several thousands seen near Atafu, where islanders were catching these birds for food at a rate of up to 60 per day with long nets from canoes. A specimen of this tern was captured on 25/1/67, by a hunter at Atafu. He took from it a United States Fish and Wildlife Service band (No. 893-16158), which was handed to David Gravatt (pers. comm. 1967). According to the Secretary, Pacific Project, Smithsonian Institution (*in litt.* 5/4/67) this band "was put on a Sooty Tern *Sterna fuscata* by our Pacific Project on Laysan in August 1965 when the bird was immature." Apparently it is unusual for Sooty Terns to be captured south of the Equator when they have been banded as chicks north of the Equator.

*21. *Sterna lunata* Peale 1848. Spectacled Tern. Tala? Visitor? No evidence of nesting found, but apparently has bred in the Tokelaus (particularly at Atafu) in the past. Informants who had visited Hull Island (Phoenix Group, north of Atafu), assured the junior author that there is a large colony there (c.f. Child 1960, Clapp, 1968b). The species was seen in flight at Nukunonu (five examples, 22/5/60) and Atafu (three examples, 17/10/58), the white underparts, grey upperpart and black cap, also the distinctly larger size than that of the Black-naped Tern, all being evident. Perhaps it is worth mentioning that Tara is the Maori name for *Sterna striata*.

22. *Anous stolidus pileatus* Scopoli, 1786. Common or Brown Noddy. Gogo. Resident.

The Tokelau name is the same as that commonly used in the Ellice Islands (Child 1960). As already pointed out, though, the Samoan name resembles the one employed for boobies, especially the Brown Booby, in the Tokelaus.

A tame noddy was found among the few birds recorded from Atafu in the Narrative of the United States Exploring Expedition (Wilkes 1845). About a dozen tame Common and White-capped Noddies were observed at Atafu on 13 June 1968 (K.W.). This species and the White-capped Noddy (*q.v.*), which it may outnumber at Atafu, but which outnumbers it at Nukunonu and Fakaofo, are the commonest birds of the Tokelaus; they have been found prevalent everywhere throughout the 1958, 1960, 1966/67, 1968 and 1970 expeditions.

Seven Common Noddies were collected by the authors, six of which were deposited in the American Museum of Natural History and Dominion Museum respectively. The measurements of these birds are found below.

AMNH 2246, Matautu, Long islet, Nukunonu, 20/4/60, 34, 22, 228 and 134. AMNH 2247, same locality and date as last, 38, 24, 260 and 152. DM 15,339, Tokelau islet, Nukunonu, 11/1/67, male, 42.4, 21.9, 41.5, 292 and 173. DM 15,348, north end of Long islet, Nukunonu, 26/1/67, sex female, 38.5, 24.9, 37.6, 283 and 164. DM 15,345, from nesting colony at Avelau, Long islet, 30/1/67, sex ?, 42.7, 26.3, 37.9, —, and 154 (moult on primaries of both wings). DM 15,346, same locality and date, sex ?, 42.7, 27.8, 41.5, —, and 164 (moult on primaries of both wings, No. 1 - 9 new, No. 10 new, ½ grown, also strong body moult). DM 15,337, north end of Long islet, 26/1/67, sex ?, 40.5, 26.2, 36.9, 271 and 147 and Tokelau islet, Nukunonu, female, 43.4, 28.1, 40.6, 282 and 170.

Twenty-two Common Noddies were collected by Thompson and Hackman (1968) but data on size of gonads and presence of fat were recorded from 18 birds only. Four had enlarged testes (from 4 x 3 to 10 x 5 mm.) and six had enlarged ova (largest ovum from 1 to 5 mm.). Fat condition was recorded in nine birds only (one without fat, two showing light fat, four with medium fat, and two with heavy fat).

Nesting colonies were observed in *Pisonia grandis* trees and/or the crowns of coconut palms at Palea (Fakaofo), Fenualoa (Atafu) and Tokelau, Long and Tepuka islets (Nukunonu). It seems worth commenting that the old *Pisonia* trees to which the latter islet owes its name were destroyed in the 1914 hurricane, nesting there being in coconut palms (as is the case in some of the other Nukunonu islets, perhaps for a similar reason?). As indicated by Child (1960), the Common Noddy cries harshly from the nest when its nesting tree is approached. Unlike the White-capped Noddy, birds of this species have the habit of perching on driftwood near the shore, in small groups, usually facing into the wind. When seen in flight, the Common Noddy appears distinctly larger than its relative, which has a somewhat shorter tail and a whiter cap. In good light, its brownish (instead of blackish) colour is evident, too. It was often observed mobbing Matuku *(Egretta s. sacra)*. The senior author confirmed most of the above observations. The largest concentration observed were 40 Gogo roosting on sand, north of Helakehe, Nukunonu, on 16/12/66 but smaller groups of 10 - 20 birds were often noted at a time, sometimes roosting and sometimes fishing in the lagoon.

