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ATOLL RESEARCH BULLETIN

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19. Check List of Atolls

by E. H. Bryan, Jr.

20. Health Report on Kapingamarangi

by Ralph E. Miller

21. Notes on Ngaruangl and Kayangel Atolls, Palau Islands

by J. L. Gressitt

22. Summary of Information on Atoll Soils

by E. L. Stone, Jr.

23. Vegetation of Central Pacific Atolls, A Brief Summary

by F. R. Fosberg

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ACKNOWLEDGMENT

It is a pleasure to commend the far-sighted policy of the Office of Naval Research, with its emphasis on basic research, as a result of which a grant has made possible the continuation of the Coral Atoll Program of the Pacific Science Board.

It is of interest to note historically, that much of the fundamental information on atolls of the Pacific was gathered by the U. S. Navy's South Pacific Exploring Expedition, over one hundred years ago, under the command of Captain Charles Wilkes. The continuing nature of such scientific interest by the Navy is shown by the support for the Pacific Science Board's research programs, CIMA, SIM, and ICCP, during the past six years. The Coral Atoll Program is a part of SIM.

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No. 19

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CHECK LIST OF ATOLLS

Compiled for the Pacific Science Board

by E. H. Bryan, Jr.

The following is a list of islands which are believed to qualify as "atolls," as defined at the Coral Atoll Symposium, held in Honolulu, T.H., in February 1951. Included are non-elevated limestone structures with dry land, with or without a lagoon, and not associated closely with high land. Excluded are elevated atolls (height more than about 25 feet above the sea), sunken atolls (without dry land), barrier reefs surrounding high islands (such as the Truk group), and reef structures on fringing shelves or platforms adjacent to land masses (such as those on the Great Barrier Reef or to the north of western Java.)

This list is believed to contain most of the reef structures which qualify as "atolls" in Polynesia and Micronesia. The compiler is less familier with the reefs of other regions, and it is not unlikely that some "atolls" have been overlooked. Additions and correotions are desired, and your help is solicited to make a future edition of this list as complete as possible. A number of suggestions have been received from Dr. F.R.Fosberg, and his help is gratefully acknowledged. Please send any data you may have to the writer at Bernioe P. Bishop Museum, Honolulu 17, Hawaii. Please include the geographical coordinates of the reef, or reference to some chart or publication, from which its qualifications as an "atoll" may be verified.

The arrangement in this list is similar to that used in the author's various gazetteers of Pacific islands: a tabulation arranged geographically is followed by an alphabetical list of all the names, keyed to the first list by means of letters and numbers. The letters refer to logical, convenient, or established areas; the numbers to islands within the areas, in some definite sequence.

Under "notes", brief reference is made to such items of interest as elevations, number of islets, and the like; particularly those which might indicate that the reef is not a typical atoll. In the last column, reference is given to a chart which shows the atoll or its location. Most of the numbers refer to U. S. Hydrographic Office charts.

About 400 "atolls" are listed. Of these, 136 are in Polynesia, 92 in Micronesia, 66 in Melanesia, 15 in Indonesia, 5 northwest of Australia, 68 in the rest of the Indian Ocean, 26 in the Caribbean Sea, and only one in the Atlantic. The greatest number in any political subdivision is the 75 in the Tuamotu Archipelago; however, across the central Pacific and out through Micronesia there are 136, one group crowding close upon the heels of another. Notes scattered through this list explain uncertainties regarding the exact status of reef structures in various groups, such as the Louisiade Archipelago [which has been added as M'], Indonesia, the islands northwest of Australia, and the Caribbean region.

GEOGRAPHICAL LIST OF ATOLLS

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
A.	EASTERN PACIFIC				
1.	Clipperton Island	1 39 N.	92 00 W.	Rock 62' high	1680
2.	Ducie Island	24 40 S.	124 48 W.	Trees 26 feet	1977
3.	Oeno Island (Martha Island)	23 56 S.	130 44 W.		1977
4.	Timoe Island (Crescent Island)	23 20 S.	134 30 W.	[Gambier Is.]	77
B.	TUAMOTU ARCHIPELAGO (Paumotu, Low Islands)				
1.	Morane Island (Cadmus Island)	23 07 S.	137 07 W.		77
2.	Maria Island (Moerenhout Island)	22 01 S.	136 10 W.		77
3.	Maturei-vavao [Island] (Melbourne Island)	21 26 S.	136 25 W.	[Nos. 3 to 6 make up the Actaeon or Amphitrite Islands]	77
4.	Tenarunga Island (Minto Island)	21 19 S.	136 33 W.		77
5.	Vahanga Island (Bedford Island ?)	21 20 S.	136 39 W.		77
6.	Tenararo Island	21 19 S.	136 46 W.		77
7.	Fangatau Island (Fangataufa Island) (Ahunui Island) (Cockburn Island)	22 15 S.	138 42 W.		77
8.	South Marutea Island (Marutea Island) (Lord Hood(s) Island)	21 30 S.	135 30 W.		77
9.	Mururoa Island (Matilda Island) (Osnaburgh Island)	21 50 S.	138 55 W.		77 2004
10.	Tematangi Island (Bligh(s) Island)	21 40 S.	140 40 W.		77

Key No. B.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
11.	Tureia Island	20 46 S.	138 31 W.		77
	(Carysfort Island)				
	(Papakena Island)				
12.	Vanavana Island	20 37 S.	139 08 W.		77
	(Barrow Island)				
	(Kuratake Island)				
13.	Nukutipipi Island	20 42 S.	143 03 W.	[Nos 13-15 make	77
	(Margaret Island)			up the Duke of	84
				Gloucester	
14.	Anu-anu-runga Island	20 38 S.	143 33 W.	Islands]	77
	(Four Crowns)				84
	(Quatro Coronados)				
	(Teku Island)				
15.	Anu-anu-raro Island	20 28 S.	143 33 W.		77
	(Archangel)				84
	(Heretua)				
	(San Miguel Archangel)				
16.	Hereheretue Island	19 53 S.	145 05 W.		77
	(Saint Paul Island)				84
	(San Pablo Island)				
17.	Reao Island	18 30 S.	136 20 W.		77
	(Clermont de Tonnere I.)				78
	(Clermont-Tonnerre)				
18.	Pukaruha Island	18 20 S.	137 02 W.		77
	(Searle Island)				78
19.	Tatakoto Island	17 20 S.	138 22 W.		77
	(Clerke Island)				
	(Narcissus Island)				
	(San Narciso)				
20.	Pinaki Island	19 22 S.	138 42 W.		77
	(Whitsunday Island)				
21.	Nukutavake Island	19 [illegible] S.	138 51 W.		77
	(Queen Charlotte I.)				
22.	Vairaatea Island	19 18 S.	139 19 W.		77
	(Egmont Island)				
23.	Vahitahi Island	18 44 S.	138 52 W.		77
	(Cook Lagoon)				
	(Four Facardins)				
	(Lagoon Island)				

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
B. [TUAMOTU ARCHIPELAGO, Cont.]					
24.	Akiaki Island (Lancier Island) (Thrum Cap)	18 30 S.	139 14 W.		77
25.	Ahunui Island (Byam Martin Island)	19 40 S.	140 25 W.		77
26.	Paraca Island (Gloucester Island) (Hariri Island)	19 09 S.	140 43 W.		77
27.	Manuhangi Island (Cumberland Island)	19 11 S.	141 15 W.		77
28.	Nengonengo Island (L'Orange Island) (Prince William Henry I.)	18 50 S.	141 47 W.		77
29.	Hao Island (Bow Island) (Harp Island) (La Harpe Island)	18 10 S.	140 55 W.		77 2004
30.	Amanu Island (Moller Island)	17 48 S.	140 45 W.		77 2061
31.	Ravahere Island (Dawhaida Island)	18 13 S.	142 10 W.		77 79
32.	Marokau Island	18 03 S.	142 17 W.		77 79
33.	Reitoru Island (Bird Island)	17 48 S.	143 06 W.		77
34.	Haraiki Island (Croker Island) (St.Quentin Island)	17 28 S.	143 32 W.		77
35.	Hikueru Island (Melville Island)	17 36 S.	142 40 W.		77
36.	Tekokota Island (Doubtful Island)	17 19 S.	142 37 W.		77
37.	Tauere Island (Resolution Island) (St.Simeon Island)	17 22 S.	141 28 W.		77 83

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
B.	[TUAMOTU ARCHIPELAGO, Cont.]				
38.	Rekareka Island (Good Hope Island)	16 49 S.	141 55 W.		77
39.	North Marutea Island (Furneaux Island) (Marutea Island)	17 00 S.	143 10 W.		77
40.	Nihiru Island (Nigeri Island)	16 43 S.	142 50 W.		77
41.	Pukapuka Island (Dog Island) (Henauke Island) (Honden Island)	14 56 S.	138 45 W.		77 83
42.	Fakahina Island (Fangahina Island)	15 59 S.	140 07 W.		77 2038
43.	Angatau Island (Arachecheeff Island) (Arakchev Island)	15 49 S.	140 51 W.		77
44.	Napuka Island (Wytoohee Island)	14 09 S.	141 15 W.	[44 & 45 make up the Disappointment Group]	77 78
45.	Tepoto Island (Otooho Island)	14 05 S.	141 24 W.		77 78
46.	Takume Island (Wolchonsky Island) (Wolkonsky Island)	15 45 S.	142 10 W.		77 83
47.	Raroia Island (Barclay de Tolley I.)	16 05 S.	142 23 W.	[1952 survey]	77 2024
48.	Taenga Island (Holt Island) (Yermaloff Island)	16 19 S.	143 06 W.		77
49.	Makemo Island (Koutousoff Island) (Phillips Island)	16 35 S.	143 20 - 144 W.		77 2037
50.	Katiu Island (Saken Island)	16 25 S.	144 20 W.		77
51.	Tuanake Island (Reid Island)	16 40 S.	144 14 W.	[51-53 make up the Raveski or Seagull group]	77 82

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
B.					
52.	Hiti Island	16 42 S.	144 08 W.		77, 83
53.	Tepoto Island (Eliza Island)	16 48 S.	144 17 W.		77, 83
54.	Motutinga Island (Adventure Island)	17 05 S.	144 22 W.		77
55.	Tahanea Island (Tchigschagoff I.)	16 56 S.	144 47 W.		77 2159
56.	Anaa Island (Chain Island)	17 25 S.	145 30 W.		77
57.	Faaite Island (Myloradowitich I.)	16 44 S.	145 15 W.		77
58.	Fakarava atoll (Wittgenstein Island)	16 20 S.	145 30 W.		77 2063
59.	Raraka Island	16 10 S.	144 50 W.		77, 80
60.	Taiaro Island (King's Island)	15 44 S.	144 37 W.		77, 79
61.	Kauehi Island (Vincennes Island)	15 50 S.	145 10 W.		77, 80 88
62.	Aratika Island (Carlshov Island) (Karlshoff Island)	15 33 S.	145 30 W.		77, 81
63.	Toau Island (Elizabeth atoll)	15 52 S.	146 - W.		77 2004
64.	Niau atoll (Greig atoll)	16 10 S.	146 20 W.		77
65.	Kaukura atoll	15 40 S.	146 49 W.	[65 to 67 called Palliser,	77
66.	Apataki Island (Hegemeister Island)	15 25 S.	146 20 W.	Schadelyk, or Pernicious Islands.]	77,81 2062
67.	Arutua Island (Rurick Island)	15 10 S.	146 45 W.		77
668.	Tikei Island (Romanzoff Island)	14 54 S.	144 32 W.		77
69.	Takaroa Island (Tiokea atoll)	14 27 S.	144 55 W.	[69-70, King George's group]	77, 81

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	B. [TUAMOTU ARCHIPELAGO Cont.]				
70.	Takapoto Island (Oura I., Ura atoll) (Taputa Island)	14 36 S.	145 12 W.		77, 81
71.	Manihi Island (Waterlandt Island) (Wilsens Island)	14 26 S.	145 55 W.		77, 82
72.	Ahe Island (Peacock Island)	14 30 S.	146 17 W.		77, 82
73.	Rangiroa Island (Deans Island) (Nairea atoll) (Rahiroa atoll) (Vliegen atoll)	15 05 S.	147 40 W.		77, 85 960
74.	Tikahau Island (Krusenstern Island)	15 00 S.	148 10 W.		77, 85
75.	Matahiva Island (Lazareff Island) (Mataiwa Island)	14 54 S.	148 40 W.		77, 85
	C. AUSTRAL [1], SOCIETY [2-6], and MARQUESAS ISLANDS [7]				
1.	Maria Island (Hull Island) (Nororutu Island) (Sands Island)	21 49 S.	154 41 W.		2228
2.	Tetiaroa Island (Fugitive Island) (Tetuaroa Island) (Umaitia Island)	17 05 S.	149 32 W.		77
3.	Tubai Island (Motu Iti)	16 16 S.	151 49 W.		2023
4.	Mopihaa Islands (Howe I., Lord Howe I.) (Maura Island) (Mobidie Island) (Mopelia Island)	16 49 S.	153 57 W.		1987
5.	Fenua Ura (Scilly Islands)	16 30 S.	154 40 W.		824a
6.	Bellingshausen Island	15 50 S.	154 30 W.		824a
7.	Coral Island (Cotar Island) (Ile de Sable)	7 63 S.	140 23 W.		1797

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
D.	CENTRAL PACIFIC (British South Equatorial [1-5], Equatorial [6,10,33,34], British North Equatorial [7,8,9], Cook [11,12], Northern Cook [13-19], Tokelau [22-24], Phoenix [25-32].				
1.	Caroline Island (Thornton I.)	10 00 S.	150 14 W.		1980
2.	Flint Island	11 26 S.	151 48 W.	No lagoon	1980
3.	Vostok Island (Anne I.) (Stavers I.) (Bostock I.)(Vostock I.) (Wostock I.)	10 06 S.	152 23 W.	No lagoon	1980
4.	Starbuck Island (Volunteer I.)	5 37 S.	155 53 W.	No lagoon	1980
5.	Malden Island (Independence I.) (Maldon I.)	4 03 S.,	154 59 W.	Shallow lagoon entirely enclosed	1980
6.	Jarvis Island (Brock, Brook I.) (Bunker, Jervis I.) (Volunteer I.)	0 23 S.	160 02 W.	No lagoon, "pancake"	1198
7.	Christmas Island	1 55 N.	157 20 W.	Largest land area	1839
8.	Fanning Island (Tapuaerangi)	3 54 N.	159 23 W.		1824
9.	Washington Island (New York I.) (Prospect I.)	4 43 N.	160 26 W.	Bogs and fresh water lake	1839
10.	Palmyra Island (Samarang I.)	5 52 N.	162 06 W.		1839
10A.	Kingman Reef	6 23 N.,	162 20 W.	Sunken atoll dry patch E end	2020
11.	Takutea Island (Fenua Iti) (Otakootaia)	19 49 S.	158 18 W.		2000
12.	Hervey Islands [Made up of:] Auotu or Te Au o Tu Manuae [I.]	19 21 S.	158 56 W.		2000
13.	Tongareva Island (Mangorongoro I.) (Penrhyn I,)	9 00 S.	158 03		1980
14.	Manihiki Island (Humphrey I.) (Manahiki I.)	10 23 S.	161 01 W.		1980

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	D. CENTRAL PACIFIC (cont.)				
15.	Rakahanga Island (Grand Duke Alexander) (Reirson I.)	10 02 S.	161 06 W.		1980
16.	Palmerston Islands (Auarua I.)	19 04 S.	163 10 W.		1980
17.	Suvarov Islands (Souworoff Is.) (Suwaroff, Suwarrow Is.)	13 15 S.	163 05 W.		1980
18.	Nassau Island (Mitchell I.)	11 33 S.	165 25 W.	No lagoon	1980
19.	Pukapuka [atoll] (Danger Islands)	10 55 S.	165 50 W.		1980
20.	Rose atoll (Kordinkoff I.)	14 33 S.	168 09 W.		2924
21.	Swains Island (Gente Hermosa) (Jenning's I.) (Olosenga, Quiros I.)	11 03 S.	171 05 W.	"Doughnut", nearly fresh lake	5419
22.	Fakaofu Island (Bowditch I.) (Fakaafo I.)	9 23 S.	171 15 W.		126
23.	Nukunono Island (Duke of Clarence I.)	9 10 S.	171 53 W.		126
24.	Atafu Island (Duke of York I.) (Oatafu I.)	8 32 S.	172 31 W.		126
25.	Sydney Island (Manra I.)	4 27 S.	171 16 W.	"Doughnut", very salt lagoon	5738
26.	Hull Island (Orona I.)	4 29 S.	172 10 W.		5737
27.	Gardner Island (Kemins I.) (Nikumaroro)	4 40 S.	174 32 W.		5738
28.	McKean Island	3 36 S.	174 08 W.	"Pancake" "dug" lagoon	5739
29.	Birnie Island	3 35 S.	171 31 W.	"Pancake"	5739
30.	Phoenix Island	3 43 S.	170 43 W.	Small lagoon	5739
31.	Enderbury Island	3 08 S.	171 05 W.	Small lagoon	5739
32.	Canton Island (Abariringa, Mary I.) (Mary Balcout I.) (Swallow I.)	2 50 S.	171 43 W.		5740
33.	Baker Island (New Nantucket, Phoebe I.)	0 13 N.	176 28 W.	"Pancake", no lagoon	1198

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	D. CENTRAL PACIFIC (cont.)				
34.	Howland Island (Worth I.)	0 48 N.	176 38 W.	"Pancake" no lagoon	1198
35.	Johnston Island (Cornwallis I.)	16 45 N.	169 30 W.	2 sand islets on shoal	5356

[There are no true atolls in Tonga, and none in Samoa other than Rose atoll. Swains I., administered by American Samoa, is geographically in the Tokelau (or Union) group. Minerva Reef has been called an "atoll", but is submerged.]