Collection of nesting material was observed in the last week of November and in December, 1966, and in late April, 1968. Also, large numbers of Gogo were observed flying in and out of the Long islet, Nukunonu, presumably still feeding chicks in nests, on 7/5/68. Isaia stated (pers. comm. to K.W., May 1968) that egg laying starts in January and goes on until June, the chicks hatching out between February and July. However, Isaia added, that October and November are the only months when no nesting takes place. In conclusion we may say that the above observations are in general agreement with the data on gonads and fat collected by Thompson and Hackman (1968).

According to Isaia, Gogos have always been used as food on Nukunonu. The taking of birds, particularly of adult ones demands great skill and a noose of coconut midrib on a long stick is used, the birds being whipped up by their necks. The Tokelauan name for this device is Tipa-manu-lele. Previously, and in areas least utilized by man, Gogo mainly used to nest on gagie trees *Pamphis acidula* but at present at Nukunonu Gogo nest on coconut palms between the stalks of two leaves. At Fakaofo, according to Vaopuka up to 800 birds are taken annually and as there are no restrictions, he and Isaia believe that the Gogo population has already significantly declined in consequence.

Seven examples were shot at Nukunonu for parasitological examination. The junior author was searching for life history stages of a heterophyiid trematode, eggs of which had been discovered during the examination of human faecal samples after the 1958 trip (Laird, 1961). Certain of these parasitic worms normally pass part of their life cycle in marine fish, part in piscivorous birds. None were recovered from these or any other of the birds dissected, and it now seems probable that the eggs earlier discovered in islanders were (as subsequently shown in Curaçao) simple pseudoparasites derived from eating flying fish (Schouten *et al.*, 1968). The only recognizable remains of food organisms in the stomach contents were those of fish, including, in one instance, small halfbeaks. The latter (hemiramphids) are so common in the Nukunonu lagoon that night fishing sorties are commonly made to capture large numbers of them as bait by means of an attractant petrol lantern and a long-handled flying fish net. They are now often referred to the Exocoetidae, the fish family most commonly found in the gut contents of *A. stolidus* on Christmas Island by Ashmole and Ashmole (1967). Two of these birds (from Tokelau islet, Nukunonu) yielded hippoboscid ectoparasitic flies duly identified by Dr. T. C. Maa of Taipei, Taiwan (*in litt.* to M.L. 15/4/63) as *Ornithoica pusilla* Schiner (not the *pusilla* Schin. misinterpreted by Bequaert and other authors) and *Alphersia senescens* Thomson. The latter fly is common in the tropics and was identified by Bequaert from this host from Rota, Mariana Islands (c.f. Baker, 1951, p. 168 — specific name misspelt *aenescens*). Dr. Maa pointed out that the former ectoparasite is very rare in collections. Previously he had only seen the type from Tonga and two examples from the Tuamotu Islands.

23. *Anous minutus minutus* Boie 1844. White-capped Noddy. Lakia. Resident. Seven specimens were collected. Their measurements follow:

AMNH 2242, Matautu. Long islet, Nukunonu, 20/4/66, 47, 21, 217, and 125. DM 15,335, Tokelau islet, Nukunonu, 11/1/67, sex ?. 43, 23, 34.2, 223 and 120. DM 15,343, Avelau, Long islet, Nukunonu, 30/1/67, male from nesting colony, 40.8, 21.8, 33.4, 222 and 111. DM 15,344, same place and date, sex ?, from nesting colony, 46.3, 26.1, 25.8, 158 and 66. Tokelau islet, 11/1/67, sex ?, 41.5, 21.7, 33.3, 228 and 117. Same locality and date, male, 44.9, 22.0, 35.8, 232 and 125 and weight 133g. Same locality, 15/1/67, female, 42, 22, 34.1, 224 and 119.

Eight birds were shot for parasitological examination (by M.L.), all of them at Nukunonu. It was with respect to one of these that Dr. Charles O'Brien informed us (*in litt.* to M.L., 1 December 1960) " Your identifications are all correct with just one exception . . . which proves to be the White-capped Noddy *Anous minutus minutus*." The interim field determination was in deference to Mayr (1945) and the Check-list of New Zealand Birds — Fleming's (1953) publication, a revised version of which will shortly appear (Kinsky, 1970). The top of the bird's head was white instead of greyish-white, the rest of the plumage being black, not sooty brown as in *A. tenuirostris*.

Sixteen specimens were obtained by Thompson and Hackman (1968), who also reported upon another 13 examples collected in April 1924 (15 were from Fakaofo, seven from Nukunonu, and seven from Atafu). Four of these birds had small testes, while in 10 the testes were large (4 x 3 mm. to 13 x 7 mm.). Similarly, 11 females had small ovaries and four had large ones.

Lakia were recorded as common at Fakaofo by Fry (1966) on 6/7/65, when both nesting adults and flying juveniles were observed. It was prevalent everywhere on all five of our trips. David Gravatt found Lakia very common at Atafu, nesting on crowns of coconut palms, *Pandanus* spp. and larger trees such as kanava *Cordia subcordata* or pukakakai *Pisonia grandis*. The senior author often observed 12 - 20 Lakia at a time in the Nukunonu lagoon between November, 1966, and February, 1967. Lakia is also very

common at Fakaofo: on 31/8/70, within half-an-hour before sunset 47 Lakia were observed arriving into the lagoon to roost on several islets.

The following information was recorded on Lakia's nesting in the three atolls. Lakia were nesting in January - early February, 1967, at Atafu and occupied nests were found on Tokelau, Long (Vaitupu and Kavakava) and Tepuka North islets, Nukunonu (by K.W.). In 1970 rat control work was carried out on Fenualoa islet during the first three weeks of August (K.W.). Early in August only small numbers of Lakia were observed roosting during daylight but 14 nests were recorded on 14/8/70 on a pukavaka *Hernandia peltata* tree and since that time the numbers of roosting Lakia and nests seemed to increase. However, other observations seem to confuse the issue as collection of nesting material was observed during the last week of November 1966 and in late April, 1968; and on 9 May, 1968, a cluster of 20 nests was seen on Tefakanava motu. According to Isaia (pers. comm. May, 1968) White-capped and Common Noddies are well known to share nesting places.

According to Isaia Lakias have also been used as food on Nukunonu and have been taken in substantial numbers. Vaopuka estimates that about 1,000 birds are being taken a year at Fakaofo. In the past, some protection was afforded to Lakias and certain other birds in that the number of chicks to be taken each year was prescribed by the pulenuu who detailed boys to gather the victims. At present, with an increased human population, there are no restrictions. Isaia and other elders believe that the Lakia population has already significantly declined in consequence.

24. *Gygis alba candida* (Gmelin 1789). White or Fairy Tern. Akiaki[8]. Resident.

AMNH 2249, Matautu, Long islet of Nukunonu, 20/4/60, 44, 14, 245 and 126. DM 15,329, Village motu of Nukunonu, 30/11/66, sex ?, 40.4, 14.8, 26.7, 242.5, and 104. DM 15,330, Tokelau islet of Nukunonu, 28/12/66, sex ?, 39.3, 14.0, 25.9, 246 and 117. DM 15,331, same locality as last, 12/1/67.

The Akiaki follows the Noddies in order of prevalence throughout the Tokelaus. Twelve specimens were handled by Thompson and Hackman between 26 February and 4 March (1968) (four from Fakaofo, three from Nukunonu and five from Atafu). Four were males, the testes being small in one instance and measuring from 5 x 3 mm. to 7 x 5 mm. in the others. The eight females included four with granular ovaries. In two, the largest ovum measured 2 mm., one had a collapsed follicle and a brood patch, and the state of the other was unspecified.

Pairs of birds maintaining beautiful formation or hovering overhead — especially near *Pandanus* trees, as pointed out by Child (1960) — are one of the sights of the Tokelaus. The gracefulness of this species is such that we most strongly urge abandonment of the prosaic translation of the scientific name currently used (Baker 1951, King 1967, and Kinsky 1970), in favour of the more apt "Fairy Tern." This name was used by Mayr (1945) and is in common use among English-speaking residents in the South Pacific.

8 Oddly enough, "Akiaki" is applied to the Black-naped Tern in the Ellice Islands, where the Fairy Tern is called by a very different name, "Matapula" (Child, 1960).

Our subspecific identification is based on a specimen from Nukunonu examined by Dr. Charles O'Brien (*in litt.* to M.L. 1960) and the three birds deposited at the Dominion Museum, Wellington.

On occasion this Tern flies up to a considerable height, pairs of birds then being barely distinguishable as white pinpricks against the blue of the sky (as at Tagiakuli islet, Atafu, at 11.00 on 7/10/58 and on many other occasions). Its whiteness and more erratic flight than that of tropic birds combines with its numbers to make this species easily recognizable when glimpsed from flying boats landing on or taking off from Tokelauan lagoons — many were seen from approximately 300 m altitude during R.N.Z.A.F. "Sunderland" inter-island flights.