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	E. HAWAIIAN ISLANDS				
1.	Laysan Island (Moller I.)	25 46 N.	171 44 W.	Shallow lagoon	2
2.	Lisianski Island (Pell, Laskar I.) (Lassion, Cladius I.) (Lisiansky I.)	26 04 N.	173 58 W.	No lagoon	
3.	Pearl and Hermes Reef	27 48 N.	175 51 W.	Atoll	
4.	Midway Islands (Brooks, Middlebrook Is.) (Massachusetts I.)	28 13 N.	177 23 W.	Atoll	1952
5.	Kure Island (Cure I., Ocean I.)	28 25 N.,	178 25 W.	Atoll	
	F. ELLICE ISLANDS				
1.	Niulakita (Nurakita I.) (Sophia I.)	10 45 S.	179 30 E.		1981
2.	Nukulailai (Mitchell I.) (Nukulaelae)	9 22 S.	179 51 E.		1981
3.	Funafuti (Ellice atoll) (Fanaawa I.)	8 31 S.	179 08 E.		1802
4.	Nukufetau (De Peyster I.)	8 00 S.,	178 29 E.		1981
5.	Vaitupu Island (Aitupu, Oaitupu I.) (Tracy I.)	7 28 S.	178 41 E.		1981
6.	Nui Island (Egg, Netherland I.)	7 16 S.	177 10 E.		1981
7.	Niutao Island (Lynx, Sepper I.) (Speiden I.)	6 06 S.	177 16 E.		1981
8.	Nanumanga Island (Hudson, Nanomana I.)	6 18 S.	176 21 E.		1981

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(F. ELLICE ISLANDS cont.)				
9.	Nanumea Island (Nanomea I.) (St.Augustine Is.)	5 39 S.	176 08 E.		1981
	G. GILBERT ISLANDS				
1.	Arorae Island (Arorai I., Hurd I.)	2 39 S.	176 49 E.	[No lagoon]	119
2.	Tamana Island (Rotcher I.)	2 32 S.	175 58 E.	[No lagoon]	119
3.	Onotoa Island (Clerk I.)	1 50 S.	175 33 E.		119
4.	Tabiteuea Island (Drummond I.) (Tapeteuea, Taputeuea I.)	1 25 S.	174 50 E.		119
5.	Nikunau Island (Byron I., Nukunau I.)	1 21 S.	176 28 E.	[No lagoon]	119
6.	Beru Island (Francis I., Peru I.)	1 20 S.	176 00 E.		119
7.	Nonouti Island (Nonuti, Sydenham I.)	0 40 S.	174 20 E.		121,2179
8.	Aranuka Island (Henderville I.) (Nanouki I.)	0 10 N.	173 38 E.		122
9.	Kuria Islands (Woodle I.)	0 14 N.	173 25 E.	[No lagoon]	122
10.	Abemama Island (Apamama, Hopper I.)	0 21 N.	173 51 E.		122 4001,4002
11.	Maiana Island (Hall I.)	1 00 N.	173 01 E.		122
12.	Tarawa Island (Cook I., Knox I.)	1 30 N.	173 00 E.	[AMS and war maps]	122
13.	Abaiang Island (Apaiang I., Apia I.) (Charlotte I.)	1 50 N.	173 02 E.		123
14.	Marakei Island (Maraki I., Matthew I.)	2 00 N.	173 20 E.		122
15.	Butaritari Island (Makin I., Taritari I.)	3 05 N.	172 50 E.	[AMS maps]	2179
16.	Little Makin Island (Makin I.["Muggin"]) (Makin Meang, Pitts I.)	3 16 N.	172 58 E.	[AMS maps] [No lagoon]	

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	H. MARSHALL ISLANDS				
	(RATAK Chain, south to north)				
1.	Mili Atoll (Mille, Milli I.) (Mire, Miri To) (Mulgrave I.)	6 08 N.	171 57 E.	[AMS maps]	6001,6002
2.	Arno Atoll (Ahrno I.,Aruno To) (Daniel D.,Pedder I.)	7 05 N.	171 42 E.	[AMS maps]	6004,6005
3.	Majuro Atoll (Arrowsmith I.) (Madjuro I.,Mezyuro To)	7 07 N.	171 12 E.	[AMS]	F.2007,2008.
4.	Aur Atoll (Aurh I.,Auru To) (Ibbetson, Traversey I.)	8 15 N.	171 05 E.	[AMS maps]	6014
5.	Maloelap Atoll (Arakcheeff Is.) (Bass Reeftied, Calvert) (Kaven, Kawen) (Maloelab, Maroerappu To)	8 45 N.	171 00 E.	[AMS maps]	6014,6016
6.	Erikub Atoll (Erikuppu To) (Tschitschagoff)	9 08 N.	170 00 E.	[AMS maps]	6017
7.	Wotje Atoll (Odjia, Odtia) (Romanzoff,Romanzov,Romanzow) (Wotsch, Wozzie To)	9 28 N.	170 00 E.	[AMS],	6017,6018,6019
8.	Likiep Atoll (Count Heiden) (Likieb, Rikieppu To)	9 55 N.	169 08 E.	[AMS maps]	6020
9.	Jemo Island (Djemo,Temo,Timo) (Tiemo To)	10 08 N.	169 32 E.	[AMS maps] (No lagoon)	5413,5427
10.	Ailuk Atoll (Ailu, Airukku To) (Tindal, Watts)	10 20 N.	169 57 E.	[AMS maps]	6022
11.	Mejit Island (Mejdit, Meziti To) (Miadi, New Year I.)	10 17 N.	170 53 E.	[AMS map] (No lagoon)	5413
12.	Taka Atoll (Teke To) (Suvarov, Suwarow)	11 08 N.	168 38 E.	[AMS maps]	6023
13.	Utirik Atoll (Kutusov, Kutusow) (Utorokku To)	11 15 N.	169 48 E.	[AMS maps]	6023
14.	Bikar Atoll (Dawson, Pikaru To)	12 15 N.	170 05 E.	[AMS maps]	6024

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(H. MARSHALL ISLANDS cont.)				
15.	Taongi or Pokak Atoll (Gaspar Rico) (Pokaakku To, Smyth I.)	14 35 N.	168 58 E.	[AMS maps]	6024
	(RALIK Chain, south to north)				
16.	Ebon Atoll (Boston, Epon To)	4 38 N.	168 43 E.	[AMS maps]	5429
17.	Namorik Atoll (Baring, Namurikku To)	5 36 N.	168 07 E.		5429
18.	Kili Island (Hunter I., Kiri To)	5 39 N.	169 07 E.	[AMS map] (No lagoon)	5414
19.	Jaluit Atoll (Bonham, Djaluit) (Yaruto To) (Coquille [N.part]) (Elizabeth [S.part])	6 00 N.	169 35 E.		6007 ,6008,6010
20.	Ailinglapalap Atoll (Airingurapurapu To) (Elmore, Odia) (pronounced "Eye-ling-lub-lub")	7 25 N.	168 45 E.		6011,6012
21.	Jabwot Island (Djabwat I.,Zyabatto To)	7 45 N.	168 59 E.	[AMS map] (No lagoon)	6011
22.	Namu Atoll (Namo, Nemu, Musquillo) (Lambert [N.part]) (Ross Is.[S.part])	8 00 N.	168 10 E.	[AMS maps]	6013
23.	Lib Island (Erippu To, Lip I.)	8 19 N.	167 24 E.	[AMS map] (No lagoon)	5428
24.	Lae Atoll (Brown, Lai, Rae To)	8 56 N.	166 15 E.	[AMS maps]	6036
25.	Ujae Atoll (Catherine, Katharine) (Udjae, Uzyae To)	9 04 N.	165 38 E.	[AMS maps]	5428
26.	Kwajalein Atoll (Kuezyerin To) (Kwedhelin & other variants) (Menschikoff, Mentschikow) (Catherine [N.part]) (Lydia [middle part]) (Margaretta [S.part])	9 05 N.	167 20 E.	[AMS maps] (Largest lagoon in Marshalls)	5428
27.	Wotho Atoll (Schanz, Uotto,Wotto To) (Wottho Inseln)	10 07 N.	165 58 E.	[AMS maps]	5427
28.	Ailinginae Atoll (Airinginae To)	11 08 N.	166 30 E.	[AMS maps]	6026

Key No.	Accepted name	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(H. MARSHALL ISLANDS cont.)				
29.	Rongerik Atoll (Pescadore Is.) (Rongirikku To)	11 20 N.	167 27 E.	[AMS maps]	6026
30.	Rongelap Atoll (Rimski-Korsakoff Is.) (Rongelab, Rongorappu To)	11 20 N.	166 50 E.	[AMS maps]	6029
31.	Bikini Atoll (Bigini, Pikinni To) (Escholtz, Eschscholtz)	11 35 N.	165 23 E.	[AMS maps] (Atomic tests)	6032
32.	Eniwetok Atoll (Brown, Eniaidok) (Eniwetakku To)	11 30 N.	162 15 E.	[AMS maps] (Atomic tests)	6033
33.	Ujelang Atoll (Arecifos, Providence) (Udjelang, Uziran To)	9 50 N.	160 55 E.	[AMS maps]	6035
	I. ISOLATED ISLANDS IN NORTHWEST PACIFIC				
1.	Wake Island or Atoll (Halcyon, Mendana) (San Francisco, Otori Jima) (Wakes I.)	19 17 N.	166 35 E.	[AMS map]	162
2.	Marcus Island (Minami Tori Shima)	24 18 N.	153 58 E.	(No lagoon)	5590
3.	Parece Vela (Douglas Reef)	20 25 N.	136 05 E.	(Reported 10 ft. elev.)	5590
	J. CAROLINE ISLANDS (east to west)				
1.	Pingelap Atoll (McAskill, Macaskill) (Musgrave, Pelelap, Pelelep) (Pingarappu To, Pingoulap)	6 13 N.	160 41 E.		5425
2.	Mokil Atoll (Duperry, Duperrey) (Mokiru To, Mogal) (Wellington I.)	6 40 N.	159 46 E.		5425
3.	Ant Atoll (Andema, Anto To) (Fraser, William the Fourth)	6 54 N.	157 58 E.		6039,6041
4.	Pakin Atoll (Pagenema, Paguenema)	7 03 N.	157 48 E.		6039
5.	Ngatik Atoll (Natikku To, Los Valientes) (Raven, Seven Is.)	5 50 N.	157 48 E.		6042,6108
6.	Oroluk Atoll (Baxotristo) (Oraluk, Ororukku To)	7 32 N.	155 18 E.		6043

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(J. CAROLINE ISLANDS cont.)				
7.	Nukuoro Atoll (Dunkin, Monteverde) (Monteverdeson's group) (Nugoru To)	3 51 N.	154 58 E.		6042
8.	Kapingamarangi Atoll (Constantine, Greenwich) (Gurmnitti To, Kabeneylon) (Kapen-Mailang, Makarama) (Pescadores, Pikiram)	1 03 N.	154 46 E.		6042
9.	Nomoi or Mortlock Islands (Lukunor-gruppe) (Mototokke Shoto)			[Made up of three atolls]	6044
a.	Etal Atoll (Etaru To, Naiad) (Namolotou)	5 35 N.	153 34 E.		6044
b.	Lukunor Atoll (Namonefeng, Rukunoru To)	5 31 N.	153 46 E.		6044
c.	Satawan Atoll (Satoan, Sataoan, Satouwan)	5 23 N.	153 35 E.		6044,6045
10.	Namoluk Atoll (Harvest, Skiddy, Namorukku To)	5 55 N.	153 08 E.		5425
11.	Losap Atoll (Duperrey, Lossop-Inseln) (Louasappe, Lukeisel) (Rosoppu To, Royalist)	6 52 N.	152 42 E.		5424
12.	Nama Island (San Rafael, d'Urville-Insel)	7 00 N.	152 35 E.	(No lagoon)	5424
13.	Hall Islands			[Made up of two atolls]	
a.	Murilo Atoll (Morileu, Mourileu) (Muriro Shoto)	8 40 N.	152 12 E.		6052
b.	Nomwin Atoll (Fananou, Namoin) (Namolipiafane, Namuuin Shoto)	8 31 N.	151 47 E.		6052,6098,6099
14.	East Fayu Island (East Faiu, Faieu) (Japan Fayu, Lütke I.) (Rukute To)	8 34 N.	151 22 E.	(No lagoon)	5425
15.	Kuop Atoll (Kimisisima Shoto) (Kunto Shoto, Royalist Is.)	7 04 N.	151 55 E.	[Immediately south of Truk, which is <u>not</u> an atoll.]	6046
16.	Namonuito Atoll (Aniaima, Bunkey) (Livingston, Lütke) (Onon, Onoun, Onoune) (Ororu Shoto, Remp, etc.)	8 45 N.	150 05 E.		5422

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(J. CAROLINE ISLANDS cont.)				
17.	Pulap Atoll	7 35 N.	149 25 E.		5421
	(Los Martires, Ollap)				
	(Pollap, Pourappu To)				
	(Pullop, Puttep, Tamatam)				
	(Tametam, Temetam Is.)				
18.	Puluwat Atoll	7 21 N.	149 11 E.		5425
	(Endabi, Enderby)				
	(Kata, de Cata, Luguen)				
	(Poloac, Poloat, Polowat)				
	(Poulouote, Puluot, etc.)				
19.	Pulusuk Island	6 41 N.	149 19 E.	(No lagoon)	5425
	(Haug, Hog, Hok, Houg)				
	(San Bartolome, Saok, Saugk)				
	(Sauugk, Schoug, Scheug, Schoog)				
	(Shukku To, Socu, Sog, Sooughe)				
	(Sougk, Souk, Sove, Syukku To)				
20.	Pikelot Island	8 05 N.	147 38 E.	(No lagoon)	5425
	(Coquille, Bigali, Pigali)				
	(Lydia, Pigoualao, Pigerotto To)				
	(Pikela, Pyghella, etc.)				
21.	Satawal Island	7 21 N.	147 02 E.	(No lagoon)	5426
	(Sataual, Satavan, Satawan)				
	(Satuwal, Satowal, Satowalairak)				
	(Sasaon, Setoan, Tucker)				
22.	West Fayu Island	8 05 N.	146 44 E.	(No lagoon)	5426
	(Faliau, Faiyao)				
	(Huiyao, West Faiu)				
23.	Lamotrek Atoll	7 30 N.	146 20 E.		6042
	(Lamorsu To, Lamureck)				
	(Lamurrec, Namotikku To)				
	(Namochikku To, Namouttek)				
	(Namurrek, etc.)				
24.	Elato Atolls	7 30 N.,	146 10 E.	[Two atolls]	5426
	(Elat, Elath, Erato To)				
	(Helato, Olutai, Olutel, Ylatu, etc.)				
25.	Olimarao Islands	7 41 N.	145 52 E.	[Two islands: Olimarao and Filifil]	5426
	(Namoliaour, Olimarau)				
	(Onomarai)				
26.	Gaferut Island	9 14 N.	145 23 E.	(No lagoon)	6042
	(Grimes I., Gurimesu To)				
27.	Faraulep Atoll	8 36 N.	144 33 E.		6042
	(Faraulip, Farroilap)				
	(Fattoilap, Foraulep, Foroilap)				
	(Furaarappu To, Huraarappu To)				
28.	Ifalik Atoll	7 15 N.	144 27 E.		5425
	(Faloc, Furukku To, Hurukku To)				
	(Ifaluk, Ifalouk, Ifelug, Ifeluk, etc.)				

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(J. CAROLINE ISLANDS cont.)				
29.	Woleai Atoll (Anangai, Mereyon To) (Oleai, Oleei, Olie, Ouleai) (Ulea, Uleai, Ulie, Wolea, etc.)	7 21 N.	143 53 E.		6054
30.	Eauripik Atoll (Auripik, Aurupig, Iuripik) (Kama Is., Yoropie) (Yorupikku To, Yuripik, etc.)	6 41 N.	143 03 E.		5426
	[Note: Fais Island is a raised reef structure.]				
31.	Sorol Atoll (Sarol, Saraon, Soral) (Sororu To, Phillip Is.,Zaraol)	8 08 N.	140 23 E.		5426
32.	Ulithi Atoll (Mackenzie Is.,Ouluthy) (Uluthi, Urushi To)	9 56 N.	139 40 E.		6055,6056,6057
33.	Ngulu Atoll (Angegul, Kurru To, Matelotas) (Lamoliaur Ulu, Lamoliork) (Lamuniur, Lumuliur, Ngelu) (Ngiul, Ngolu, Ngoli, Ngolii) (Ngoly, Ngolog)	8 27 N.	137 29 E.		6058
34a.	Ngaruangl Reef	8 10 N.	134 38 E.	[Reef has one islet, 6 ft.]	6074
34b.	Kayangel Islands (Kajangle, Kajanguru) (Kazanguru To, Moore Isle)	8 03 N.	134 43 E.	[Both these are in northern Palau]	6073,6075
35.	Sonsorol Islands (Sonisol, Sonsol, Sonesor) (Sonsonorol, Sonesor, Songosor) (Sonsoru To, Kodgubi) (San Andreas, St.Andrew I.)	5 20 N.	132 13 E.	[Two small islands, no lagoon.]	5424
36.	Pulo Anna Island (Bur, Current, Palolo) (Pul, Pur, Puru Anna, Wul, Wull)	4 40 N.	131 58 E.	[No lagoon]	5426
37.	Merir Island (Merier, Meliel) (Pulo Marier, Warren Hastings)	4 19 N.	132 19 E.	[No lagoon]	5426
38.	Tobi Island (Lord North, Nevil I.) (Codopuei, Kadogubi) (Togobei, Tokobe)	3 00 N.	131 10 E.	[No lagoon]	5426
39.	Helen Reef (Heren Sho, Hoten Rif)	2 55 N.	131 47 E.	[Small, low islet at N. end]	6072
40.	Mapia Atoll (Freewill Is., Onata Is.) (St.David Is.)	0 50 N.	134 17 E.	[Not part of Micronesia, but claimed by Dutch]	5426

K. FIJI

[Note: There are numerous reef structures in Fiji, but few of them qualify as "atolls" because of absence of dry land or proximity to high islands. Only two, Wailangilala and Nggele-levu, are classed as "true atolls" by R.A.Derrick, The Fiji Islands, a geographical handbook. 1951.]

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
1.	Tuvana-i-tholo (Simonoff I.)	21 02 S.	178 50 W.	Small sand cay, 95 ft.to treetops, surrounded by reefs	409
2.	Tuvaba-i-ra (Michaeloff I.)	21 00 S.	178 44 W.	Ditto, 90 ft. to treetops.	409
3.	Niambo Island	18 57 S.	178 22 W.	Ditto, 40 ft. to treetops.	2852
4.	Wailangilala Island	16 45 S.	179 07 W.	True atoll.	2851
5.	Nanuku Reef [Reef complex on or near which are located: Nukusemanu I. 60 ft. Nuku-levu ("covered with trees") Nuku-lailai I. " " "]	16 45 S.	179 27 W.		2851
6.	Nukumbasanga Reef [Circular reef enclosing: Nukumbasanga I. (70 ft.to treetops) Nukumbalate I. (60 ft.to treetops)]	16 17 S.	179 15 W.		2851
7.	Nggele-levu Lagoon [Atoll-like reef, on or near which are: Taulalia I. (30 ft. to treetops) Tainimbeka I. 40 " " " Ngele-levu I. 90 " " ")]	16 05 S.	179 10 W.		2851
8.	Vatauua Island	15 57 S.	179 24 W.	[90 ft.to treetops]	2851

[Near atolls: Mbukatatanoa or Argo Reef has the reef structure of an atoll, but instead of sand islets on the reef there are two piles of rock, Vanua Masi and Bacon Island, in the lagoon.

Reid Reef is an atoll-like, circular reef containing three small, rocky islets: Latei Viti, Latei Tonga, and Booby Rock.

Vekai Rock is a reef rock on the edge of a circular reef, 2 miles in diameter, at 17°33' S., 178°50' W.

Two of the three Nukutolu Islands (17°17'S.,179°39' W.) are low, the third of raised reef material.]