The Akiaki probably breeds on most reef islets of all three atolls. It does not build a nest, the single egg simply being deposited on a suitable site, e.g. the rough surface of a more-or-less horizontal *Pandanus* branch as at Kenakena islet, Atafu, 6/10/58 (M.L.). In this context, the observation of Thompson and Hackman (1968) that "Nests . . . were seen on all of the islands" is misleading. The egg is pale green, with brownish and purplish-grey mottling. Egg-laying was recorded at Nukunonu from the end of November 1966 to mid-February 1967, when small unfledged chicks were found. In May 1968 numbers of Akiaki were seen flying inland with fish. These observations indicate that breeding takes place at least from spring to late autumn. According to Isaia and other Tokelauans, most birds breed between September and February but eggs and young can always be found. Vaopuka stated that Akiaki has no regular nesting season on Fakaofo. This agrees with King's (1967) suggestion that breeding of this species takes places throughout the year.

According to elders of Nukunonu, there is no organized catching of this tern. However, children capture many unfledged chicks, some of which are killed, while others are kept as pets. In Fakaofo, according to Vaopuka, 100 - 200 birds are taken annually.

Order Columbiformes
Family Columbidae

25. *Ducula pacifica pacifica* Gmelin 1789. Pacific Pigeon. The Tokelauan name for this, the only resident land bird of the Group, is Lupe. This name is also the one used in Samoa (Armstrong, 1932; Mitchell, 1909) and the Ellice Islands (Child, 1960). Resident.

DM 15,337, Tokelau islet of Nukunonu, 15/12/66, male, 32.1, 46.7, 224 and 132. DM 15,336, same locality as last, 28/12/66, female ?, 24.7, 31.0, 40.8, 228 and 130. DM 15,338, same locality and date as last, male, 27.1, 33.7, 41.8, 232.5 and 138.

"Tame oceanic pigeons" were reported from the Village islet, Atafu, by the United States Exploring Expedition (Wilkes 1845). Material collected by this Expedition was presumably the origin of Gray's (1859) record of "*Carpophaga (Globicera) microcera*" or "'Lupi' of the natives of Samoan Islands" from Duke of York's Island (= Atafu). The Whitney South Sea Expedition (Amadon 1943) observed Lupe on Atafu and obtained specimens from Fakaofo (misspelt "Fakaafo."). This pigeon was also recorded by Mayr (1945) as present in the Tokelau Islands. Recently, Thompson and Hackman (1968) declared it to be "common on all of the atolls."

The black knob at the base of the bill, grey crown and upper back, bluish-green upperparts and pinkish-grey underparts served to identify several birds at close range.

The authors found Lupe decidedly less common than indicated by Thompson and Hackman. Thus, in a virtually complete coverage of all the islets of Atafu in October 1958, pigeons were only sighted on Gaga, Te Oki, Titi-o-Pua, Motu-ita-Niu, Tagiakulii, Hakea Losi (three birds) and Itufakalalo (two birds). In April 1960, pairs of pigeons were recorded from three additional localities — Atafu Village islet, Fenualoa and Fogalaki Lalo. The Pacific Pigeon is appreciably less plentiful than this at Nukunonu. David Gravatt found pigeons " not very common but, because of the difficulty in locating them, they may be more plentiful than is believed." On Nukunonu pigeons were only seen in September 1958 at Hologatautai, Lalo, Long islet and Gahapiti islet, and in April 1960 at Tokelau (twice) and Matautu. On the first visit every single islet was thoroughly searched (for mosquito larval habitats) by a line of men moving within talking distance of one another, and it is very unlikely that any significant number of pigeons escaped notice. The junior author failed to observe any pigeons during either visit to Fakaofo, which was not, however, covered by his ground surveys as exhaustively as the other two atolls were. The scarcity of Lupe on Fakaofo was confirmed ten years later in 1970, when most of the islets were visited (Wodzicki 1970): only a single Pacific Pigeon was seen by Vaopuka on Fenualoa islet. At Nukunonu in 1966/67, pigeons were observed three times, twice as small flocks of three to four birds on Tokelau islet. On the other occasion, a pair was seen on the small islets between Tokelau and the Long islet.

Fresh droppings of one of the Tokelau islet birds contained many seeds of gahu *Scaevola frutescens* and islanders with M.L. at the time told him that the berries of this tree and of puapua *(Guettarda speciosa)* constitute the usual food of Lupe. The latter species, *Scaevola* and *Ficus* are mentioned in this context by Child (1960). As in the Ellice Islands, nesting is said to take place in the crowns of tall coconut palms, at the bases of the petioles. The puapua was mentioned to us as an additional site, too.

There is little information regarding the breeding of Lupe in the Tokelaus. Among the four specimens collected and sexed by Thompson and Hackman (1968), two males had testes 14 x 7 mm., one female had an ovum of 3 mm., and all specimens had medium or heavy fat (although one had been producing crop milk between 26 February and 4 March 1965).

Order Cuculiformes

Family Cuculidae

26. *Urodynamis taitensis taitensis* (Sparrman 1787). Long-tailed New Zealand Cuckoo. Kaleva [wrongly reported as " Kaleua " by Thompson and Hackman (1968)]. Migrant. Recorded from Fakaofo in early April 1924 by the Whitney South Sea Expedition (Bogert 1937). Three specimens were recorded by Thompson and Hackman (1968) on 2-4 April 1964 and one in March 1965 — all with small gonads. Its characteristic screech was heard more often than we saw this species. Examples were glimpsed (by M.L.) flying between the crowns of coconut palms at Te Puka north (16/4/60) and Matautu (20 April), Nukunonu. At least two were heard several times and seen on Fenualoa islet, Fakaofo, in the second and third weeks of August, 1970. Also heard but not seen in May 1968 at Vao and Long islet, Nukunonu. The name " Aleva " is employed in Samoa (Armstrong, 1932; Mitchell, 1909) and " Kaleva," as in the Tokelaus, is used in the Ellice Islands (Child, 1960). In New Zealand, though, this bird's Maori name is " Koekoea " (Oliver, 1955).

SOME OBSERVATIONS ON TOKELAUAN BIRD LORE

(i) *Bird Traps*

Although bird traps are known to have been used in many islands of the Pacific (Child 1960), they were not described by Macgregor (1937). The latter stated that seabirds " are snared and netted " though with their eggs they " form a very small part of the food supply." Two such traps were demonstrated (to M.L.) by Opeta Faraimo of Fakaofo, and are described below.

The first of these (Plate XXXII) is called Mailei-Tuli (" Mailei," trap; " Tuli," Pacific Golden Plover). Consisting of a coconut with the husk removed and the top quarter or so of the shell sliced away, this has three vertically-orientated slip nooses of coconut fibre arranged just within the cavity and a larger slip noose standing up from the lip. A Tuli or another charadriiform bird trying to reach the undisturbed white meat would follow the route indicated by Opeta's finger in Plate XXXII, thus ensnaring itself. The coconut fibre loops are termed " mata-tipa," the shell and intact kernel being called " gai." This type of trap closely resembles the first of the two types of Gilbertese turnstone traps briefly described by Child (1960).

[Marshall Laird

Plate XXXII — Mailei-Tuli, slip-noose trap for northern waders. Fakaofo Village islet, 28/4/60.

The second type, called Mailei-Fiti (Plates XXXIII & XXXIV), is somewhat more complex. In it, the cut-off end of a niumata-stage coconut is placed meatside uppermost as bait, with a vertical peg in the middle. The top of the latter abuts against a horizontal stock braced beneath a cross-piece, wedged beneath pieces of coral and holding open a slip noose depending from a gagie *(Pamphis acidula)* or puapua *(Guettarda speciosa)* upright termed the " hilaki." The taut cord at the far right of Plate XXXIII is leading up to this; although in the present case it happens to be made of nylon fishing line, the broadly spread noose is still called " mata-tipa." When a Tuli leans down into the trap as again indicated by the finger, the peg and horizontal brace are flung aside as the trap is sprung, the noose being jerked tight around the neck of the bird, which remains tethered to the top of the " hilaki " (Plate XXXIV). The name " mailei-fiti " (" fiti " spring) is applied to this device. Both types of traps, it should be noted, are carefully set with the lateral areas (shown open in the photographs) blocked up with coral fragments or wood, so that the victim approaches from the correct direction.

(ii) *Bird Tales*

On each of the atolls the same story of how the migratory birds reproduce was told (to M.L.) that Child (1960) relates with respect to the Gilbertese and Long-tailed Cuckoo (and also to other species including the Bristle-thighed Curlew). Namely, that these birds (and especially the Pacific Golden Plover, in the Tokelau version) fly far up into the sky before laying their eggs. As hatching takes place on the way down, and the duration of the fall further permits the chicks to become fully fledged before reaching the ground, the Tuli obviously has no need of a nest; which explains why nobody has ever discovered one in the Tokelaus.

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Plate XXXIII — Mailei-Fiti, spring trap for northern waders. Set position. Fakaofo Village islet, 28/4/60.