L. WEST OF FIJI TO CORAL SEA (South of Solomon Islands)

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
1.	Reef Islands Rowa Island [50 ft. to treetops] Sanna Island (I.de Sable) [50 ft.]	13 35 S.	167 33 E.		2877
2.	Conway Reef	21 45 S.	172 03 E.	[Sand cay, 6 ft.]	1996
3.	Nokanhui Reef (Hokanhiui)	22 45 S.	167 34 E.	[2 sand cays: Ana and Ami]	2871

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
(L. FIJI TO CORAL SEA, south of Solomon Is. cont.)					
4.	Uvea Atoll	20 35 S.	166 30 E.	Classed as an atoll, possibly raised.	2230
5.	Beautemps-Beaupre Atoll (Heo I.)	20 24 S.	166 10 E.		2230
6.	Petrie Reef (Betsy Reef)	18 27 S.	164 20 E.	(Land 20 ft.)	2027
7.	D'Entrecasteaux Reef Suprise I., Fabre I., Le Leizour I.	18 29 S.	163 07 E.	(Palms, 67 ft.)	2027
8.	Huon Island [& Lagoon]	18 03 S.,	162 58 E.		2027
9.	Bampton Reefs				
	North Bampton Reef:				
	Renard Island	19 14 S.	159 00 E.	[20 ft.]	
	Southeast Bampton Reef	19 08 S.	158 40 E.	[17 ft.]	
10.	South Bellona Reef	21 52 S.	159 25 E.	[10 ft. sand I.]	2002
11.	Middle Bellona Reef	21 24 S.	158 51 E.	[6 ft. cay]	2002
12.	Chesterfield Reefs				2002
	Anchorage Islets	19 54 S.	158 29 E.	[38 ft.]	
	Loop Islet			[12 ft.]	
	Passage (Bennet) I.			[41 ft.]	
	Long Island	19 53 S.	158 19 E.	[25 ft.]	
13.	Avon Isles	19 32 S.	158 15 E.	[17 ft.]	2002
14.	Mellish Reef				
	Herald Bacon Island	17 25 S.	155 52 E.	[6 ft.]	2002
15.	Keen Reef	21 12 S.	155 45 E.	[6 ft. cay]	2002
16.	Cato Reef & Island	23 15 S.	155 32 E.	[19 ft.]	2002
17.	Wreck Reef	22 11 S.	155 20 E.	[18 & 12 ft.]	2002
18.	Frederick Reef	20 58 S.	154 23 E.	[2 cays, 5 ft.]	2002
19.	Saumarez Reefs	20 45 S.	153 40 E.	[2 cays, 8 ft.]	2002
20.	Marion Reef Carola Cay, Second Cay, Paget Cay	19 06 S.	152 24 E.	[3 cays, 5-10 ft.]	2567
21.	Lihon Reef	17 08 S.	152 07 E.	[6 cays, 6-19 ft.]	2941
22.	Diamond Islets	17 26 S.	150 59 E.		2941
23.	Tregrosse Islets	17 43 S.	150 43 E.	[2 small islets]	2941
24.	Coringa Islets	16 57 S.	149 58 E.	[2 islets:	3568
	Chilcott Islet			26 ft. to brushtop]	
	Southwest Islet			44 ft. to brushtop]	
25.	Herald Cays	16 56 S.	149 13 E.	[2 islets: 15-23 ft]	2942
26.	Magdelaine Cays	16 36 S.	150 20 E.	[25 ft. to brushtop]	2942
27.	Willis Islets Willis, Mid and North Islets	16 15 S.	150 00 E.	[3 islets: 19-22 to brushtop]	2002

[Note Middleton Reef and Elizabeth Reef are sunken atolls, awash

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
M.	North of the SOLOMON ISLANDS				
1.	Lord Howe Islands or Ontong Java * (Luangiua, Leueneuwa)	5 20 S.	159 30 E.	[1 of the islets]	2910
2.	Nukumanu group (Tasman Is.)	4 32 S.	159 26 E.		2899
3.	Tanu atoll [Tauu on chart] (Marqueen Is.)	4 50 S.	154 24 E.		2896
4.	Kilinailau Islands (Carteret Is.)	4 44 S.	155 24 E.		2896
5.	Nukuria or Nuguria Islands (Abgaris or Abgarris atoll)	3 20 S.	154 40 E.	[2 atoll reefs]	2943

[Note *: Lord Howe generally is given preference over Ontong Java, but should not be confused with other islands of the same name in the Banks group and east of Australia.
Roncador (Candelaria) 6° 13' S., 159° 20' E., is a circular atoll reef, but awash, without land other than rocks on the reef.]

M'. LOUISIADE Archipelago

[Note: There are numerous small, atoll-like reefs in this area, but the majority seem to make up a barrier reef around Tagula and adjacent high islands. The following may qualify as "atolls."

Key No.	Accepted name	Latitude	Longitude	Notes	H.O. Chart
1.	Bramble Haven	11 14 S.	152 00 E.		2950
2.	Long Reef	11 11 S.	151 45 E.		2950
3.	Redlick Islet	10 55 S.	152 33 E.		2950
4.	Conflict Reef	10 45 S.	151 45 E.		2950
5.	Gallows Reef	10 16 S.	151 10 E.	(2 islets on a sunken atoll rim.]	2950

N. ADMIRALTY Islands and westward.*

Key No.	Accepted name (Alternative names)	Latitude	Longitude	Notes	H.O. Chart
1.	Tong Islands (San Rafael I.)	2 03 S.	147 45 E.		BA.3832
2.	Papialou Islands (Hayrick, Heuschauber)	2 42 S.	147 24 E.		BA.3832
3.	Alim Island (Elizabeth I.)	2 52 S.	147 07 E.		BA.3832
4.	Johnston Islands	2 25 S.	147 05 E.		BA.3832
5.	Purdy Islands (Nager Is.)	2 53 S.	146 20 E.	(4 islets)	BA.3832

[* Note: Hermit Islands are a "Truk type" group of high islands surrounded by an atoll-like barrier reef. Doppel (Sherburne) Reef, Kreis (Circular) Reef, and the Whirlwind Reefs are all sunken atolls, without permanent dry land. Ottilien Reefs consist of four reefs which make up an atoll-like group, with a sand cay on the western reef. Other reef islands, such as Los Reyes, Pak, San Miguel Islands, and St. Andrews Islands, seem to be of raised reef formation.]

Key No.	Accepted name (Alternative names)	Latitude ° '	Latitude ° '	Note	H.O. Chart
(N. ADMIRALTY ISLANDS cont.)					
6.	Sabben Islands	2 12 S.	146 16 E.	Extensive reef	BA.3832
7.	Palawat Islands	1 56 S.	146 29 E.	3 low islets	BA.3832
8.	Western islets	2 13 S.	146 01 E.	Low islet	BA.3832
9.	Kaniet Islands (Anchorite Is.)	0 55 S.	145 30 E.	5 islets	BA.3832
10.	Sae Islands (Commerson Is.)	0 46 S.	145 15 E.	2 islets	BA.3832
[Nos.11-17 make up the NINIGO group]					
11.	Heina atoll	1 07 S.	144 30 E.	6 islets	2969
12.	Pelleluhu or Pelleluch atoll	1 08 S.	144 24 E.	12 islets all on E.side	2969
13.	Ninigo atoll (L'Echiquier)	1 15 S.	144 16 E.	28 islets	2969
14.	Sama "group"	1 24 S.	144 05 E.	3 islets	2969
15.	Sumasuma or Samusamu Island	1 28 S.	144 03 E.	1 islet	2969
16.	Awin and Maletin Islands	1 39 S.	144 03 E.	2 islets	2969
17.	Liot Island	1 24 S.	144 30 E.	1 islet	2969
18.	Manu Island (Allison I.)	1 18 S.	143 35 E.	Flat islet	BA.3832
19.	Aua Island (Durour)	1 28 S.	143 06 E.	120 ft.treetops may be raised	BA.3832
20.	Wuvulu Island (Maty I.)	1 43 S.	142 50 E.	May be raised	BA.3832
21.	Asia Islands	1 05 N.	131 15 E.	3 low islets	3003

P. INDONESIA [former East Indies]

[Note: Atolls and raised coral islands in this area are listed by J.F.H,Umbgrove (Bulletin, Geological Society of America, 58 (8): 729-778, Aug. 1947). Although he distriguishes "raised atolls" and "almost atolls" from others, the same symbol is used for surface atolls and sunken atolls, and several are marked with a query. From available data it is difficult to determine the exact nature of many of the reef formations listed, especially those queried by Umbgrove himself.

The following are omitted from this list for the reasons given: Noekwendi (probably one of the Padaido Islands), no data; Ormsbee (sunken, -9 fathoms); Aurora (sunken, -7 fathoms); another, unnamed drowned atoll (-13 fathoms) between these two; Gisser, Goram, and Watoe [Watu] Bela, SE of Ceram (all seem to have closely associated high islands); Kabia, if the same as Kakabia or Baars Island [6° 54' S., 122° 13' E.,] (raised, listed as having an elevation of 125 feet); Pasir Tengah and "East Atoll" [in the Gulf of Tomini,

(P. INDONESIA continued)

Celebes](lie in close proximity to the high Togran Islands); of the Sibutu group [north of Borneo] only one is of true atoll formation, that to the west being submerged and to the east, raised; various other reef islands, such as Amboengi and the Little Paternoster Islands [off the southeast curve of Borneo], and the Thousand Islands (including Dapur and Edam Islands) in the Bay of Batavia [north coast of Java] lie on platforms adjacent to high land masses.]

					H.O.
1.	Noekori, Dauwi, Wamsoi and Roeni Islands	1°20' S.	136°40' E.	S.E. of Biak I. [Nature & status?]	3003
2.	Meatij Miarang (Brisbane I., Meati I.)	8 15 S.	128 25 E.	[In Sermata Is.]	3002
3.	Gosong Boni	8 25 S.	122 15 E.	[N.of Flores I.]	3002
4.	Angelica Shoal (Pasir Lajaran)	7 47 S.	122 20 E.	[Dries in places]	3002
5.	Tukang Besi Islands (Toekang Besi)			[Most of this group are high islands]	3002
	Karang Keledupa (Kg. Kaledoepa)	5 45 S.	123 45 E.	[Atoll-like, high ?]	
	Karang Koka	6 04 S.	124 23 E.	[low reef islands?]	
	Kenti Ole	5 45 S.	123 32 E.		
6.	Tijger [Tiger] Islands (Taka Boné Raté)	6 50 S.	121 10 E.	[Islets scattered over intermittant reef]	3046
7.	Taka Garlarang	6 30 S.	121 15 E.	[Exact nature ?]	3002
8.	Zandbuis Banks (Sadapur)	7 47 S.	117 08 E.	[Also adjacent Maria Reigersbergen Banks]	3006
9.	Paternoster Islands: Pulo Tengah Kg. Kapoposang Bali Sailoes Saoedjoeng Tampoang Kg. Satoenggoel	7 30 S.	117 20 E.	[Several small islets on extensive reef complex]	3006
	POSTILJON Islands [10 and 11]				
10.	Sapuka Islands (Sapoeka)	7 05 S.	118 10 E.	[S.W.group]	3006
11.	Sabalana Islands (Poeloe Sabalana) Soemanga I. Sabaroe I., etc.	6 50 S.	119 50 E.	[N.E. group]	3006
12.	Taka Rewataya (De Bril Bank)	6 05 S.	118 54 E.	[Sunken atoll ? light on SW edge]	3045
13.	Dewakang Kechil (Laars Island) Dewakang Besar	5 26 S.	118 22 E.		3045
14.	Kalu Kalukang (Kaloe Kaloekoeang)	5 12 S.	117 35 E.		3045

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(P. INDONESIA continued)				
15.	Muaras Reef (Moearas)	1 50 N.	118 55 E.		3044

Q. NORTHWEST OF AUSTRALIA

[All of the reefs immediately off the northwestern coast of Australia lie on the continental shelf. The majority are within the 100 fathom line. Imperieuse Reef, Clerke Reef, Scott Reef and Cartier Islet lie outside the 100 fathom line, but are on the outer edge of the shelf. Despite this fact, they are included here because of their similarity to "atolls." Mermaid Reef, although of atoll form, has no dry land. Cocos-Keeling Islands are the only true atolls in this area.]

Key No.	Accepted name (Alternative names)	Latitude	Longitude	Notes	H.O. Chart
1.	Imperieuse Reef	17°36' S.	118°50' E.	[Sandy I., 8 ft.]	3420
2.	Clerke Reef	17 25 S.	119 20 E.	[" I., 8 ft.]	3420
3.	Scott Reef	14 05 S.	121 50 E.	[" I., 8 ft.]	3419
4.	Cartier Islet	12 32 S.	123 33 E.	[Small islet, 4 ft. on small reef]	3419
5.	Cocos-Keeling Islands Cocos atoll North Keeling atoll	12 10 S.	96 50 E.	[Two atolls]	3109

[Note: Pelsart [in Houtman's Abrolhos, 28°56' S., 113°59' E.] is not an atoll, but consists of islets in lagoon shape on the edge of the continental shelf.]

R. LACCADIVE ISLANDS [North to South] 1590

Key No.	Accepted name (Alternative names)	Latitude	Longitude	Notes	H.O. Chart
1.	Cherbaniani Reef Beleapani Reef	12 18 N.	71 54 E.	[2 sand cays]	
2.	Byramgore Reef Chereapani Reef	11 50 N.	71 54 E.	[No dry land areas ?]	
3.	Chetlat Island	11 42 N.	72 42 E.	[Single islet]	
4.	Bitra Reef	11 32 N.	72 10 E.	[Tree I., trees 55 ft.]	
5.	Kiltan Island	11 29 N.	73 00 E.	[Small islet]	
6.	Kardamat (Cardamum) I.	11 13 N.	72 47 E.	[Treetops 85 ft.]	
7.	Peremul Par	11 10 N.	72 04 E.	[Sand cay, 4 ft.]	
8.	Ameni (Amini) Island	11 07 N.	72 45 E.	[Islet and sand cay]	
9.	Aucutta or Agatti Island Kalputi I., Pirli I.	10 51 N.	72 11 E.	[4 small islands; 80 ft. to treetops]	
	Tinnagara I., Bunngara I.	10 56 N.	72 19 E.	[on one reef patch]	
10.	Androth Island	10 50 N.	73 41 E.	[Small, narrow islet]	
11.	Kavaratti Island	10 33 N.	72 38 E.	[Treetops 90 ft.]	
12.	Kalpeni Island Charia Island	10 05 N.	73 38 E.	[Treetops 84 ft.] [2.5 mi. to NNE]	
13.	Suheli Par	10 04 N.	72 17 E.	[Oval patch, 3 islets, palms 90 ft.]	

(Nine degree channel)

Key No.	Accepted Name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(R. LACCADIVE Islands continued)				
14.	Minikoi or Minicoy	8 30 N.	73 00 E.		1590
	(Eight degree channel)				
	S. MALDIVE ISLANDS (Double line of atolls, north to south)				5661,1591
1.	Ihvandiffulu atoll	7 02 N.	72 55 E.	[About 17 islets]	5661
2.	Tiladummati atoll (Tilla dou Matte) [N.part] Miladummadulu atoll [S.part] (Milla dou Madou)	6 15 N.	73 05 E.	[Over 130 islets and "rings"]	5661
3.	Malcolm or Makaenudu atoll	6 18 N.	72 35 E.	[3 small islets]	5661
4.	North Malosmadulu atoll	5 35 N.	72 55 E.	[80 islets & rings]	5661
	(Moresly channel)			[2 miles wide]	
5.	South Malosmadulu atoll (Mahlos Mahdoo)				
	Northern part	5 20 N.	72 58 E.	[12 islets & rings]	5661
	Southern part	5 10 N.	72 58 E.	[62 islate & rings]	
6.	Horsburgh atoll	4 52 N.	72 53 E.	[4 islets on nearly continuous rim]	5661
7.	Fadiffolu atoll	5 25 N.	73 30 E.	[45 islets & rings]	5661
8.	Gaha Faro [Island]	4 45 N.	73 25 E.	[E.end small atoll]	5664
9.	Male atoll [Residence of Sultan and seat of government]	4 25 N.	73 30 E.	[96 islets & rings]	5664 5662
	(Wadu Channel)			[2.3 mi.wide]	
10.	South Male atoll	3 57 N.	73 25 E.	[31 circular reefs]	5662
11.	Toddu Island	4 25 N.	72 57 E.	[isolated islet]	
12.	Rasdu atoll	4 18 N.	72 58 E.	[3 islets,2 reefs]	5662
13.	Ari atoll	3 50 N.	72 50 E.	[150 reef patches]	5662
14.	Nilandu (Nillandoo) atoll				
	Northern part	3 13 N.	72 55 E.	[48 reef rings]	5662
	Southern part	2 48 N.	72 56 E.	[56 reef rings]	
15.	Felidu (Phaleedoo) atoll	3 30 N.	73 30 E.	[75 reef rings]	5662
16.	Wataru Reef	3 15 N.	73 26 E.	[2 small islets]	5662
17.	Mulaku (Moluque) atoll	3 00 N.	73 28 E.	[70 reef patches]	5662
18.	Kolomadulu atoll	2 23 N.	73 08 E.	[25 rings & islets]	5662
19.	Haddummati atoll	1 55 N.	73 25 E.	[Isdu, Gang, and 3 other islets on nearly continuous reef]	5662 5663
	(One and Half degree Channel)				
20.	Suvadiva atoll (Huvadu, Suadiva)	0 30 N.	73 15 E.	[84 closely spaced patches]	5663
21.	Fua Malaku Island (Phoowa Moloku)	0 17 S.	73 26 E.	[Islet, fringing reef]	5663
22.	Addu atoll (Addoo)	0 38 S.	73 10 E.	[7 islets on 2 curved reef patches]	5663

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
T.	CHAGOS Archipelago			[A complex of atoll reefs, some with islets, others completely sunken rings.]	Br.3,4,3869
1.	Peros Banhos	5 20 S.	71 50 E.	[33 islets]	3869
	Ile de Coin			[settlement]	
2.	Salomon Islands			[pear-shaped atoll]	3867
	Boddam Island			[at S.point]	
3.	Nelsons Island	5 41 S.	72 20 E.	[on N.side of a sunken atoll]	3869
4.	Great Chagos Bank			[has the following three groups of islets:]	3869
	Three Brothers	6 10 S.	71 33 E.	[3 small islets]	
	Eagle Islets	6 10 S.	71 21 E.	[2 " "]	
	Danger Island	6 22 S.	71 16 E.	[40 ft. high.]	
5.	Egmont [atoll]			[6 small islets]	3869
6.	Diego Garcia	7 20 S.	72 25 E.	[wedge-shaped lagoon enclosed by land rim]	3868
U.	WESTERN INDIAN OCEAN				
1.	Cargados Carajos Shoals	16 30 S.	59 30 E.	[6 islands:]	3864
	Albatross, North, South, Siren, Pearl, Frigate				
2.	Coco Reef	16 25 to 16 50 S.		[6 islands:]	3864
	Ile Raphael, Avocare, Mapare, Verrange, Coco Is. [2]				
3.	Agalega Islands	10 25 S.	56 40 E.	[2 islets]	3864
4.	Ile Tromelin	15 62 S.	54 25 E.	[15 ft.]	1881,3864
	Tromelin I.)				
	SEYCHELLES group [Most of this group are high islands; scattered along a barrier-like reef are the following: (5 to 8)				2809
5.	Bird Island	3 43 S.	55 12 E.	[58 ft.]	3851
	(Ile Vasches de Mer)				
6.	Denis (Dennis) Island	3 48 S.	55 40 E.	[30 ft.]	2809
7.	Platte Island	5 55 S.	55 20 E.		2809
8.	Coetivy Island	7 06 S.	56 15 E.	[40 ft.]	2809
	AMIRANTE Islands [9 to 20]				
9.	"Africa Islands"	4 52 S.	53 20 E.	[2 islets,10 ft.]	2809
10.	Eagle Island	5 08 S.	53 15 E.	[Treetops,50 ft.]	2809
11.	D'Arros Island	5 25 S.	53 15 E.	[Treetops 86 ft.]	3851
12.	St.Jospeh Islands	5 26 S.	53 20 E.	[Circular reef with:	3851
	Resource [40 ft.], Fourquet [40 ft.], St.Joseph [treetops 80 ft.], Benjamin [10 ft.], Cascassage (10 ft], Poule [10 ft.] Pelican [20 ft.], Chien Islet [20 ft.]				
13.	Desroches Island (Amirante)	5 40 S.,	53 40 E.	[Treetops,120 ft.]	3851
14.	Poivre Islands	5 45 S.,	53 15 E.	[2 islets, 75 ft.]	3851
15.	Etoile Cay	5 54 S.,	53 15 E.	[15 ft.]	3851

Key No.	Accepted Name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
	(U. WESTERN INDIAN OCEAN continued)				
16.	Boudeuse Cay	6 05 S.	52 50 E.	[15 ft.]	2809,3851
17.	Marie Louise Island	6 11 S.	53 09 E.	[Treetops 90 ft.]	2809
18.	Ile des Noeufs	6 15 S.	53 03 E.	[18 ft.]	2809
19.	Alphonse Island	7 01 S.	52 45 E.	[Inhabited]	2809
20.	[Atoll-like reef, center]	7 10 S.	52 45 E.	[2 islets:]	2809
	Bijoutier Island	7 04 S.	52 45 E.	[Coconut palms]	
	San Francoise Island	7 11 S.	52 45 E.		
21.	Farquhar group	10 10 S.	51 08 E.	[Elliptical reef with:]	3861
	North I., South I., Goelette I. and other small islets.				
22.	Cerf Islands Reef			[24 x 5 miles, with:]	3851
	Wizard Reef	8 50 S.	51 03 E.	[awash, rocks uncovered]	
	Providence Island	9 14 S.	51 02 E.	[50 ft., village]	
	St.Pierre Island	9 20 S.	50 43 E.	[40 ft., coconuts]	
	Cerf Island	9 32 S.	51 00 E/	[7 small islets]	
23.	Isles Glorieuses (Glorioso Islands)	11 33 S.	47 20 E.	[Reed, 10 mi.dia. with:]	BA. 724
	Ile du Lise or Lys			[35 ft.]	
	Verte Rocks & South Rocks			[3 ft.]	
	Isle Glorieuse			[1 mi.square]	
24.	Astove Island	10 06 S.	47 45 E.	[45 ft.]	3861
25.	Cosmoledo group	9 42 S.	47 35 E.	[7 islets around elliptical lagoon]	3861
	Menai [40 ft.], North Is.[2], Polyte [35 ft.], Wizard [55 ft.], Pogoda [20 ft.], South [25 ft.]				
26.	Aldabra atoll	9 25 S.	46 22 E.	[Nearly continuous land surrounds lagoon; 3 channels; 4 islets on rim, 2 in lagoon]	3861
	West I. (Ile Picard)				
	Polymnie I. [70 ft. clumps]				
	Middle (Malabar) I. [60 ft.]				
	South I. [largest, 70 ft.]				
	Euphrates (Ile Esprit) [40 ft.]			[In the lagoon]	
	Coconut I. (Ile Michel) [70 ft.]			[In the lagoon]	

V. CARIBBEAN Sea [Counterclockwise from north]

[Note: It has been stated that there are no true "atolls" in the Caribbean Sea or Gulf of Mexico; the following are coral or reef islands outside the 100 fathom line on the continental shelf.]