Our second tale has strong Samoan overtones. It concerns a girl named Sina (" Hina " would be the Tokelauan version) and is probably simply put into a Tokelauan setting from a Samoan original. It seems that all the birds — and not only the common ones like Lakia, but Talagogo and Tavake, too — wanted to marry Sina. Her mother was against the idea from the start, though, saying " where would she sleep, for example ? On the sand ? In a tree ? " However, she was finally won over after Tavake had promised to provide a home in the hollow trunk of a puka tree. The marriage duly took place. Every morning Tavake would now fly off to catch fish for Sina (who had an excellent appetite) and himself. Resenting the increasing mortality, the fish declared their enmity to the union. Things came to a head one morning when Tavake was standing on a stone on the reef (to show that this is a true story, the teller can point out to this day the stone in question, " Fatu o te Tavake," on the seaward side of the Village islet, Nukunonu). Holding an emergency meeting, the fish decided that one of their number would knock Tavake into the water. Aseu (Mala-ovi in Samoan) promptly volunteered, saying that when the waves washed him up to the stone he would leap out and seize the bird. The other fish, though, felt that this plan would not work. Then a second volunteer, Gagale, said that as he somewhat resembled a leaf he would edge his way close, protected by his camouflage, and drag Tavake down. This was approved, so off he went and duly succeeded in grasping Tavake by the leg, calling out to his friends to come and help. They did, those first to arrive killing and eating the luckless bird. The ones that had been furthest away were able to eat only the feathers. To this day these species are still attracted to Tavake feathers when Tokelauans use them as fishing lures, but Gagale, sharks and others whose ancestors devoured the flesh and bones will not respond to

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Plate XXXIV — Mailei-Fiti, spring trap for northern waders. Activated. Fakaofo Village islet, 28/4/60.

this lure. Poor Sina — and it is noted that the dainty Fairy Tern is called Manu Sina in Samoan (Armstrong, 1932; Mitchell, 1909) — was left alone and weeping.

DISCUSSION

Numbers and Relative Abundance of Tokelau Islands Birds

Thompson and Hackman (1968) attempted during their week-long visit to the entire Group to estimate the populations of nine species:— Matuku, Tuli, Tiafee, Vahavaha, Kolili, Tovivi, Gogo, Lakia and Akiaki. The total population of these nine species amounted to 14,094 birds for the three atolls. Unfortunately, they failed to provide information on the method they used for the assessment of the populations counted. In any case, personal experience indicates that such estimates made in so short a time are conjectures rather than evaluations of the populations present.

On the other hand, one of us (M.L.) listed the birds seen in order of abundance, by questioning various inhabitants of Atafu and Nukunonu on a number of separate occasions, often during canoe trips across the lagoon, these being made on most days of the two WHO Expeditions (Laird, 1967). Time precluded building up a similar list at Fakaofo. Table 2 presents these data in decreasing order of abundance for Atafu and Nukunonu and compares them with the population estimates of Thompson and Hackman (also set out therein in decreasing order of their population estimates for all three atolls).

Subjective though these lists are, they do serve to sum up the outstanding characteristics of the avifauna of the Tokelaus. Firstly, they show the difference in relative abundance between various seasons (the junior author's visits took place in September/October 1958 and April 1960). Secondly, they show:

- the overall dominance of a few resident species of noddies and terns;
- the frequency with which northern waders visit the Group;
- that there are well-established resident populations of Reef Herons;
- the relative scarcity of two land birds, the resident Pacific Pigeon and the migratory Long-tailed Cuckoo;
- and the presence in this area of the usual South Pacific frigate birds, boobies, tropic birds and a shearwater.

Especially in view of the Tokelauans' capacities as observers, it was perhaps remarkable that we were never able to learn anything about either petrels or storm-petrels in these waters. Admittedly, the cessation of long inter-island trips many years ago must have certainly limited the opportunities for glimpsing such pelagic birds. Also, pelagic birds even in the past, seldom had the importance that nesting or roosting sea birds had as a welcome food variety in a monotonous diet of fish and coconut.

The Tokelau Islands Bird List

The Tokelau Islands are outside the main shipping lanes (Harrison 1962) and until the recent survey by Thompson and Hackman (1968), no checklist of their birds was available. King (1967) indicated that three species (Sooty Tern, Black-naped Tern, and Brown Noddy) " may breed " and that two species (Black Noddy and White Tern) breed " all year ? " King also reported four species (Red-tailed Tropic bird, Brown Noddy, Great and Lesser Frigate birds) as visitors, and three more (White-tailed Tropic bird, Red-footed Booby and Blue-grey Noddy) as probable visitors.