Key No.	Accepted Name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
1.	Hogsty Reefs Los Corrales	21 41 N.	73 49 W.	[Reef-enclosed lagoon with 2 sand cays]	2805
2.	Mira-por-vos Islets	22 05 N.	74 30 W.	[Kite-shaped shoal with cay and rocks]	2806
3.	Cay Sal Bank	24 - N.	80 - W.	[Bank, 60x35 mi. cays around edge]	944,1290 2624
	Cay Sal [30 ft.], Elbow Cay [30 ft.] Water Cays, Muertos Cays, Dog Rocks [30 ft.], Damas Cays, Anguila Isles [40-50 ft.]				

[On BANCO CAMPECHE, north of Yucatan, within 100 fathom line, but individually isolated, are the following, 4 to 8.]

Key No.	Accepted Name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
4.	Arrecife Alacran (Alacran Reef)	22 30 N.	89 42 W.	[Ellictical reef, no marked lagoon, 5 islets]	966 1233,1240

Key No.	Accepted name (Alternative names)	Latitude ° '	Longitude ° '	Notes	H.O. Chart
(V. CARIBBEAN Sea continued)					
5.	Cayo Arenas)Arebas Cay)	22 07 N.	91 24 W.	[2 reef patches, cays]	1233
6.	Cayo Nuevo	21 40 N.	92 10 W.	....	2056
7.	Los Triangulos Cayo Este [24 ft.], East and West	20 55 N.	92 13 W.	[2 reef patches, each with los cays]	1233
8.	Cayos Arcas (Arcas Cays)	20 12 N.	91 58 W.	[Reef with 3 cays,21']	1234
9.	Chinchorro Bank (Banco Chinchorro)	18 35 N.	87 20 W.	[Nearly continuous reef, 3 cays, 56' treetops]	1072
	Turneffe Islands	[Not sufficiently surveyed to determine form]			
10.	Lighthouse Reef	17 20 N.	87 30 W.	[Atoll-like,5 cays]	1120,1498
11.	Glover Reef	16 50 N.	87 50 W.	[Sunken atoll-like; 5 small cays]	1120
12.	Swan Islands	17 25 N.	83 50 W.	[up to 60 ft.]	5170
13.	Caratasca Cays	15 56 N.	83 16 W.		5381
14.	Becerro Cay	15 55 N.	83 15 W.		5381
15.	Vivario Bank	15 33 N.	83 20 W.		5381
16.	Albuquerque Cays	12 10 N.	81 51 W.	[2 cays on shoal]	2077
17.	Courtown Cays	12 24 N.	81 28 W.	[3 cays on shoal]	2077
18.	Roncador Bank	13 32 N.	80 02 W.	[cay,13 ft. on shoal surrounding lagoon]	1374
19.	Serrana Bank	14 22 N.	80 18 W.	[2 lagoons,6 cays]	1374
20.	Quita Sueno Bank	14 20 N.	81 15 W.	[1 cay on bank]	945
21.	Serranilla Bank	15 50 N.	79 55 W.	[4 cays on shoal]	1489
22.	Bajo Nuevo	15 52 N.	78 39 W.	[2 atoll-like reefs, with 1 cay]	1488
23.	Pedro Bank	17 - N.	78 - W.	[4 cays; not atoll-like; 100x60 mi.]	5350
24.	Morant Cays	17 20 N.	76 00 W.		708
25.	Albatross Bank	17 40 N.	75 45 W.	[Cays ?]	708
26.	Islas des Aves or Aves Island	12 - N.	67 30 W.		6563
W. ATLANTIC OCEAN					
1.	Rocas Reef or Atol das Rocas	3 52 S.	33 49 E.	[Small atoll, with 2 islets]	537
		[135 miles NE of Cabo Calcanhar, Brazil]			

Moore Isle	J.34b
Mopelia, Mopihaa Islands	C.4
Morane Island	B.1
Morant Cays	V.24
Moresly channel	S.4/5
Morileu	J.13a
Mortlock Islands	J.9
Mosley Islet	N.7
Mototokke Shoto	J.9
Motu Iti, Motu One	C.3
Mototunga Island	B.54
Mourileu	J.13a
Muaras Reef	P.15
Muertos Cay	V.3
Mulaku atoll	S.17
Mulgrave Island	H.1
Murilo, Muriro Shoto	J.13a
Murray Islet	N.7
Musgrave	J.1
Musquillo	H.22
Myloradowitich Island	B.57
Nager Islands	N.5
Naiad	J.9a
Nairea atoll	B.73
Nama Island	J.12
Namo	H.22
Namochikku To	J.23
Namoliaour	J.25
Namolipiafane	J.13b
Namolotou	J.9a
Namoluk atoll	J.10
Namonefeng	J.9b
Namonuito atoll	J.16
Namorik atoll	H.17
Namorukku To	J.10
Namotikku To	J.23
Namouin-atoll	J.13b
Namouttek	J.23
Namu atoll	H.22
Namurikku To	H.17
Namurrek	J.23
Nanuuin Shoto	J.13b
Nanomana Island	F.8
Nanomea Island	F.9
Nanouki Island	G.8
Nanuku Reef	K.5
Nanumanga Island	F.8
Nanumea Island	F.9
Napuka Island	B.44
Narcissus Island	B.19
Nassau Island	D.18
Natikku To	J.5
Nelsons Island	T.3
Nemu	H.22
Nengonengo Island	B.28
Netherland Island	F.6
Nevil Island	J.38
New Caledonia	L
New Hebrides	L
New Nantucket Island	D.33
New Year Island	H.11
New York Island	D.9
Ngaruangl Reef	J.34a
Ngatik atoll	J.5
Ngele-levu Island	K.7
Ngelu	J.33
Nggele-levu Lagoon	K.7
Ngiul, Ngoli, Ngolii	J.33
Ngolog, Ngulu, Ngoly	J.33
Ngulu atoll	J.33
Niambo Island	K.3
Niau atoll	B.64
Nigeri, Nihiru Island	B.40
Nikumaroro	D.27
Nikunau Island	G.5
Nilandu, Nillandoo atoll	S.14
Ninigo atoll	N.13
Ninigo group	N.11-17
Niulakita	F.1
Niutao Island	F.7
Noekori	P.1
Noekwendi	P (note)
Noeufs, Ile des	U.18
Nokanhui Reef	L.3
Nomoi Islands	J.9
Nomwin atoll	J.13b
Nonouti, Nonuti Island	G.7
Nororutu Island	C.1
North Bampton Reef	L.9
North Cay	L.27(etc.)
North Island	U.1,3,9,21
North Islands	U.25
Northeast Cay	L.25
Northern Cook Islands	D
North Keeling	Q.5
North Malosmadulu	S.4
North Marutea Island	B.39
Northwest Pacific	I
Nuevo, Cayo	V.6
Nugoru To	J.7
Nuguria Islands	M.5
Nui Island	F.6
Nukufetau	F.4
Nukulaelae	F.2
Nukulailai	F.2,K.5
Nukulevu Island	K.5
Nukumanu group	M.2
Nukumbalate Island	K.6
Nukumbasanga I., Reef	K.6
Nukunau Island	G.5
Nukunono Island	D.23
Nukuoro atoll	J.7

Pulap, Pullop atoll	J.17
Pulo Anna Islands	J.36
Pulo Marier	J.37
Puluot	J.18
Pulusuk Island	J.19
Puluwat atoll	J.18
Pur	J.36
Purdy Islands	N.5
Puru Anna	J.36
Puttep	J.17
Pyghelia	J.20
Quatro Coronados	B.14
Queen Charlotte Island	B.21
Quiros Island	D.21
Quita Sueno Bank	V.20
Rae To	H.24
Rahiroa atoll	B.73
Rakahanga Island	D.15
Ralik chain	H.16-33
Rangiroa Island	B.73
Raphael, Ile	U.2
Raraka Island	B.59
Raroia Island	B.47
Rasdu atoll	S.12
Ratak chain	H.1-15
Ravahere Island	B.31
Raven group	J.5
Reao Island	B.17
Redlick Islet	M'.3
Reef Islands	L.1
Reid Island	B.51
Reid Reef	K (note)
Reirson Island	D.15
Reitoru Island	B.33
Rekareka Island	B.38
Remp	J.16
Renard Island	L.9
Resolution Island	B.37
Resource Islet	U.12
Rikieppu To	H.8
Rimski-Korsakoff Islands	H.30
Romanzoff Island	B.68,H.7
Romanzow, Romanzov	H.7
Roncador	M (note)
Roncador Bank (Cay)	V.18
Rocas Reef	W.1
Rongelab, Rongelap atoll	H.30
Rongerik atoll	H.29
Rongirikku To	H.29
Rongorappu To	H.30
Rose atoll, Island	D.20
Rosoppu To	J.11
Ross Islands	H.22
Rotcher Island	G.2
Rowa Island	L.1
Royalist Island, Is.	J.11,15
Rukunoru To	J.9b
Rukute To	J.14
Rurick Island	B.67
Sabalana Islands	P.11
Sabaroe Island	P.11
Sabben Islands	N.6
Sable Isle de	C.7,L.1
Sadapur	P.8
Sae Islands	N.10
Saliloes	P.9
St.Andrew Island	J.35
St.Andrew Islands	N (note)
St.Augustine Island	F.9
St.David Islands	J.40
St.Jospeh Islands	U.12
St.Paul Island	B.16
St.Pierre Island	U.22
St.Quentin Island	B.34
St.Simeon Island	B.37
Saken Island	B.50
Sal, Cay	V.3
Salomon Islands	T.2
Sama "group"	N.14
Samarang Island	D.10
Samoa, American	D.20,21
Samusamu Island	N.15
San Andreas	J.35
San Bartolome	J.19
Sands Island	C.1
Sandy Islet	Q.1,2,3
San Francisco Island	I.1
San Francoise Island	U.20
San Miguel Archangel	B.15
San Miguel Islands	N (note)
Sanna Island	L.1
San Narciso [Island]	B.19
San Pablo Island	B.16
San Rafael	J.12,N.1
Saoedjoeng	P.9
Saok	N.19
Sapoeka, Sapuka Islands	P.10
Saraon, Sarol	J.31
Sasaon, Satahual	J.21
Sataoan	J.9c
Sataual, Satavan	J.21
Satawal Island	J.21
Satawan atoll	J.9c
Satawan Island	J.21
Sataon	J.9c
Satoenggoel, Karang	P.9
Satouwan	J.9c
Satowal, Satowalairak	J.21
Satuwal	J.21
Saugk	J.19
Saumarez Reefs	L.19
Sauugk	J.19
Schanz atoll	H.27
Scheug, Schoog, Schoug	J.19

ATOLL RESEARCH BULLETIN

No. 20

Health Report on Kapingamarangi

Part I A Health Survey of Kapingamarangi, 1950

Part II A Parasitologic Survey of Kapingamarangi, 1950

Part III Blood Groups of the Kapingas, November 1950

by Ralph E. Miller

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Health Report on Kapingamarangi

by
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Hanover, New Hampshire

INTRODUCTION

This report covers field work carried out from June to December 1950 and is a study of the health beliefs and practices of the atoll dwellers of Kapingamarangi. The research was carried out by the author as a special project under the SIM (Scientific Investigation of Micronesia) program of the Pacific Science Board of the National Research Council. Generous support was given to this project by the Office of Naval Research, the Pacific Science Board, the Office of Island Governments, Office of the Chief of Naval Operations, Department of the Navy and by the Civil Administration Units in the Trust Territory. The results of the survey are submitted in three parts, consisting of the Health Survey of Kapingamarangi as Part I, A Parasitologic Survey of Kapingamarangi as Part II, and Blood Groups of the Kapingas as Part III.

The author was completely dependent upon the leader of the expedition, Dr. Kenneth P. Emory, for background material, orientation and interpreting, without which the attempt to survey would have been fruitless.

PART I

A HEALTH SURVEY OF KAPINGAMARANGI, 1950

General Description of the Atoll

Kapingamarangi atoll is situated just north of the equator at 155°30' degrees east longitude. It is a typical "low atoll" with the islands scattered closely along the eastern arc of the oval coral reef. There is one deep opening through the reef on the southwest where a narrow, tortuous passage will admit only small craft with ease.

The south easterly trade winds provide a nearly constant cooling breeze. In contrast to the islands to the north, rainfall is not abundant. Nearly every year sees a period of water scarcity when coconuts are used as the standard beverage. Dug wells are used for wash water. The occasional rainy periods provide enough water to store, for the greater part of the year, in cisterns above ground. Typical trade wind showers permit verdant plant growth. The annual rainfall is reported as 80 inches.

Temperature varies slightly, the coldest periods being during the rare overcast periods of rainy days when the temperature reaches 75° degrees. The warmest days occur when the low tide permits the exposed reef eastward of the islands to be heated by the midday sun. Islands close to the eastern reef edge are noticeably cooler than those separated by a wider band of reef from the cooling overwater breeze.

The tides rise once in the twenty-four hour period to about 3 feet above mean low and once during the period to 2 feet above mean low. The extreme low follows the extreme high. Only the extreme low tide permits exposure of the reef for a long enough period to permit noticeable temperature change inland. The usual daily temperature is 80° at night and 90° in the day, reaching the maximum at noon. Deviation from this daily cycle is very rare, and one day is so like another that no thought need be given to "dressing for the weather" or for the time of day.

Tidal current is, with rare exceptions, from easterly to westerly between the islands, that is, from ocean to lagoon along the island portion of the reef. There is a reversal for a short period of each tide through the pass. The current varies in strength with the time of tide and the wind velocity and very rarely with wind direction. The almost constant surf from the east has to be interrupted to cause a reversal of the current flowing by the islands. Violent storms are rare, the only one within memory being one of three days in 1947 when the wind was from the west during the entire storm.

The soil of the islets is a thin layer of coral gravel and sand mixed with leaf mold on a base of conglomerate slab of the raised reef type. The average level is about ten feet above mean sea level. In areas where large excavations have been made for taro swamps, coral rock and sand from

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the excavations are piled to a height of twenty feet, in several areas producing, with their overgrowth of breadfruit trees and pandanus, park-like vistas along the pathways of the ridges.

The activities of the population are centered at Touhou which is an entirely residential island. There, buildings are closely placed leaving space only for the working areas about the houses shaded by the trees which provide also food, fuel and fiber. Werua, the other essentially residential island in the total of 32, is more rural with broad areas of taro and woodland. The other island adjacent to Touhou, Taringa, is essentially rural, its forty houses well separated by woodland. Some islands are of the nature of country estates of the families living on the central islands. Such is Hare to the south, and, to a lesser extent Ringotoru to the north. To these, visits are made at frequent intervals to cultivate taro, collect coconuts or timber and on special occasions such as childbirth or funeral or cutting out of canoes, whole families move to the island for the day or days, returning with canoeloads of produce.

There is constant traffic between the central islands on the dry reef at low tide and wading or swimming at other times.

Plant Life

Taro and puraka are cultivated extensively, and the food trees, coconut, breadfruit and pandanus are tended with care. These trees provide timber as do the HAU (wild hibiscus), RAKAU MHE (Cordia subcordata) and WORO WORO (Premna obtusifolia).

These plants, shrubs and trees play their customary part in the economy of this atoll and a large part of the daily occupation of the men, women and children consists of culturing, harvesting and preparing for food, shelter, clothing and equipment, the various parts of this abundant plant growth. There are allowed to grow uncultivated, grasses, shrubs and trees, some of the products of which are used for casual ornamentation. Wherever these plants encroach on those essential for the economy, the encroacher is sacrificed. Some introduced shrubs are used principally as ornamentals, though they are given additional space because of their bloom or because the leaf provides a convenient dish cover.

Animal Life

Animal life is not abundant. The oceanic rat is a pest on the outer islands but is kept under control on Touhou by the introduced cat. Cats are numerous and largely uncontrolled. They constitute a menace to rest and a hazard to supplies and light equipment which can be destroyed in the numerous cat fights. There is active husbandry of pigs but their number is decreasing because there is insufficient forage on the outer islands and too much care is required to keep them in water and food. The pig must be

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considered as a luxury. It serves no purpose as scavenger. There is no garbage. It must be fed on food supplies that would serve for men. Taringa and Werua islets provide some space and are close enough to permit feeding and watering. Here the pigs are kept tethered or in small stone sties and separated from the dwelling area. The children are fond of little pigs as pets and keep them tethered to a shrub or tree adjacent to the house despite rules prohibiting pigs in the dwelling area. Small, apparently harmless lizards are numerous.

Sea Life

Sea life is abundant and varied. Fishing is one of the principal activities of the men and provides, beside the chief protein food, relaxation, exercise and play for the men and youths. It also constitutes a considerable hazard because of the jagged coral and the poisonous and well armed animal life of the reef and lagoon floor. Long immersion and exposure to sun also produce casualties on each of the group-fishing expeditions.

Bird Life

Birds are represented by the usual island varieties in small numbers. There are terns, herons, curlew, and frigate birds. A starling, reputedly introduced by the Germans, [possibly Micronesian starling?—ed.], is a nuisance and destroys a considerable quantity of breadfruit. Chickens are kept on all the frequently visited islands except Touhou. They are cared for much as are the pigs, as a luxury. Eggs are not used as food but allowed to hatch.

Insect Life

Insect life is made obvious by the house fly, or as it is called locally the "breadfruit fly". Mosquitoes, ants and cockroaches are also numerous. Mosquitoes interfere with sleep on the outer islands. The ants destroy wooden buildings and the cockroaches destroy clothing. The spiders and small scorpions are not known to cause casualties. No ticks or chiggers are seen.

The People

The islands are inhabited by about 500 typical Polynesians including a small element of recently added Micronesian stock. The atoll lies off the trade routes and has been visited infrequently and that in recent years (since 1870). For centuries these people lived a stone age culture and are in the very early stages of adaptation to modern tools, equipment, clothing and concepts of disease. The shell adze is replaced by the steel adze. The steel knife is used by all. Cotton fabric has replaced the native

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pandanus sail and HAU cloth. The cloth kilt has replaced the HAU kilt for daily wear and whenever available for special occasions trousers and shirts are worn by the men and long dresses by the women. A few men have shoes which are worn for dress occasions. Use of clothing of temperate climate type and of the cloth sail have prompted the importation of a few sewing machines (German period).

Sheet metal strips are used instead of thatch on a few roofs and for rainwater catch areas adjacent to concrete cisterns. Fish lines and nets are largely imported twine, though the largest nets are made from coconut fiber and cannot be duplicated by imported material. The metal fishhook has entirely replaced the shell and wooden variety and every fisherman prefers the glass and wood or glass and plastic diving goggles to the less efficient coconut oil-slick surface.

Nearly every household has at least one metal cooking utensil and there are a few eating implements.

Despite the modern importations, at times advantageous and at times of questionable value, the culture is essentially that of an isolated, primitive people. The daily routine of the women is the dawn bath and toilet in the tidecurrent, the opening of the ground-oven for morning food, forenoon gathering and preparation of food from plant and tree or cultivating of taro, the afternoon cooking and cleaning of fish, the late afternoon bath at the time clothes are washed, the evening meal after the family is reunited from trips to outer islands or fishing. Such routine is kept from monotony by mat weaving and basket making at odd moments or by groups of families working at preserving foods for out of season use. The trips to outlying islands on special occasions provide an element of recreation. There is this element in most of the daily tasks. None is carried to the point of fatigue and the spirit of play is seen in every occupation.

Men are concerned with building houses, canoes and shelters and with making the gear and equipment for such building and for fishing. The work is done usually in groups where there is mild competition of skill and exchange of tasks resulting in much fun and little fatigue. There are masters of each skill who take their acknowledged places as leaders.

Recreation, as such, is chiefly the play of children and, on Sundays, since work has become tabu by decree of the church, card playing by all age groups.

As might be expected in such a placid environment which is rarely unkind, there is little to cause nervous strain. An occasional crying child gives evidence of the frustrations of infancy. Rarely are these frustrations evident beyond infancy, and then are seen in the rare maladjusted household. A few of the populace have fear of disease and a few are over-concerned about their personal health evidenced by disproportionate apprehension about mild symptoms. Most, however, are happy, completely adjusted, with little thought for the future beyond a food supply.

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The family units of this society are tied together by church meetings and by the frequent meetings for carrying on government affairs by the men. These serve to accept or reject publicly the proposals that have been discussed and usually settled in the daily informal meetings in the men's house and other work shops. Public announcements are as likely to be made at church gatherings as at the government meetings, and with equal weight.

This environment appears especially kind to children. They have few restrictions. For their first few years they are unhampered by clothing of any kind. Family discipline is so mild and casual as to appear like neglect. The children are as at home in the water as on land. They handle canoes with ease at an early age and a load of five captained by a ten year old is a not uncommon sight. The strongest, and apparently most effective admonition is a loud "sh--h!"

Youth is as unhampered. Boys or girls are seen in separate groups during the day but after sunset especially on moonlight nights canoe loads of mixed parties are off to outer islands or singing and dancing on the beach. There is apparently complete freedom of sex play and no stigma attached to premarital pregnancy or childbirth. An unknown father is in no way a handicap for such offspring. They are adopted and have the status of the mother. A single marriage partner is the rule but exceptions are noted and the household of a sterile marriage may be blessed by the offspring of a mutually acceptable partner to replace temporarily the unfruitful one.

The people are governed by a chief who has two assistant chiefs, one for Touhou islet and one for Werua islet. The ancient priesthood has been partly replaced by the Christian church. The position of magician or medicine man was one of importance with grave responsibilities and considerable authority. There is no one quite comparable in the present organization.

The administrative officers, school teacher and a medical aide receive salaries from the United States Civil Administration.

Order is maintained without visible restraints. Public opinion is all powerful, occasionally overruled by the chief, but at the risk of his chiefship.

The men and women take their positions of adult responsibility only after organizing a household of their own including at least one child, their own or adopted. The position is of full responsibility even then only if the work of the adults is considered as contributing to group welfare. Youths of both sexes are not compelled or even urged to work. The male takes full advantage of this, and for a certain period, comparable to the highschool and early college age, the boys are set apart from this otherwise industrious society. They loaf, sing, dance, are pampered by their mothers, are well fed and wear the gaudiest SERU the family can afford. They are even organized against work and exert their own public opinion against the occasionally ambitious youth. This period passes, and generally, without harm. A few carry the attitude on into their own adult household.

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The girls early learn their task of being the burden bearers, and in youth do most of the household work, including care of younger children.

Sanitation

The sanitation of Kapingamarangi is of the natural type due to tide, sun, wind and rain. Man has altered his environment slightly, in part advantageously and in part with some hazards to health. When the alteration has favored health that aspect of the change has been a by-product and not the direct result of an attempt at more healthful conditions. There has not been, and is not now, any comprehension of the spread of disease from man to man or from animal to man.

Personal cleanliness is notable but not universal and there is a strong suspicion that its prevalence is induced by the desire to avoid attracting flies. The sea is ever present and easily accessible. Bathing in it is a daily activity of practically everyone. Pools on the reef reach 100 degrees F. in the midday sun and are a favorite bathing place. Prolonged soaking of clothing in the tide current is a favorite cleansing method and the nearest they ever come to sterilization.

Within the family circle personal contact is intimate and frequent. It starts before the first breath of life as the delivered infant has its mouth and nose aspirated by the application of the attendant's mouth and tongue. The infant is cared for by every member of the family, young and old. Some infant food is prechewed. All are served at the family table by the only common eating implement, the hands. Though food is ideally aseptic when removed from the ground oven in its tight containers, thereafter it is handled without regard for sanitation, unless it is to be kept for a later meal. It has been learned that food left intact in its wrapping after cooking will not spoil as rapidly as opened food, and that recooking will prevent spoiling for many hours, but this experience has not been transferred to the use of heat to clean clothes, mats, sheets or blankets, towels or wound dressings.

Handkerchiefs are an affectation. Fingers are the acceptable substitute. Spitting is common, a gesture of slight nervousness.

Disposal.

The common toilet is the reef, covered or uncovered by sea. At times children consider that the general direction of the designated spot on the reef satisfies the convention, and many an adult contaminates areas of the reef close to a play area for children, a sand beach of which will be smeared by the drift of the next high tide. Even the effluvia of the several over-water (except during low tide) toilets is swept ashore either directly or by the swift current about the end of the islands into the lagoon. This is

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preserved from severe contamination in the backeddy of the lagoon shore by dilution and speeding of the biologic cycle by the abundant sea life.

Refuse disposal areas are those requiring fill because of erosion or because mulch is desired for planting. The value of compost is known and banana and coconut plantings are made on compost pits in which vegetable refuse has been accumulating for months. The grounds generally are kept quite free from refuse. There is a daily morning "policing" of grounds when women and children pick up all fallen leaves and such refuse as the men and boys have thrown down anywhere. The houses do not accumulate refuse. All the cooking is done in or near the cook house, which is usually several feet, at least from the dwelling. Preparing of food and eating is generally out of doors. The times when indoor eating is necessary are rare. Under these circumstances scraps and bones are thrown out through the open sides of the house. Feet are washed before entrance onto matting portions of the floors.

There are weekly cleanup days and, periodically, days for burning stumps and refuse heaps along the high tide mark. A common type of refuse that appears difficult to control is ripe breadfruit falling at the peak of the season. Chewed pandanus keys are discarded without discretion.

The lagoon is the repository of all refuse except that put in compost pits for later tree planting. It is apparent that anything thrown or drifted into the lagoon is considered completely and finally disposed of. Baskets of miscellaneous refuse are dumped into the lagoon among groups of swimmers. People living along the lagoon shore wade into the water and use this universal toilet without regard for wind or tide. The currents of the back eddy that is fairly constant at each end of the islands form a sort of cess pool used for evening bathing by all and for fishing by small boys. The lagoon shore is a scene of constant activity, clothes washing, preparing coconut husk fiber for rope making, bathing, swimming, cleaning fish, loading and unloading canoes. All refuse remains where dropped in this shallow shore area until the next tide brings about a redistribution and dilution. Despite the dilution this remains a constantly contaminated area through which the populace (and visitors, until a pier was completed recently) wade or swim without a thought that it is any less pure than the open sea or rapidly flowing current between the islets. The same situation prevails at the common landing areas of the outer islands.

Residences and traffic are much more widely scattered at Werua and Taringa and their waterfronts are noticeably cleaner.

Food

The staples of the diet are taro, PURAKA, and coconut with fish as an almost constant accompaniment as are breadfruit and pandanus in season. The three variables, fish, breadfruit and pandanus are preserved (dried) in times of plenty but the supplies are insufficient to sustain the population for very long without the staple components. Breadfruit trees of three varieties are now well established and this item of food is approaching

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the constancy of taro and coconuts. The varieties vary in maturing times and in duration of season but all are affected by drought. The oldest grown here and known as the Kapingamarangi variety matures in two months and bears for three months. The Nukuoro variety bears for a month then matures a new crop in one month. These two varieties of fruit contain large seeds which are edible when cooked. The third variety brought in from Ponape has been established too short a time to be certain of its season here, however it is different from the other two, maturing either two or three crops a year. This variety is without edible seeds, and does not lend itself to preservation by drying as do the other two.

Pigs, chickens, bananas and papayas are produced in too small quantity to contribute much to the diet and are considered as luxuries.

In times of drought taro, PURAKA, and coconut and fish may be the only supplies that persist and the coconuts are fewer and smaller. The taro is much smaller during these dry periods. The PURAKA does much better in the dry times and tends to overgrow the taro.

One famine has been recorded (1915 to 1917) when there was no rain for two years. Over fifty people died and the famine was aggravated by imposed rules restricting coconuts to copra production, denying their use for food. There were insufficient canoes during this same period reducing the amount of fish available.

Diet

Taro is cooked in coconut cream or grated coconut. This form of food accounts for the greater part of the use of coconuts as food. The soft pulp of drinking nuts is eaten but recognized as having little food value so far as sustaining activity is concerned. Pandanus is eaten, either raw or boiled, by chewing the soft part of the key. Flour is made for storage by pulverising baked pandanus pulp cakes. The flour is later eaten mixed with water as a porridge.

Fish is usually baked in leaf wrappings but some is eaten raw during its preparation and cleaning or may be served raw. The raw liver is relished by fishermen, and the liver allowed to remain within some varieties for cooking. The visible fat of fish and eels is a choice item of diet. Much variety is achieved in the diet, and possible additions of food value, by varying the leaf wrappings. Such additions are the only condiments beside the generally used coconut cream. No salt is used in cooking or during the meal. Salt is now used for preserving fish when the slices receive a slight coating of salt preliminary to drying in the sun.

Strong evidence of the adequacy of the diet is the condition of the residents who are robust, energetic, active, industrious and happy. No instance of malnutrition or obvious vitamin lack was noted. Their own studied analysis of what these people need to survive the most difficult times yields the answer that fish hooks and twine for the finer nets would see them through, because all other essentials of life are present or can be secured if they can maintain a sufficient supply of food fish.

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The abundant varied food supply compensates for some items of the diet which have limited direct food value such as the fiber component of coconut husk (young nuts) and pandanus. During the pandanus season the faeces of children and some adults consist of a mass of such fiber. In any season when there is a decrease of standard items the husk of young coconuts is consumed in quantity for its slight sugar content. Both sources of fiber yield a fecal mass of such size and consistency as to be alarming. It may be that one of the unheralded virtues of the coconut alleviates the possible hazard of fecal impaction. The unaltered oil of the raw (and perhaps cooked) coconut is found in nearly all faeces specimens and in quantity in many. The oil is apparently a relatively bland lubricant. However this oil consists of a lost element of considerable amount from the theoretical quantity of available caloric content of the coconut. In quantity, the cooked oil is a cathartic of some violence. The pandanus oil is likewise found unaltered in the faeces. The assimilability of both these oils requires investigation, if not already studied.

Another food item used in quantity at certain times and as a small component of the diet throughout the breadfruit season is breadfruit seeds. Each fruit of the two seed-containing varieties contains from 10 to 30 seeds varying from 1 cm. to 1.5 cm. in diameter. Removal of the thin soft shell yields a kernel with the flavor of boiled chestnuts. The food value of this seed must be considerable. It takes the place of fish or meat in the dietary during fish shortage and immediately following the peak of the breadfruit season when the large quantity of seeds removed from the fruits prepared for drying are stored for a short time and then consumed in quantity as boiled or roasted nuts.

Rice is used at feasts. It has not been adopted as a staple of diet because of cost and availability of other food. In times of scarcity it is welcomed. Many families have a pot used especially for boiling rice. The leaders recognize that rice cannot replace items of the regular diet without interfering with the stability of supply. Coffee and sugar are luxuries, available to a few.

Water Supply

Formerly the water supply was from dug wells in the villages of Touhou and Werua and on the margins of the taro swamps. The water level in these wells rises and falls with the tide. The water is brackish in the village wells, precipitating much of the soap before suds are obtained. The concrete cisterns and metal strip catch areas, introduced by the Japanese, provide storage for months of use. This rain water is augmented by a store in metal drums filled from the same catch areas and from natural catchments such as coconut trees.

The wells are still the source of wash water except in times of abundance of rain water. It is stated that yearly there is some time when rainwater is scarce and, periodically, about once a generation, a prolonged drought. A survey of the cisterns indicates there is sufficient capacity to last two months. (See chart I).

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Chart I

TOTAL NUMBER OF TANKS	27
TOTAL CAPACITY cubic feet	4800
USABLE TANKS	21
USABLE CAPACITY cubic feet	3700
TOTAL CATCH AREA USED	3800
Four large tanks CAPACITY	1500
Four large tanks CATCH AREA	1300

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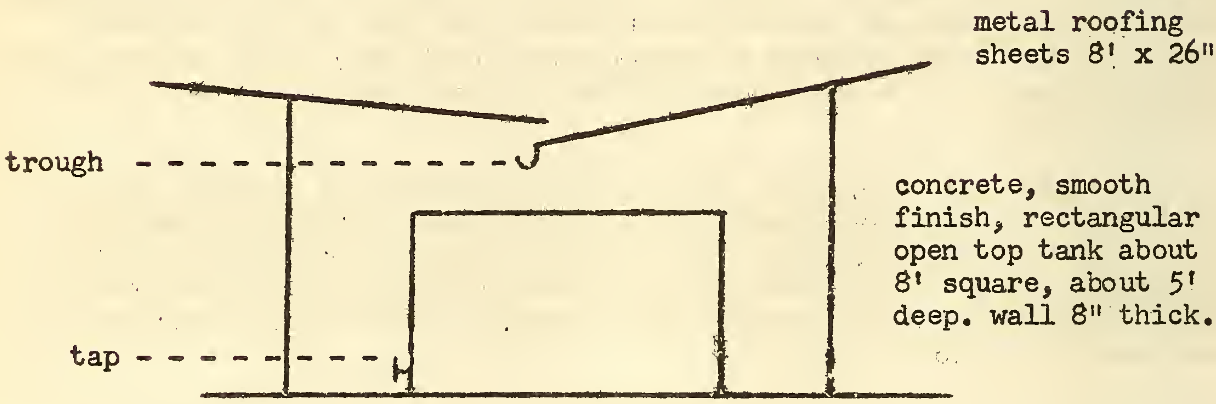

Diagram I.

PREFERRED TANK AND CATCH AREA

The tanks are not now used to capacity, rarely lasting more than a month. Their proper use would require some over-all supervision concerning catch areas, periodic cleaning and rotation of use. Several tanks are so managed now and indicate the value by yielding a water supply after other tanks are dry. Upon several inspections about half the tanks were found in good condition of cleanliness and repair. Cleaning is made necessary by the daily fall of leaves from the breadfruit trees and by the inflow carrying partly decayed leaves into the tank from the catchment areas. Roofing of the tanks and frequent removal of leaves from the catchment areas is helpful, but is not a constant practice. One factor in the incomplete use of tanks is the scarcity of the roofing strips used for the catchment areas.

A contributing factor to the neglect of the tanks is the luxury nature of this water supply. The wells never fail. In dry spells the women carry water from the wells for washing and coconuts are used for drinking in extreme drought. When the nuts are scarce even the well water may be drunk. The water from the taro pit wells is quite sweet. In extreme dry spells the tanks are dry long before the plant life suffers from lack of rain. The tanks are an aid to the economy of time and effort and probably contribute to the health of the populace but they are not an essential. They are highly prized for prestige, alone. Tanks most recently built are larger than the early tanks and appear to be more easily managed.

The water tanks serve as breeding places for mosquitoes. This is controlled by de-roofing the tanks and letting sunlight in. The larger tanks are not easily uncovered and probably copper screening might be a better solution to the mosquito problem.

Tanks on the outer islands have fallen into disuse because of the amount of care required to keep the water from them useable. Water stored in the concrete tanks was still of good quality after two months. Their position above ground and the high sides make them unlikely to contamination by children.

The contamination of the wells is chiefly from surface drainage, most abundant at the central well on Touhou where bathing and clothes washing is a daily practice quite close to the well. This central well supplies the wash water for the entire village whenever cisterns are at a low level. There is traffic throughout the day about the well. The children play with small buckets in imitation of the water carriers. Loose sand and gravel gradually reduce the water depth, and require periodic removal, at which times the rock wall is repaired and brought to ground level. This use of the well is probably no hazard to health, but habits of use are transferred to other wells used for drinking water. The use of concrete is known in the construction of the tanks. Its use to make raised rims would eliminate much of the present gross contamination.

The periodicity of the rainfall which controls the state of the food-supplying trees is now the only very serious problem in water supply.

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Shelter

The traditional shelter and clothing of the Kapingas are admirably adapted to the climate. In contrast, the adoption of foreign clothes habits and foreign building material has proved unhealthful. Shoes, worn part of the time because constant wear is impossible, introduce the hazard of softened natural foot covering which is incapable of withstanding the wear and tear of coral. Constricting temperate climate clothing is uncomfortable and prevents proper body cooling. The laundry methods in use are not suitable for the care of such clothing, adding much time to that required for repair.

The few board houses roofed with metal strips are hot, dark, dirty and harbor cockroaches, ants, mosquitoes and flies. The open sided pandanus thatch roofed, coral gravel floored house is so far superior that only the strongest urge for prestige and the possession of abundant funds have accomplished a change from the traditional house. There is an indication that as soon as the termites have destroyed the few present board buildings no more will be built. Reversal to a normal type of clothing for the climate is less likely because of the well established church requirement that clothes be worn by all who have them.

Health

Trauma and communicable disease are the two principle causes of casualties. Long adaptation to the environment is evident in resistance to the effects of sun and sea and coral gravel. The keratinized layer of the sole of the foot is usually 5 mm thick, which permits running and walking on the coarse sharp gravel of the islands and reef. Feet and legs, however, are a frequent site of injury in the form of abrasions and lacerations. Puncture wounds are common and there are occasional fractures. Many of the abrasions become subcutaneous abscesses which are well circumscribed. The same type injury in the non-immune new-comer leads to a diffuse inflammation with lymphangitis and lymphnode enlargement.

The inhabitants are subject to sunburn, and they, as any pale-skinned new-comer, must become readapted if unexposed to the sun for long periods. A chronic conjunctivitis localized to the exposed areas of the conjunctiva is prevalent. It occurs most often in fishermen who do not wear hats or who cannot because of the type of fishing such as netting on the reef during which the fishermen are submerged frequently. Others who spend hours in the sun, develop the same type lesion to a milder degree. In the fishermen the cornea adjacent to the pinguecula acquires a pannus which with repeated injury becomes opaque. In its mildest form this lesion is a congestion of the conjunctiva limited to the exposed areas, and most intense at the pinguecula. Repeated long exposure to sun aggravates this. Some of the fishermen have attributed the affection to the use of swimming goggles. However it occurs in the women who may paddle in the bright sun for a few hours, but who do not use swimming goggles. The symptoms are like those of "snow blindness" with a feeling of "sand in the eyes".

Drowning is infrequent considering the amount of time spent in the water from infancy to old age. There have been three deaths from drowning in the past 3 years: One child fell from a tree into a taro swamp, smothering in the mud. Another waded out too far on the reef. A fisherman drowned in the swift current of the pass.