The present paper provides a list of 26 species, comprising 15 sea birds, eight shore birds and three land birds (including a duck, probably the Grey Duck *Anas superciliosa*, an occasional visitor.) Five sea birds, *Puffinus pacificus, Sula dactylatra, Fregata minor, Sterna lunata* and *S. bergii*, and two shore birds, *Limosa lapponica* and *Numenius phaeopus*, are species not previously reported from the Tokelau Islands. We have not included Ramsay's (1878) almost century-old record of a Blue-grey Noddy *Procelsterna cerulea*. Neither have we attempted to guess at the identity of the Kuli, a whitish Tern, larger than the Fairy Tern, which sometimes lands in trees at Atafu but doesn't nest there (the name of Atafu's Tagiakulii islet means " the crying of the kuli "). It is likely that future investigations may add a few sea- or shore-birds to the present list.

TABLE 2 — Order of Abundance of Characteristic Tokelau Island Birds

DECREASING ORDER OF ABUNDANCE	PRESENT (M.L.) SPECIES	DECREASING ORDER OF ABUNDANCE	ATAFU (M.L.) SPECIES	DECREASING ORDER OF ABUNDANCE	TOKELAU IS. (Thompson and Hackman 1968)
1.	Anous minutus	1.	Anous stolidus	1.	Anous minutus
2.	Anous stolidus	2.	Anous minutus	2.	Anous stolidus
3.	Gygis alba	3.	Gygis alba	3.	Sterna fuscata
4.	)	4.	)	4.	Gygis alba
5.	)	5.	)	5.	Fregata ariel
6.	)	6.	)	6.	Arenaria interpres
7.	)CHARADRIIFORMES	7.	)CHARADRIIFORMES	7.	Sterna sumatrana
8.	)	8.	)	8.	Heteroscelus incanum
9.	)	9.	)	9.	Egretta sacra
10.	Egretta sacra	10.	Sterna sumatrana	10.	Pluvialis dominica fulva
11.	Sterna sumatrana	11.	Egretta sacra	11.	Numenius tahitiensis
12.	Fregata ariel	12.	Sterna fuscata	12.	Sterna bergii
13.	Fregata minor	13.	Fregata ariel	13.	Phaethon rubricauda
14.	Sterna lunata	14.	Fregata minor	14.	Sula sula
15.	Sterna pacifica	15.	Sterna pacifica	15.	Phaethon lepturus
16.	Procelsterna tattensis	16.	Procelsterna tattensis	16.	Sula leucogaster
17.	Sula rubripes	17.	Phaethon rubricauda	17.	Procelsterna tattensis
18.	Sula leucogaster	18.	Phaethon lepturus	18.	Crocethia alba
19.	Phaethon rubricauda	19.	Sula leucogaster	19.	Anas spp.
20.	Phaethon lepturus	20.	Sula sula		
21.	Sterna bergii	21.	Sterna bergii		
22.	Sula dactylatra	22.	Sula dactylatra		
23.	Puffinus pacificus	23.	Puffinus pacificus		
24.	Anas spp.				

Affinities with Other Islands of the Central Pacific

Olosega or Swain's Island is the nearest neighbour, a densely forested atoll only 160 km. from the Tokelau Islands. Clapp (1968a) reported nine species of sea birds, six shore birds and one land bird (New Zealand Long-tailed Cuckoo, *Eudynamis taitensis*). The " vasavasa " referred to Clapp by the islanders is probably the Vahavaha (Ruddy Turnstone, *Arenaria interpres*).

By comparison with the birdlife of the Tokelaus, the most striking absentee from Olosega is the Pacific Pigeon *Ducula pacifica*. Also, the Reef Heron (erroneously described by Clapp, 1968a, as a migrant) appears to be much less common than in the Tokelau Islands. The same applies to the White-capped Noddy *Anous minutus*. The smaller size and the accessibility of all parts of Olosega, together with the presence of casual workers not concerned with bird preservation, help to explain the relative paucity of bird species and the apparently smaller populations present there.

The Phoenix and Line Islands are the two nearest island groups north and north-east of the Tokelau Islands. According to Clapp (1968b), of the 13 bird species recorded in these islands only four shore birds, *Egretta sacra, Numenius phaeopus, Limosa lapponica, Calidris alba,* and one land bird, *Eudynamis taitensis,* are also found in the Tokelau Islands. In the Gilbert Islands which are to the north-west of the Tokelaus, 14 sea birds were recorded (Amerson 1969), of which 12, *Phaethon rubricauda, P. lepturus, Sula dactylatra, S. leucogaster, Fregata minor, F. ariel, Sterna sumatrana, S. fuscata, S. bergii, Anous stolidus, A. tenuirostris* and *Gygis alba,* are shared with the Tokelaus. Similarly, the Gilberts have 19 land and fresh-water species of which 10, *Egretta sacra, Anas* sp., *Pluvialis dominica, Numenius phaeopus, N. tahitiensis, Limosa lapponica, Tringa incana, Calidris alba, Arenaria interpres* and *Urodynamis taitensis,* were recorded in the Tokelaus. The relationship between the Tokelaus and the Ellice Group is even closer, for of some 18 species of sea birds known from the Ellice Islands (Child 1960), 15 have now been recorded in the Tokelaus. Again, of the 14-odd land birds and waders, 12, *Arenaria interpres, Anas* sp., *Pluvialis dominica, Tringa incana, Numenius tahitiensis, Limosa lapponica, Sterna bergii, S. sumatrana, S. fuscata, Calidris alba, Ducula pacifica* and *Urodynamis taitensis,* are shared by the Tokelaus.