The injuries due to sea fauna are fish bites, puncture wounds and lacerations from fish spines, lacerations from crab and lobster spines and claws, and punctures from sea-urchin spines. All these are not different from similar lacerations and punctures received from metal instruments. If the wound remains uncleansed it responds with the same type of suppuration as that seen in abrasions from coral or other injuries. The wounds heal rapidly and without suppuration if thoroughly cleansed by some such method as soaking in a mild antiseptic solution, if superficial or by opening and cleansing if deep.

It is stated that several types of poisonous spines are encountered such as the cone snails, a dark-colored sea-urchin, and a fish camouflaged to resemble the rock bottom. "Jelly fish" are numerous and their tentacles produce a transient itching and vesiculation. A yellow coral with fine branches produces the same type of lesion.

The daily use of open fires leads to burns, usually of infants.

Falling coconuts and fronds are a potential source of injury thoroughly understood by the inhabitants who keep the ageing fronds cut from the palms on Touhou and Weria where also the nuts are harvested young for drinking before they reach the falling stage.

Stone bruises are common. They are large and longlasting. The keratin layer protects, but prevents the drainage of the hematoma of a stone bruise which may disable for months. When the stonebruise is finally exposed by wearing off the keratin covering, a rough crevassed region is left which might be mistaken for serious diseases by the uninitiated.

Fish hooks and knives are widely used and produce their usual casualties.

Communicable Disease

The lack of any accurate concept of the spread of disease, and the personal habits of this compact population, bring about a rapid spread of such diseases as acute upper respiratory tract infections, acute epidemic conjunctivitis, skin infections, and yaws. A display of this type spread followed the cowpox vaccinations of June, 1950. For the following month accidental vaccinations occurred in several families in which some of the members had escaped vaccination at the physicians visit. Many of the vaccinated showed wide distribution of large vaccinia lesions.

For a month or two following the visit of a boat there are epidemic sore throats, colds and intestinal infections characterized by diarrhoea. These epidemics are like those occurring in any isolated community when the isolation is broken by visitors introducing a new respiratory tract and

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intestinal flora. The boat that brings back the student group for summer holiday from Ponape is the bearer of the greatest single burden of infection. Intestinal parasites, respiratory infections, pink eye and, reportedly, gonorrhoea are the principal offenders.

Hands, mouths, clothing, sleeping mats within the family soon come to bear the same flora and fauna. Dishes are gradually coming into greater use to replace the disposable type such as breadfruit leaf plates, coconut leaf plates, coconut leaf platters or coconut shell bowls. The dishes provide an excellent medium for exchanging acute infection because of the cold water washing technique, but even hot water methods might be presumed superfluous so long as the common eating method with fingers dipped into the same bowl persists. The spread of disease in this group is much like that in an individual; the entire surviving population becomes immune shortly after the introduction of a new agent of infectious disease.

Isolation of infected individuals is an impossibility at present. The exposure of a newborn infant to the group bacteria is an example of how little comprehension of bacterial disease exists. All newborn infants are subjected to mouth to mouth transfer of infectious agents of many female relatives, friends and assistants at the birth. An infant cry is a signal for repetition of the transfer. The death records indicate little mortality from this practice, but the morbidity is high. Thrush fungus is prevalent, as are coughs and colds in the newborn group. It would be difficult to ascribe a more likely source for the infection of a four months old infant who died of *tuberculous meningitis, than this mouth to mouth transfer.

About one fifth of the populace has fungus infection of the skin. Four types are identified clinically, from which fungi were demonstrated in potassium hydroxide preparations. These are Tinea imbricata, Tinea versicolor, and Tinea cruris. Tinea favosa is uncommon. Conditions are ideal for the continuance of fungus infections and for their transfer. There is an indication of decreasing incidence in recent years since soap and rainwater have been more regularly available.

Tuberculosis is not common. Occasional cases of cough with emaciation have occurred, and such patients have been isolated in a house set aside for this purpose. "Isolation" as practical here means little more than a change of scene for the usual bacterial transfers. Patients isolated at the infirmary for acute infections were visited regularly by family and friends. Spouse slept with spouse and friend with friend on the narrow infirmary cot. The usual eating habits are practiced under isolation as at home. At funeral ceremonies the deceased is kissed good-bye by all regardless of the cause of death. Under the circumstances, if tuberculosis were common it should be more evident. Only one case of probable tuberculosis was seen in five months, that of a four months old infant dying of tuberculous meningitis. Of the many coughs treated at the infirmary none was found with physical signs of tuberculosis. No emaciated sick people with cough were seen.

Arthritis is uncommon. Two patients were seen with symptoms and signs characteristic of mild infectious arthritis. The women complain of pain in the sacroiliac region radiating down the leg. These patients gave a history of some type of unusual activity prior to the attack. Such work

* Clinical diagnosis

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as pounding pandanus leaves or mashing breadfruit or pandanus pulp with a heavy pounder is done periodically with little preparation for the strenuous exercise of muscles required. The young women pride themselves on ability to carry heavy loads, and occasionally complain of the same symptoms.

Psychologically the people appear well adjusted to their situation of isolation. Many of the older people recognize the advantages of climate, location and food supply. These have returned after visits abroad to spend their remaining days here without regret. Youth wants to get away. Many of them return with appreciation that the contrast with other places is in favor of Kapingamarangi. Ninety Kapingamarangi people have migrated to Ponape (village of Porokiet). The reason given by some, and this is agreed to by the leaders at Kapinga, is that the atoll will support only a limited number, and that 500 is too large a population.

No severe psychoses were seen. Certain young women are noted for hysterical attacks attributed to seeing ghosts. There is some concern for personal health usually manifested by calling for medical aid for slight aches and pains. This apprehension appears to be based upon the concept that pain is the only symptom of disease. This is further emphasized by the patient's failure to call for help until other symptoms and signs are well advanced when pain develops. This is not out of proportion to the degree of education concerning disease processes. One case of presenile dementia was seen.

No cancer was seen, either in skin where it would be obvious, or as signs of internal disease. Epidermal inclusion cysts (wens) are common and two lipomas were seen. No basal cell epitheliomas were seen.

Sterility of women is a common complaint. There are 101 married couples, 29 of which have no children. The cause of this was not learned. The reputed frequency of gonorrhoea might explain this and the frequent occurrence of unions with but one child. However, the only signs or symptoms called to my attention despite my frequent requests to treat any cases of gonorrhoea was one case of recurrent bartholinitis and one case of acute epididymitis.

Parasitism

Specific evidence of disease due to parasites is lacking. Faeces from 275 people were examined for intestinal parasites and 100 found to carry at least one parasite, an incidence of 36.4%. Hookworm 21.9%, and pinworm found in 4 of 20 NIH preparations represent the common intestinal parasites. Protozoa were rare. Blood parasites were not found in 20 thick and 20 thin preparations stained with Giemsa stain. Even though no direct evidence of disease from these parasites was found, such a burden of parasites is a hazard. Twenty-four carried both hookworm and whipworm, both parasites producing blood loss. If this population were investigated for anemia, abnormality might be demonstrated due to these parasites. Lice are common.

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Anomalies

Anomalies are infrequent. One boy with a mild degree of pigeon breast is apparently not handicapped and has no other obvious anomaly. One small pit in the pinna of an ear was classed as a remnant of a branchial cleft because it had been present from birth. Two children with apparent endocrine dyscrasia were seen. An 8 year old boy with Simmon's disease, and an 18 year old girl without secondary female sex characteristics. The usual age for development of secondary sex characteristics of the female is 12.

Of a debatably anomalous nature was one case of hydrocephalus, a boy aged 4 with fontanells open and head circumference increased. In the same category are two cases of mild spastic paraplegia.

Mutilation

A mild form of mutilation of ear lobes was discontinued when church replaced priesthood. Women still pierce the ear for ear rings. Youths scarify their arms in commemoration of early sex experiences, usually with a glowing cigarette.

Medical Care

In 1947 an infirmary was built on Touhou. This is a native type house of post and thatch construction, separated into two rooms by a partition. The infirmary is equipped with utensils, simple instruments, two beds with mattresses, three small tables, instrument stand, shelves, examining table, benches and a chair.

The medical aid, Samuel (June to August) relieved by Masao (August to November) works under the remote supervision of the staff of the Ponape hospital from which supplies are replenished periodically. Beginning in August 1950 the periods were increased from two months to three months. The medical aid makes inspections and, through the assistant chiefs secures the burial of refuse heaps, burning of trash and the cleaning of water tanks, isolation of pigs and spraying to reduce the flies. The persistence and success of the fly spraying program is largely due to the enthusiasm of the assistant chiefs. The flies are convincingly fewer on Touhou and Werua where the spraying is done than on the outer islands. There is no comparable program to reduce the ant or cockroach population.

The medical aid acts as the people's physician, prescribing, while they last, the simple and harmless remedies which, under the circumstances can be the only ones supplied in quantity. These remedies are given on the basis of a symptom: A cough received medication A, a headache receives medication B and a stomachache receives medication C. A patient with all three symptoms gets the three remedies. Abrasions and lacerations are cleaned and bandaged in a manner commensurate with several months training on the basis of complete ignorance of the concepts of infection and asepsis.

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The aid enjoys some prerogatives of the former medicine man without the latter's social position of respect due to age and training. This situation leads to certain mild conflicts, as between the assistant chiefs and the medical aid. The assistant chiefs are highly respected executive officers of the chief. One is the son of the former chief. The medical aid is not now looked upon as having attained a mature position of responsibility.

It is a favorable commentary on the sound policy of the basic program that even with these handicaps, the people are benefitting from the infirmary and its personnel. There is almost daily use of the facilities for wound dressing. The gauze and bandage material provided is still preferred for head dress and arm band decoration and may be replaced by a home bandage. Many prospective patients treat their own wounds at home with unsterile bandage or KAU leaf covering until, in some instances, abscesses develop. Others come for treatment of very slight abrasions, indicating a possible appreciation that early treatment may prevent later trouble. All cases of severe injury are brought to the infirmary.

The infirmary is serving a need. It is a symbol to the people that there is an outside interest in their welfare and it serves as a meeting place from which sanitation and health knowledge can be spread as soon as the planned personnel is available. A government poster, a translation for which was prepared by Masao the temporary aid, has been displayed prominently in infirmary, church and school. It deals with flies, mosquitoes, rubbish and disease and has received much attention and comment. The enthusiasm for the health program is spreading but still remains largely with the leaders. Serious illness is still treated by long established primitive methods.

Medical Lore and Practices

The gods of the Kapingas are deified ancestors of their atoll home who inhabit the sea outside the reef. These gods are the benefactors of the people and are all powerful.

The ancient priesthood acted as intermediaries with these tribal gods, requesting their aid to ward off afflictions or assist in special projects,

The spirits of the recently dead reside in the lagoon and return to wander about their former home on land. Some of these ghosts are mischievous or have grudges against specific living enemies.

Medical practice for the treatment of disease was traditionally in the hands of practitioners or magicians, who had power passed on from their ancestors. The power consisted of methods of control of the ghosts of the lagoon and of formulae for specific remedies. Any obscure illness is attributed to seeing these ghosts, the sight of certain spirits producing particular illnesses.

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One of the commoner ghost-caused diseases is a condition of young women called HOTUPE (fits). It is a temporary apparent disorientation of the attacked patient who may run into the sea if not restrained. The attack starts suddenly with a series of loud, shrill screams resembling those of a suddenly hurt child. The cries follow a stereotyped pattern immediately recognized as being those of the individual attacked. Some have advocated as treatment a lack of restraint; the patient runs into the sea (on the smooth part of the reef) and recovers immediately.

A disease characterized by menorrhagia is attributed to seeing two ghosts.

A practitioner maintained his position by the success or failure of his exorcising and his herbal remedies. Herbal remedies were, and still are, used for common afflictions. Some former remedies have been discarded in favor of some imported from Nukuoro (probably once the home of the Kapingas). These remedies are carefully written and indexed in a note book prepared by Alfred Patterson who was trained in the ancient practices. He recorded them while visiting Nukuoro. Their antiquity is not known. Some differ little in principle from remedies devised by any one desiring a purge, relief from pain or irritation or for hemostasis. The complexity of some formulae hints of their possible origin in secretly compounded magic. It is stated that the remedies must be made and used in a certain way to be effective. This is the reason given for keeping the formulae carefully guarded.

One series of remedies, totalling 12 were in a separate category called sacred. These are all mixtures of the juices of plants, for external and for internal use. They are described completely in the appended list. One internal and one external remedy are described here as examples.

A. A remedy for headache.

a. Three yellow leaves of PUKA (<u>Pisonia grandis</u>)
Three green leaves of PUKA
Three leaflets of TUA KIMOA (<u>Vigna marina</u>)

b. A husk of coconut that has been soaking in the sea to rot, is soaked in fresh water for a day.

c. A hole about a food deep is dug in the ground and this lined with a leaf of NGAUNGAU (<u>Alocasia macrorrhiza</u>)("ape" in Hawaiian).

After pounding the leaves in a bowl, a coconut cloth is used as a strainer and the juice squeezed into this hole.

d. The water is wrung from the coconut husk and added to the juice in the "ape" leaf.

The patient lies on his back immersing his head in the mixture allowing just nose and mouth above the fluid. The treatment is given for an hour or less for three successive days if necessary. If the patient has not recovered after three days of rest from treatment another series of three is given.

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B. A remedy for bloody diarrhoea and fever.

A stem of fruit of WARANGA (Pipturus argenteus), 6 fruits of the HUATORO (Triumfetta procumbens), and a 3-inch square of outer layer of coconut trunk.

These are pounded in a bowl and the juice squeezed through a cloth into a small immature coconut about half full of its juice. The mixture is heated and drunk for the first dose and repeated cold for two more doses.

A second category of remedies is used because of well demonstrated ability of the remedy to produce a certain effect. One of these, WARE WARE is used as a home remedy for any one not feeling well enough to be up and about his work. A mature coconut is opened with strokes of the sharp edge of a knife blade leaving about 1/3 of the shell as a cover. The juice is saved, the meat shredded with a scraper including all of the thin brown coating of the meat. The shredded meat and juice are replaced and the covered nut cooked in the ground oven. The mixture is drunk hot and produces a moderate purging.

An absorbent dressing is made from the hairy portion of the "Bird nest" fern (Asplenium nidus).

Round flat leaves, such as the HAU (wild hibiscus) (Hibiscus tiliaceus) are applied either directly or by use of a gum, to abrasions and lacerations to keep the flies away.

Coconut water from the young nut is given new-born infants pending a supply of milk from the mother. This water produces a purging, thought desirable by the Kapingas, sometimes sufficient to produce a bloody mucous fecal mass. Microscopic examination of such material shows many macrophages filled with the coconut oil droplets.

Obstetrical care

Obstetrics is entirely the field of older women, some of whom have earned a place comparable to that of midwife by attending many births. From the onset of pregnancy the prospective mother is set apart and advised by the older women. During the first month of pregnancy she does not work but carries on her usual tasks thereafter because it is thought she will be unable to carry on labor properly otherwise. Sexual intercourse is tabu throughout pregnancy and thereafter for one year. There is a strong belief in prenatal influence, and many tabus concerning what the mother should look at and avoid seeing. A first pregnancy and delivery are accompanied by much ceremony omitted from subsequent ones. Traditionally at the onset of labor the obstetrical party retreated to a remote island. Now many deliveries take place in a neighbor's or friend's house within the village.

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There are apparently two schools of thought concerning the desirability of early bearing down. Some urge the mother to exert herself throughout labor, others insist it does no good until the third stage of labor which is recognized by the bursting of the amniotic sac and the resultant flow of watery fluid. Long cloths are tied about the epigastrium and pulled tight to assist the expulsion, frequently in the early stages of labor. The mother is provided with a rope tied to the upper part of a house post against which her feet rest while she pulls. Primipara were found exhausted in the early hours of labor with the infant head still above the pelvic brim. There is apparently agreement of all the older women that once the amniotic sac has ruptured the delivery must be speeded because the child will inhale blood. One severe perineal tear was seen which may well have been due to a hurried third stage. There is comparable urgency to speed the placenta and membranes, even to exerting traction on the membranes, if there is delay, to the point of tearing them free. Traction on the cord is avoided. The delivery bed is an old mat of pandanus. The mother is draped to keep the flies away.

The infant is received in the hands of the midwife who immediately cleanses the mouth and nose of the infant by sucking them free of mucous. The tongue of the midwife is inserted into the infant's mouth to search out any foreign material. This process is repeated especially if the infant cries. It is thought such cleansing must be done to permit the first breath and that it must be repeated to insure that it is a complete cleansing process.

Formerly the cord was cut about three inches from the umbilicus with a sharp sea shell and left untied. Only rare hemorrhage occurred. Now cords are tied with thread. The infant is immediately washed with fresh coconut cream.

Any indication of a concept of asepsis is lacking. The use of clean cloths is a gesture in that direction and the cleanliness of the cloth is of the cold water variety. A bath in the ocean is attempted by some immediately prior to delivery. The mouth to mouth aspiration is repeated by relatives and friends of the family. The first solid food of the infant, given pending the mother's milk supply, is prechewed.

The placenta is washed, wrapped in a cloth and buried in the channel between the islands. The cord stump is allowed to drop off and is then placed, if from a female, in the base of the leaves of a lily plant, and if from a male, in the fold of the leaves of a young coconut tree.

The mother is urged to take food throughout labor and immediately after delivery, even though exhaustion may cause its immediate vomiting. One sixteen year old primipara was delivered while chewing a pandanus key. Maternal rest following delivery is looked upon as a sign of weakness, and an effort is made to avoid the stigma. The mother sits up shortly after delivery. She travels to the ocean for a bath as soon as she can walk, and is usually visiting neighbors within three days. A journey from an outlying island is undertaken the day after delivery. Some of the women are in a state of exhaustion, but apparently no concessions are made for a prolonged or difficult labor. A tea made from any one of several varieties of plant is routinely taken by the mother shortly after delivery.

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The medical aid and the medicine man professed ignorance of all obstetrical practices.

There is room for the application of a few simple remedies in delivery and the puerperium. Two instances of omphalitis in the newborn were seen. Thrush fungus was severe in four mouths of newborns. Suppurative skin infections were seen in four. One infant had bronchopneumonia.

None of the infants died, and infant mortality is said to be low. One is compelled to great caution in advising any change of procedure in the face of such a mortality rate and absence of alternatives. The mouth to mouth practice which violates the principle of isolation of an infant from new bacterial flora goes all the way in the opposite direction and brings to the infant almost all the bacteria it is going to meet. The abandonment of a practice which achieves a difficult task, that of removing mucous from the upper respiratory tract, might be harmful, especially when we consider that the same result is attempted commonly in medical practice by wiping out the mouth with sterile gauze and aspirating with a sterile catheter.

I believe the people are quite anxious to accept innovations in their obstetrical practice, but both equipment and personnel must be available before any improvement is possible. The medical aid might be able to introduce an alcohol cord dressing and a perineal pad soaked in some antiseptic solution such as is commonly available at infirmaries.

Two puerperal deaths have occurred in the past two years during which time there have been 45 births. The cause of the deaths is not known. There were 3 infant deaths in the same period.

There is shown in Table 1 a record of seven weeks infirmary visits as an indication of the conditions diagnosed and treated there. In addition house calls were made during the five months of residence for the following probable conditions.

Auricular fibrillation with failing circulation	M.90.
Bronchopneumonia	F.74.
Ruptured ectopic pregnancy	F.21.
Early pregnancy	F.20.
Miscarriage of mascerated foetus, 4 Mo.	F.21.
Recurrent abscess Bartholin's Gland	F.15.
Acute epididymitis	M.18.
Chronic arthritis, hypertrophic.	M.60.
Tuberculous meningitis, death.	F.4 Mo.
Coronary occlusion, death.	F.81.
Bleeding umbilical cord (poor tie)	F.1 d.
Suppurative omphalitis	F.2 wks.
Bronchopneumonia	F.6 d.
Hysteria, (Marital problem)	M.24.
Hysteria,	F.21.
Fever of unknown cause	F.24.
Exhaustion 2d.post partum	F.30.
Dystocia - Delayed Rupture of Membranes	F.30.

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TABLE I

TABLE OF CONDITIONS FOR WHICH 161 PATIENTS MADE 563 VISITS TO THE INFIRMARY FROM SEPTEMBER 21 TO NOVEMBER 11, 1950.

Lacerations and abrasions	27
Acute epidemic conjunctivitis	20
Tooth extraction for caries	17
Upper respiratory tract infection	14
Tinea	13
Cough	10
Infected lacerations and abrasions	7
Suppurative gingivitis	6
Headache	6
Stomachache	5
Abscess, unexplained	4
Acute otitis media	4
Vague and mild symptoms	4
Tooth ache, caries (no extraction)	4
Back strain	4
Yaws, possible	4
Yaws, probable	2
Thrush stomatitis	4
Abscess jaw, due to dental caries	3
Unexplained fever	3
Seborrhoeic dermatitis	3
Burns, accidental	2
Acute conjunctivitis (sun exposure)	2
Chronic infectious arthritis?	2
Menorrhagia	2
Amenorrhoea	2
Fracture (arm, fall due to epilepsy)	1
Chronic suppurative otitis media	1
Peptic ulcer ??	1
Diarrhoea	M.4.
Suppurative lymphadenitis (head lice)	M.3.

Summarized, these lists indicate no great variation from the conditions prevalent in any small community where the population is subject to a great deal of trauma in daily activities and where the personal sanitation is not on a high level.

One month's visits at the infirmary are recorded as 286 visits by 122 patients. The commonest complaint was cough and sore throat of which condition there were 38. Trauma, principally as lacerations and abrasions, was second with 19 instances, 6 infected. Teeth and gums were the cause of numerous complaints. There were 18 patients with tooth ache from carious teeth and five with very severe gingivitis. The natural history of tooth decay is displayed prominently in all adult mouths. Many gold and silver crowns and fillings are also seen (Japanese period, Ponape). Gingivitis is prevalent after 20 years of age, and appears to offer a fertile field for health

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improvement by education concerning well established methods of mouth hygiene. Tooth brushing with coconut husk fiber is practiced by some. The forty teeth extracted for caries with pain represent a very small part of the teeth requiring care.

TABLE 2

THE AGE DISTRIBUTION OF THE RESIDENTS OF KAPINGAMARANGI
NOVEMBER 1, 1950

AGE	M	F	TOTAL
Under 1	3	9	12
1	10	10	20
2	5	5	10
3	5	10	15
4	4	6	10
5-9	28	31	59
10-14	24	26	50
15-19	28	24	52
20-24	16	33	49
25-29	14	16	30
30-34	14	13	27
35-44	25	25	50
45-54	23	18	41
55-64	14	21	35
65-74	8	12	20
75-84	1		1
85-	1		1
	223	259	482

There are no exact data concerning births and deaths prior to 1947. No diagnoses of cause of death are available.

The Bernice P. Bishop Museum has kept a file of births and deaths since 1946.

YEAR	BIRTHS M	BIRTHS F	BIRTHS TOTAL	DEATHS TOTAL
1947			11	7
1948	7	5	12	11
1949	10	10	20	9
1950	3	10	13 (To Nov. 1)	5

Epidemiology

The prominent etiologic factors of the diseases prevalent at Kapingamarangi are of considerable epidemiological interest. The commonest chronic disease is "ring worm" due to four varieties of Tinea. The control of these skin diseases is now frustrated by the household and personal sanitation of

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the patients. Cleanliness of the hot water and soap variety is probably the basic factor necessary for progress in medication for these diseases. The families free from fungus infection are those best equipped for cleanliness. One advantage in a large constant supply of rain water on Touhou would be the proper use of soap permitted by soft water baths, now indulged in during showers and when soap is available. Clothing also requires sterilization by boiling water, at least, and there is abundant fuel to permit proper laundering. Education to the effect that heat would be less destructive than the severe pounding now administered to clothes would yield a return in both economy and health.

Parasitism is also affected by a lack of proper use of soap and water. Head lice, pin worm and whipworm and possibly hookworm as spread here are subject to some control through care of the family clothing and mats. The usual methods of spread of whipworm and hookworm appear not to be the most important factors in this community. The regularly recurring importation of certain parasites, including hookworm, appears to be a prominent feature subject to control by treating the carriers at the source of infection (principally Ponape). Disposal of excreta, though subject to improvement, is questionably a cause of spread of hookworm here where there is a low incidence in those who have not been away from the island, and where there is a family grouping of the carriers. The slight spread of hookworm is likely of the direct type which here spreads whipworm.

Circumstances that reduce the probability of spread of hookworm by the usual method of contamination of muddy soil are here the absence of general soil pollution and the absence of mud secured by spreading coarse coral gravel on all working areas and a coarse sand on the main thoroughfares. Rainfall, though in annual quantity sufficient (80 in.) to permit hookworm spread is so intermittent that the soil, even in the few ungravelled areas is dry for months at a time. The few small areas kept wet by laundering and bathing with well water are a possible region of spread of hook worm in the usual manner. A spot map shows no increased incidence in the immediate vicinity of these areas.

The high incidence of whipworm and low incidence of *Ascaris* point to some special conditions to account for the deviation from the rule that whipworm and *Ascaris* are parallel infections. To favor the low incidence is the isolation of pigs from each other and from the habitation. This isolation is not complete enough to account entirely for the low incidence. The sty areas are well drained and dry for months at a time.* The watering utensils are *Tridacna* shells, dry most of the time. There is no contamination of the sty areas by humans. The latest pig stock was imported prior to 1941. The pigs are kept tethered or singly in small rock pens. *Ascaris* may be absent from the pigs. None was found in ten pig faeces specimens and adjacent soil. Such *Ascaris* as is brought in from foreign countries by humans would find little opportunity for survival under the prevailing circumstances. It is quite likely that little *Ascaris* is imported because the traveling population is above the age commonly acquiring *Ascaris*.

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* *Ascaris* requires 30 days in moist soil to become infective.

The high incidence of acute infections due to visiting boats and returning travellers is a serious economic load for this community. The only apparent help lies in combatting with medical care the acute stages to avoid serious complications. The problem is that of any isolated community which must (preferably gradually) acquire immunity to the world's burden of bacterial and viral flora if it is to survive without return to its state of isolation.

The isolation which permitted Kapingamarangi to remain unvisited by whites until 1871 also accounts for the avoidance of the devastating epidemics which so seriously reduced the population of other atolls. There have been seven epidemics, all following the visit of boats. The first, like all the others attacked the entire population, but caused only a few deaths. The chief characteristic of this first epidemic was that it caused listlessness and death in a few days.

The second occurred between 1900 and 1910 and is described as a wasting disease with cough.

The third was synchronous with similar epidemics in Ponape and Nukuoro between 1910 and 1920 and characterized by severe headache.

Neither the fourth or fifth caused any deaths and they had the characteristic manifestations of whooping cough and of mumps. No orchitis occurred with the mumps.

The sixth was a bloody diarrhoea dated as during the Japanese times. Only a few people died.

About 1940 a severe sore throat followed by a fine red skin eruption and peeling of the skin caused the deaths of a few children and no adults. This was probably scarlet fever.

There has been a time when tuberculosis was more prevalent than now, and chronic skin diseases have decreased. The German expedition of 1910 described the populace as nearly all affected by skin disease.

The impression gained is that this very susceptible group of people has weathered many epidemics with much less loss of life than reported in other isolated groups, and that there never has been an epidemic that killed large numbers. The largest number dying in any epidemic is probably ten or twelve. The largest number of names with dates of death that could be elicited was a group of 6 occurring in the 1922-24 period.

The worst death-dealing condition was starvation in the famine of 1915-1919 when 60 people died in Kapingamarangi and 40 Kapingas removed to Ponape in very poor condition died there. It is a reasonable conjecture that the deaths would not have occurred had not the local governor prohibited the use of coconuts for food and restricted fishing, by requiring men to work at copra production.

Immunization against small pox by vaccination showed this group in June 1950 to be entirely non-immune, substantiating the absence of any history of an epidemic of that disease. No epidemics are reported characteristic of

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diphtheria, chicken pox or measles. A large proportion of the population has been immunized against diphtheria (June, 1950). The other two diseases must be considered as potential serious hazards, and their importation avoided.

The most fertile field for the application of preventive measures of the early treatment type is that of trauma. Probably no more than a third of the cases of mild trauma are seen at the infirmary in an early stage.

Judging from the number of home made bandages adorning arms, legs, fingers and toes, home treatment still predominates. This is emphasized by the number of cuts and scratches seen in a state of suppuration. Some of the bandages cover the scarification practiced by youth to commemorate their early sex experiences. These wounds are usually sterile, the favorite mark being a cigarette burn on the arm.

Thorough cleansing and covering of wounds is made more urgent by flies which are immediately attracted by any open wound.

High infant morbidity of acute infections of skin and respiratory tract is associated with long established practices some of which must persist until proper substitutes are available such as good obstetrical practice. Much, however, can be achieved by hot water and soap cleaning of clothes used for the infant and its bed. As simple as such devices appear their use requires the changing of long held concepts and despite an evidenced willingness to learn, reasons for change are difficult to grasp. Some idea of the difficulties are suggested by the finding that a medical aid, after two years of education in basic sciences required instruction in washing hands, cleaning instruments and the handling of sterile material.

Three maternal deaths in the past three years can be understood after observing the obstetrical practices in which, apparently, acquired immunity to tribal bacterial flora replaces asepsis.

Three common insect vectors, flies, mosquitoes and lice are here in sufficient numbers to cause epidemics should the proper disease factor be introduced. Flies now spread wound infection, and the control of this lies in the care of wounds rather than any hope that flies will be eliminated. The mosquitoes are controllable on the principal residential island and are now kept reduced by exposing water tanks to sunlight and by the elimination of all natural casual water containers such as coconut shells. (No anophelenes).

Lice are subject to greater control than now evidenced. In some families the children's heads are kept clipped, mats are sunned frequently, and kept clean. Adults wash frequently with soap. These families have no obvious lice. The small boys are the most conspicuous bearers of head lice. By well established custom the habits of youth are uncontrolled in this society. Gradual education to the liberal use of soap and hot water and hair clippers is possible in this intelligent group. It might be carried on through the medical establishment cooperating with the school.

Rat control is apparently quite satisfactorily maintained by the cats which are no great burden on the food supply because they scavenge all refuse.

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Summary

Five months observation, from mid-June to mid-November, 1950, of the health conditions of Kapingamarangi reveals a high degree of adaptation of the people to a salubrious environment. There is a high incidence of trauma and of infectious disease of mild varieties. There is demonstrated the usual reactions of an isolated group to commerce with foreign groups. These reactions emphasize the inadequacy of certain long established practices to meet the new environmental change.

There is indicated some progress toward readaptation to the imposed changes. Under intelligent leadership, education about modern concepts of disease and disease control is establishing the base for improvements of personal hygiene, first aid, and general sanitation.

A better rain water supply would improve the opportunity for better personal and family hygiene. Elimination of the dry reef as a toilet, and restriction of area used would appear to offer less opportunity for spread of disease.

The daily clean up could be extended to the beach areas with a reduction of fly breeding areas.

The present direct ocean disposal system is adequate only with a continued small population.

Appendix A

Medical remedies

1. For pain in the head and hot breath.

   a. Leaf buds of the WORO-WORO, _Premna obtusifolia_ are pounded until soft. The pulp is inclosed in a small piece of cloth and a drop or two of the juice squeezed into the nostrils while inhaling. This treatment is used three times a day for two days if necessary, and, after a three day interval may be repeated for two more days only.

2. For headache.

   a. Three yellow leaves of PUKA, _Pisonia grandis_
   Three green leaves of PUKA
   Three leaflets of TUA KIMOA, _Vigna marina_

   b. A husk of coconut that has been soaking in the sea to rot is soaked in fresh water for a day.

   c. A hole about a foot deep is dug in the ground and lined with a leaf of NGAU NGAU, _Alocasia macrorrhiza_.

   d. The water is squeezed from the coconut husk into the leaf lined hole and the juice of the pounded plant leaves added.

   e. The patient lies on his back, immersing his head in the mixture for an hour at a time for three days. The treatment may be repeated after three days interval.

3. A post partem medication.

   a. Six small plants of NAU, _Scaevola frutescens_ are pounded and the juice squeezed into a very young coconut.

   b. All of this is drunk, and a similar mixture each day for three days.

4. For a fall from a tree.

   a. Dark grass plants, roots and all.

   b. Leaves of T'HIA, _Clerodendrum inerme_.
   Enough of a. and b. to make a handful is crushed in a wooden bowl 16" long with

   c. three pieces each about 6" long of the growing leaf tip of HALA HALEO (N)*

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* (N) indicates a Nukuoran name

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d. The grated meat of a mature coconut (brown husk) is added to a, b, and c.

e. Three batches of the above are made and the juice placed in a tarpaulin-lined trench big enough to hold the victim and several buckets of water.

f. The patient remains immersed with only nose and mouth exposed until he has a shaking chill.

5. For prolonged menstruation.

Three sections of the base of TARA TARA, Crinum asiaticum, are pounded and the juice squeezed into water.
The patient sits in the water once a day for three days.
The treatment is omitted for three days and repeated if necessary.

6. Omitted because of its similarity to No. 3.

7. A remedy for bloody diarrhoea and fever.

a. A stem of fruit of WARANGA, Pipturus argenteus.

b. Six fruits of the HUATORO, (N) RAMUTAKE, Triumfetta procumbens.

c. A three inch square of the outer layer of coconut trunk.
These are pounded in a bowl and the juice squeezed through a cloth into a small immature coconut about half full of its juice. The mixture is heated and drunk for the first dose and repeated cold for two more doses.

8. For hot breath.

a. Six small pandanus plants.

b. Three sprouting leaves of the RAKAUTOROTORO, Polypodium scolopendria.
A coconut shell that has been rotting in the lagoon for a long time is used as a container for sea water. The plants and leaves are crushed and placed in a piece of coconut cloth. This is dipped as a sponge into the sea water and the patient given a sponge bath daily for three days. This is omitted for three days and repeated if necessary.

9. Omitted

10. For pain in the stomach (abdomen).

a. Three yellow and three green leaves of T'TOKOTOKONGO, Messerschmidia argentea, (beach heliotrope).
The leaves are pounded and the juice strained into coconut water. This is taken daily for from three to six days.

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11. For cough.

A piece of bark of T'TOKOTOKONGO, Messerschmidia argentea, and three yellow and three green leaves and three fruit bracts and three leaf buds of the same plant are pounded, the juice squeezed into coconut water and the mixture taken for cough.

12. For chest pain.

TAKAHARU, Allophylus timorensis is used in a manner similar to 11.

13. For a dressing over wet lesions the feathery mass from the center of the "bird nest fern" RAU KATAHA, Asplenium nidus is used.

14. A poultice for boils.

a. Dark grass

b. Three leaves of TUA KIMOA, Vigna marina.

c. The meat of a mature coconut in the green husk stage, grated. The pounded leaves and the grated nut meat are mixed and used as a poultice.

15. To bring boils to a head.

a. Three roots of pandanus.

b. Three roots of KANIU, Ochrosia oppositifolia.
Crush and put in coconut cloth, dip into coconut cream and salt water mixture and rub about the boil towards its center. Repeat for three days.

16. For an itching, scaling eruption.

a. Leaves of RAUTARIA, Terminalia samoensis.
Pound the leaves and sop around the area to stop the itching.

Remedies for puncture by the spine of the NOHU, (rock fish) which is said to cause severe swelling and pain.

1. Catch a NOHU and put the gall bladder juice on the injured spot. This must be done immediately.

2. a. Warm coconut cream in TUKIMA shell.

b. Young fruit of NONU, Morinda citrifolia, with flowers still on the fruit.

c. Two to four rootlets of coconut.
The fruit and rootlets are pounded and the juice strained into the coconut cream.
Place foot in mixture daily until healed.

A remedy for ghonorrhea.

A plant of RAMU TAKE, Triumfetta is stripped of its bark, the stem and leaves pounded and the juice squeezed into water. Each morning a half coconut shell of sea water is drunk. The penis is soaked for one half hour in the plant juice mixture, daily for three days.

REMEDIES in GENERAL USE

1. NONU, Morinda citrifolia flower buds are eaten by women wishing to wean a nursing infant. The milk becomes bitter and the child refuses to nurse.

2. A leaf of HAU, Hibiscus tiliaceus is a favorite cover for any open superficial wound.

3. NGIE, Pemphis acidula bark pounded and squeezed into water. The bitter liquid is taken daily for three days.

4. RAKAU HUNU KIRI, Cassia alata leaves are rubbed on chronic skin infections such as Tinea imbricata.

5. A thread is used to tie the base of warts and similar growths to cause them to drop off.

6. The vapors from steaming concoctions of various leaves are used against various affections of the head.

A cathartic.

The flesh of a sea-urchin with black and white spines is aged for a day, then mixed with some raw and some cooked coconut cream. The mixture is drunk and the limbs and body massaged toward the stomach.

A widely used cathartic, called WARE WARE. A young coconut in the late drinking stage is husked and the top third of the shell removed with the sharp edge of the knife so as to leave a tight cover. The meat and a considerable amount of the brown inner lining of the shell is scraped, and mixed with the juice, the covered shell placed in the ground oven. The whole amount is drunk hot.

A charm against spirits.

Two green coconut leaflets are placed shiny sides together. They are snapped by separating the hands rapidly and then knotted, at first with an overhand knot including both leaflets at junction of distal and middle thirds, and then an overhand knot tied with one leaflet adjacent and just distal to the first knot. This is pinned on the wall near the sick person.

PART II

A PARASITOLOGIC SURVEY OF KAPINGAMARANGI, 1950

Previous reports of parasitism in the East Carolines indicate intestinal parasites as almost universal, and few other parasites found in significant numbers. The isolated position and certain customs of Kapingamarangi relative to sanitation appeared to offer an opportunity for an exception to the rule.

Fecal contamination of the residential islands has been contrary to custom for many generations. The most heavily populated areas are free from mud even in heavy rains because coarse coral gravel is spread as a cover of used areas to prevent muddy surfaces. Thus two of the contributing causes of spread of hookworm and of *Ascaris* are curtailed.

During July and August of 1950, 283 faeces specimens were brought to the field laboratory in leaf covered coconut shell containers. Samples were removed to tight plastic vials and the remainder of the original specimen discarded (ocean). From the vial sample, iron hematoxylin stained slides were prepared, direct saline suspensions were examined, and zinc sulphate sedimentation-flotation preparations were made by hand centrifuge. Routinely, flotation specimens were examined and thirty-six sediments were examined to rule out operculate eggs, though none were expected.

Originally plans were made for the faeces parasite survey only, however time became available to make a reconnaissance of other parasites. Twenty N. I. H. preparations were made for pin worm. The unexpected absence of *Ascaris* required explanation, and ten specimens of pig faeces and adjacent soil were examined by saline flotation.

One patient was seen with chills and fever, and similar attacks were said to have occurred in men who had visited Rabaul. Twenty thick and twenty thin blood films were searched for malarial parasites and filarial larvae.

Inspection of patients coming to the infirmary was made for ectoparasites. Mosquitoes and larvae were collected for identification. It was reported by the authorities here that only one kind of mosquito was present before the Japanese came, a day biting variety, and that the Japanese brought the night biting variety.

A study was made of conditions which might affect parasitism and the observations included in "A Health Survey of Kapingamarangi."

The population is arranged in the following age groups.