The Samoan Islands are the closest major land mass, lying just over 480 km. south of the Tokelaus. We find a considerable similarity between the avifauna of these two groups of islands. Armstrong (1932) recognized 63 bird species, including some 20 sea birds and eight shore birds in Samoa. However, more recently Ashmole (1963) claims that the Samoan avifauna consists of 53 species that include 13 sea birds and six shore birds. Twelve of these sea birds, *Puffinus pacificus, Phaethon rubricauda, P. lepturus, Fregata minor, Sula sula, S. leucogaster, Sterna fuscata, S. sumatrana, S. lunata, Anous stolidus, A. minutus* and *Gygis alba,* are also found in the Tokelaus. Of the eight shore birds observed in the Tokelaus, six, *Egretta sacra, Pluvialis dominica, Arenaria interpres, Numenius taitensis, Limosa lapponica* and *Tringa incana,* occur also in the Samoan archipelago, as do the three land birds, *Anas* sp., *Ducula pacifica* and *Urodynamis taitensis.*

Bird Movements and Dispersal

Little is known of bird movements, dispersal and even of seasonal distribution (King 1967). Also, no analysis of the recoveries made of the approximately two million birds banded by the personnel of the Pacific Biological Survey Programme, Smithsonian Institution (Amerson 1969) is yet available. However, the two records of a Sooty Tern and a Brown Booby recovered during the present work at the Tokelaus indicate displacements of at least 1,600 km. in some species.

Problems of Bird Conservation

Three species of mammals, besides man, occur in the Tokelau Islands (Kirkpatrick 1966; Wodzicki, 1968a, 1968b and 1969): pigs, cats, and one rodent *(Rattus exulans)*[10]. Pigs and cats are comparatively recent introductions and have become feral in some islets of the three atolls. It is known that pigs have largely modified the invertebrate fauna of particular atolls, for example, in the Vao or Village islet of Nukunonuo. They also are potential predators on ground nesting birds, such as some terns. The discovery of Polynesian rat predation on Laysan Albatrosses (Kepler 1967) opens up the possibility that this rodent may affect the numbers and distribution of other (both ground and tree-nesting) species, although no evidence on the matter was found during our surveys. No birds of prey occur in the Tokelau Islands, but of the many invertebrates found there, the Coconut Crab *Birgus latro* may well eat the eggs and young of birds.

[10] Occasional dogs have been brought in, and according to Macgregor (1967) the Spanish discoverers of Olosega (1606) reported that the long-vanished original inhabitants kept small dogs.

Man appears to be the most important and efficient factor affecting birds in tropical islands (Amerson 1969). Thus vegetational changes are caused by the planting of coconut palms or other crops, and direct predation must be admitted too, insofar as wild birds or their eggs are used as human food. According to Macgregor (1937), in former times birds and their eggs played a much less important part in the diet of the Tokelauans than did coconuts and fish. Nevertheless, we now know that practically all the birds found in the Tokelaus (with the apparent exception of *Egretta sacra*), and their eggs, are quite commonly collected. Formerly, the elders seem to have regulated this kind of collecting to a certain degree, but nowadays it seems that any number of birds or eggs may be taken by any inhabitant of the islands on their own family holdings.

During our discussions with many Tokelauans, evidence was advanced that most of the birds particularly sought for food, such as noddies, terns and pigeons, are steadily though not drastically declining. It is thus felt imperative that not only should the existing ban on firearms in the Tokelaus be rigorously maintained, but that a return to the pre-European policy of a *regular* and *controlled* exploitation should be advocated. As in olden times, the control of the bird life — and also of some other natural resources — in the three islands should be entrusted to the Council of Elders (Fono Toeaina) of each atoll, who should decide about the numbers of birds to be taken, and the time when it is permissible to hunt them. The "Big Fono" (a two-day meeting of delegates from all three atolls, convoked by the Administration from time to time) would be the appropriate forum where the necessary legislation could be mooted before being tabled before Parliament in New Zealand. Concurrently it is recommended that an account of the Tokelau Islands birds and of other important renewable natural resources of the atolls and of their conservation should be included in the Tokelau schools curriculum.

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