AGE	M	F	TOTAL
under 1	3	10	13
1	10	10	20
2	5	5	10
3	5	10	15

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AGE	M	F	TOTAL
4	4	6	10
5-9	28	31	59
10-14	24	26	50
15-19	28	24	52
20-24	16	33	49
25-29	14	16	30
30-34	14	13	27
35-44	25	25	50
45-54	23	18	41
55-64	14	21	35
65-74	8	12	20
75-84	1	0	1
85	1	0	1
Total	223	260	483

Results of Faeces Survey

From 275 subjects, 283 faeces specimens were examined and 100 subjects found to carry one or more parasites, 36.4%. There were two common parasites, hook worm and whip worm.

TABLE 3

OVA OF PARASITES FOUND IN FAECES

PARASITE	IN MALES	IN FEMALES	TOTAL	% OF GROUP PARA-SITIZED
WHIPWORM	35	25	60	21.9
HOOKWORM	41	17	53	21.7
E. COLI	4	3	7	
ENDOLIMAX	3	0	3	1.1
IODAMOEBA	3	0	3	1.1
TRICHOMONAS	2	0	2	.73
GIARDIA	1	0	1	.34
ASCARIS	0	1	1	.34

TOTAL (multiple infections counted as 1) 36.4%

In view of the conditions which would tend to prevent hookworm spread, the history of the carriers was investigated. Table 4 indicates a higher incidence in those who have travelled to other atolls such as Ponape where hookworm incidence is known to be high.

TABLE 4

TOTAL GROUP	275	
TOTAL WITHOUT HOOKWORM	214	80%
NUMBER WHO HAVE BEEN AWAY	164	
WITH HOOKWORM " " "	48	29%
NUMBER NOT AWAY	111	
NOT AWAY WITH HOOKWORM	11	10%

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Although this distribution does not prove that the hookworm was acquired abroad, the fact that 80% of the entire group did not show hookworm would indicate the presence of factors limiting its spread in an entirely barefoot population and despite the importation of new carriers at fairly frequent intervals.

A spot map of Touhou Island indicates a high incidence of more than one infection in the same household.

The low incidence of intestinal protozoa in a population living as intimately as this one is worthy of note. The reason is not obvious. The low incidence in Ponape, the most visited foreign port is a factor. The frequent bathing permitted by access to the sea is probably another, which also contributes to keep the parasitization by all types to such a relatively low figure.

The only ectoparasite found is the body louse which must be present in nearly every household, if not all. All small boys with long hair have numerous louse egg cases (nits) attached to their hair.

Pin worm ova were found in 4 of 20 NIH. preparations from the anal region of young children. This establishes their presence, but no conclusion can be drawn concerning the incidence.

The absence of malarial parasites and filarial larvae was anticipated. No anophelene mosquitoes were seen although every opportunity to identify anophelenes was used. There are at least two species of mosquito, a day and a night biting variety. Specimens collected await identification. Complete malaria reconnaissance was not undertaken.

Treatment

The list appended shows those known to have whipworm at the time of the medical field trip from Ponape, August 1950 when medicines were brought for treatment of hookworm. The results of the hookworm treatment are not known because supplies to repeat the tests were exhausted. There is demonstrated in the same table the well known ineffectiveness of oil of chenopodium against whipworm. The oil was used in March, 1950 as part of a mass treatment for supposed Ascaris infection. Thirty-four of the fifty bearers of whipworm are known to have been treated. A complete list of those treated in March, 1950 is not available. One hundred residents were treated, and medicine left for 100 more which was not used. Therefore, at least 175 of those whose faeces were surveyed had had no recent treatment for ascariasis.

Conclusions

There are two common intestinal parasites in the residents of Kapingamarangi, hookworm and whipworm.

The hookworm is probably imported from other islands, especially by the student group returning from Ponape.

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Importation of hookworm could be most easily curtailed by treating the group returning from Ponape, before they leave.

Control of the spread of the common intestinal parasites and of ectoparasites lies in the field of general health education concerning personal and family hygiene.

APPENDIX

NAME	HOOKWORM	WHIPWORM	ISLAND	REFERENCE NUMBER	DATE LAST AWAY	DATE LAST TREATMENT	SODIUM SULPHATE	TETRACHLOR ETHYLENE	MAG. SULF.
HAKATOPE	Yes	Yes	W	261	Ponape 1939	3-50	Yes	Yes	Yes
DEHAWAI	Yes		W	264	Ponape 1936	3-50	Yes	Yes	Yes
TANGAMI		Yes	T	268	No	3-50	"	"	"
TARIPURET	Yes		W	271	Ponape 1935	3-50		one egg	
TAKITAK		Yes	W	272	Ponape 1935	3-50	"	"	"
KEREN		Yes	T	277	Truk 4-30	3-50			
ANTIPATI	Yes		W	284	Ponape 1931	3-50	"	"	"
TIOU	Yes		T	285	No	3-50	"	"	"
ARIPETI	Yes	Yes	T	286	Ponape 1946	3-50			
TANIEL	Yes		T	287	Ponape 9-49	3-50	"	"	"
DAUMIRI		Yes	T	291	Ponape 1937	3-50	"	"	"
ANION		Yes	W	292	No	3-50	"	"	"
WASAI	Yes		W	293	No	3-50	"	"	"
TIMOUET	Yes		W	294	Ponape 1935	3-50	"	"	"
SIMATI	Yes	Yes	T	295	Ponape 1949	3-50	"	"	"
NIMISIO	Yes	Yes	T	296	No	3-50	"	"	"
YESIKE	Yes	Yes	T	300	Now in Ponape				
TIRONGORONGO	Yes		T	301	Ponape 1939	3-50	"	"	"

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NAME	HOOKWORM	WHIPWORM	ISLAND	REFERENCE NUMBER	DATE LAST AWAY	DATE LAST TREATMENT	SODIUM SULPHATE	TETRACHLOR ETHYLENE	MAG. SULF.
KIKINE		Yes		307	No	3-50	Yes	Yes	Yes
PUREIKI	Yes		T	312		8-23/50	"	"	"
LUISI	Yes		W	316	Ponape 1947	3-50	"	"	"
MATINIA	Yes		T	319	No	3-50	"	"	"
KOULUA		Yes	T	320	Ponape June-50	3-50	"	"	"
TAITOS		Yes	T	323	Now in Ponape				
PELENES		Yes	T	326	No	3-50	"	"	"
TIMOTI	Yes	Yes	W	328	Ponape 1946	3-50	"	"	"
JARI	Yes		W	333	No	3-50	"	"	"
DIENEMANU		Yes	T	339	No	3-50	"	"	"
DILAUE		Yes	T	358	Truk 4-1931	3-50	"	"	"
LIETA		Yes	T	359	No	3-50	"	"	"
ISE	Yes		T	361	Ponape 12-1949	3-50	"	"	"
LIAA	Yes		T	362	Ponape 1939	3-50	"	"	"
HEKENOHO	Yes		T	365	Nukuor 1949	3-50	"	"	"
TOKORAI	Yes	Yes	W	216	Ponape 1949	3-50	"	"	"
SEMETI	Yes		T	221	Ponape 1949	3-50	"	"	"
LUI	Yes	Yes	T	222	Ponape 1949	3-50	"	"	"
RAIMON	Yes	Yes	T	224	Ponape 1945	No	"	"	"
KASTOR	Yes		T	225	Ponape 1939	3-50	"	"	"

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NAME	HOOKWORM	WHIPWORM	ISLAND	REFERENCE NUMBER	DATE LAST AWAY	DATE LAST TREATMENT	SODIUM SULPHATE	TETRACHLOR ETHYLENE	MAG. SULF.
KIMURA	Yes	Yes	T	228	Ponape 1946	3-50	Yes	Yes	Yes
LUCAS	Yes	Yes	T	229	Truk 1948	3-50	"	"	"
KATARINA		Yes	T	231	Ponape 1948	3-50	"	"	"
MASUKO	?		T	232					
MISERI	Yes	Yes	T	233	Ponape 1945	3-50	"	"	"
RISE	Yes	Yes	T	235	Ponape June 1949	3-50	"	"	"
TAWHERA	Yes			241	Now in Ponape				
RIMI	Yes		T	257	Ponape 1930	3-50	"	"	"
JOHANIS	Yes		W	367	Ponape 8-1944	3-50	"	"	"
URAK	Yes		W	371	Ponape 1932	3-50	"	"	"
ENIMA		Yes	W	373	No	3-50	"	"	"
MALIKUTI		Yes	T	376	No	3-50	"	"	"
DEDUO	Yes		T	378	Ponape 9-50	3-50	"	"	"
NOWA	Yes		T	379	Ponape 1949	3-50	"	"	"
PILIMON		Yes	T	380	Now in Ponape				
TIONI	Yes		T	381	Ponape	3-50	"	"	"
HUSAKO	Yes		T	387	Ponape 1938	3-1950	"	"	"
LETI	Yes	Yes	T	392	No	3-50	"	"	"
SIANA		Yes	T	401	"	3-50	"	"	"
TURUKO	Yes	Yes	T	402	"	3-50	"	"	"

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NAME	HOOKWORM	WHIPWORM	ISLAND	REFERENCE NUMBER	DATE LAST AWAY	DATE LAST TREATMENT	SODIUM SULPHATE	TETRACHLOR ETHYLENE	MAG. SULF.
SUSANA	Yes			404	No	3-50	Yes	Yes	Yes
TEIT	Yes		T	408	No	3-1950	"	"	"
TUHURU	Yes		T	409	No	3-1950	"	"	"
TOPIKI	Yes	Yes	T	411	Nukuor 8-1949	3-1950	"	"	"
KASUKO	Yes			415	Ponape 1935	No	"	"	"
ENELIA			T	386		Ascaris in Ponape			
MIKAR	Yes	Yes	T	416	June 1950?	Now in Ponape			
KORONIKA		Yes	T	421	Ponape June 1938	3-50	Yes	Yes	Yes
PIKITI		Yes	W	422	Ponape 2-1946	3-50	"	"	"
KARATI		Yes	T	426	Truk 6-47	3-50	"	"	"
HANAKO	Yes		T	429	Ponape 4-49	3-50	"	"	"
YOSITARO	Yes		T	434	No	No	"	"	"
BOMUKALAN	Yes		T	442	Nukuor 1946	3-50	"	"	"
MOTOHENI	Yes	Yes	T	448	Ponape 1946	3-50	"	"	"
PONTAIK	Yes	Yes	T	449	No	3-50	"	"	"
KOITI	Yes	Yes	T	450	Now in Ponape				
DERUITI		Yes		451	Ponape 1949	3-50	"	"	"
TAMASUITI	Yes			453	Ponape 1946	3-50	"	"	"
KINTARO	Yes			455	Ponape 15-8-50	No	"	"	"
SIRO I	Yes			459					
ELEATI	Yes			462	Ponape 15-8-50	No	"	"	"
TEKEWO	Yes			463	Ponape 8-50	No	"	"	"
SUPERE	Yes	Yes		428					
TOMIKI	Yes			275					

34 with whipworm had been treated with oil of chenopod

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PART III

BLOOD GROUPS OF THE KAPINGAS, NOVEMBER 1950

Residents of Kapingamarangi whose genealogies are recorded in the files of the Bernice P. Bishop Museum were blood grouped during June, July and August, 1950.

Two hundred were grouped with Anti A and Anti B serum. Of this group, 153 were tested with Anti R_o, Anti rh', Anti rh" and Anti hr' sera. Of these, 54 were tested with Anti M and Anti N sera.

Subjects were selected in the following categories.

(I) Those thoroughly documented as "Pure Kapinga"

(II) Those thoroughly documented as having foreign ancestors,

(III) Certain family groups.

Methods

The Rh typings were done by the test tube, water-bath, centrifuge method. The A-B groupings and the M-N typings were done by the depression slide method. Two percent saline washed cells were used for all tests.

Lack of refrigeration required the greatest caution to prevent contamination of the test serum. The Anti N serum failed one month after it was first opened. The Anti hr' serum failed after six weeks. The Anti A and Anti B sera were still good after 4 months though the Anti B was slightly weaker.

Control tests were made at intervals to conserve serum. When a control test showed a weakening of a serum, tests done subsequent to the previous control were discarded.

Results

Lack of proper storage facilities and insufficient sera for constant controls limit the conclusion concerning M or N and Rh occurrence. There were found MN, M, and N reactors and all tested were Rh positive. The results of the AB grouping appear in the tables.

Pure Kapinga

Group	AB	A	B	O	TOTALS
Male	0	40	0	47	87
Female	0	32	0	50	82
TOTALS	0	72	0	97	169

Mixed Ancestry

Group	AB	A	B	O	TOTALS
Male	0	6	8	4	18
Female	2	4	3	4	13
TOTALS	2	10	11	8	31

There were 10 subjects with known white ancestry

Group	AB	A	B	O	TOTAL
Number	1	4	5	0	10

ATOLL RESEARCH BULLETIN

No. 21

Notes on Ngaruangl and Kayangel Atolls, Palau Islands

by

J. L. Gressitt

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NOTES ON NGARUANGL AND KAYANGEL ATOLLS, PALAU ISLANDS

by J. L. Gressitt

NGARUANGL

Ngaruangl is an incipient atoll which includes the northernmost land of the Palau Islands. It is situated about eight kilometers northwest of Kayangel Atoll and 39 kilometers north of Babelthuap Island. Ngaruangl has a reef which is broadly oval, longest north and south, and about 5.4 by 2.7 kilometers in size. The reef has an opening at the northern end, with the reef extending farther north on the west side of the entrance. The lagoon is fairly shallow, being mostly less than three fathoms in depth, and having some coral heads. On the east side of the reef the sea bottom slopes gradually at first, from the reef platform, then suddenly. Soundings between Ngaruangl and Kayangel are mostly between 344 and 430 fathoms, beyond two kilometers off of either reef. The ocean directly north of Ngaruangl is mostly from six to 23 fathoms in depth.

Ngaruangl reef has but a single small islet, near the middle of the east side. In the Carolines, the majority of the atoll islets are on the east sides of the reefs, the prevailing winds being from the east. This islet is about 80 meters north and south, and about 35 meters east and west. It is slightly curved on its eastern, seaward side, and strongly curved on the lagoon side. It is broadest north of the center and considerably tapered at the southern end. The islet consists almost entirely of pieces of rough coral rock thrown up by surf. Most of the pieces are rough or sharp and are largely of the _Acropora reticulata_ type, or of similar form. The majority range from 15 to 60 centimeters, or more, in diameter. Sand and sandy gravel are limited to the lagoon side and the southern tip. The latter is of coral gravel and sand, and its lagoon shore, north nearly to the middle of the island, has a narrow sand beach with coral fragments on the upper portion. The coral rocks are piled higher near the borders of the main portion of the islet and thus the central portion is lower, but quite uneven. The altitude is a little less than one meter above high tide level. A few logs have been washed up on the shore on both east and west sides. Just south of the center is a tripod erected of poles. The reef surface seaward of the islet is gently sloping, but irregular and with rough coral rock or coral fragments.

There is no vegetation on the islet. Animal life is represented by numerous marine crane flies, probably _Limonia_, subgenus _Dicranomyia_. Terns were abundant on the islet, but no nests were observed.

Near the north end of the reef, close to the opening to the lagoon, a Japanese freighter, bombed during the war, has been washed up on the reef. A short distance to the northwest of it there is either a large coral boulder or a detached portion of the ship on the reef. On the southwestern portion of the reef there are two or three coral boulders washed up.

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Ngaruangl presents an interesting step in the development of an atoll, with the reef well developed and complete except for the single opening, and with a single small islet in an early stage of development, with very little sand, no soil and no vegetation. It may be assumed that if vegetation and additional sand were present earlier, they must have been washed away in storms, and that plants may reappear within the space of ten or more years.*

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* Kubary (Die Palau-Inseln in der Südsee, Jour. Mus. Godeffroy 1(4): 1-62, 1873) says, translated, on p. 32, "Northwest of Kayangel is a reef which marks the place, according to the traditions, where the land of Ngaruangl was, but which was destroyed by the sea." And on p. 33, "The Kayangel Group; it was once subject to Ngaruangl...." On p. 47 a legend is recounted, "For a long time there was to the northwest of Kayangel a great beautiful land, and its inhabitants ruled Kayangel....land....called Ngaruangl...." As a result of magic performed by a Kayangel man who had lost his son at the hands of the Ngaruangl people: "The heavens became frightfully dark, and a storm of unprecedented violence raged over all of Palau. Ngaruangl sank into the deep sea and four other small lands on the east side of Palau were likewise swallowed by the waves....."

These beliefs and legends may have no factual basis, but on the other hand, they are suggestive and might justify careful examination of the reefs of Ngaruangl for evidence of former larger islets.--Editor's note.

PLANTS OF KAYANGEL

The following plants were collected or observed on Kayangel Atoll on December 16, 1952 by J. L. Gressitt. The specimens taken were identified by F. R. Fosberg and are deposited in the U. S. National Herbarium. Numbers 1-8 are from Ngariungs Islet, 9-43b from Ngajangel Islet. Those asterisked were seen on both Ngajangel and Ngariungs islets, the remainder only on Ngajangel. The unnumbered ones were seen but not collected. Since these observations were made on a very short visit it is probable that the flora includes many more species not recorded here.

* Asplenium nidus L., no. 12

Nephrolepis biserrata (Sw.) Schott, no. 37 (The taxonomy of this species is unsatisfactory. Pacific plants may be something else.)

N. hirsutula (Forst.) Presl, no. 13 (Very young plant, identification uncertain.)

Polypodium scolopendria Burm. f., no. 36

Cycas circinalis L., no. 21

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* Pandanus tectorius Park., no. 18

Digitaria longissima Mez, no. 40

D. pruriens var., no. 43a

D. timorensis (Kunth) Balansa, no. 43b

Eragrostis amabilis (L.) W. & A., no. 42

Ischaemum muticum L., no. 41

Lepturus repens (Forst.) R. Br., no. 34

Saccharum officinarum L.

Areca cathecu L.

* Cocos nucifera L.

Alocasia macrorrhiza (L.) Schott

* Colocasia esculenta (L.) Schott

* Cyrtosperma chamissonis (Schott) Merr.

Epipremnum pinnatum (L.) Engl., nos. 10, 16 (No. 16 is a young plant and its identity is not certain.)

Xanthosoma sagittifolium Schott

Rhoeo discolor (L'Herit.) Hance

Cordyline terminalis (L.) Kunth

Tacca leontopetaloides (L.) O. Ktze.

Musa paradisiaca L.

M. sapentum L.

Piper betle L.

Artocarpus altilis (Park.) Fosb.

Ficus senfftiana Warb., no. 14

Elatostema calcareum Merr., no. 25 (Palau material is with some doubt referred here.)

Fleurya ruderalis (Forst.) Gaud. ex Wedd., no. 22 (Specimen fragmentary, determination doubtful.)

Pipturus argenteus (Forst.) Wedd., no. 15

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Achyranthes aspera L., no. 33

Pisonia grandis R. Br., nos. 1, 5

Portulaca samoensis v. Poelln., no. 23

Cassytha filiformis L., no. 7

Hernandia sonora L.

Crataeva speciosa Volk., no. 9

Canavalia microcarpa (DC.) Piper, no. 24

* Mucuna sp.

Vigna marina (Burm.) Merr., no. 11

Citrus aurantifolia (Christm.) Swingle, (Lime)

C. sinensis (L.) Osb. (Large round green orange)

Acalypha amentacea var., nos. 19, 39

Codiaeum variegatum (L.) Bl.

Euphorbia chamissonis (Kl. & Gke.) Boiss., no. 8

Manihot esculenta Crantz

Phyllanthus niruri L.

* Triumfetta procumbens Forst., no. 32

* Hibiscus tiliaceus L.

Thespesia populnea (L.) Sol. ex Corr.

Calophyllum inophyllum L.

Carica papaya L.

Cucurbita sp.

Terminalia samoensis Rech., no. 6

* Barringtonia asiatica (L.) Kurz, no. 4

Psidium guajava L.

Polyscias fruticosa (L.) Harms no. 28 (Cultivated as hedge plant.)

P. scutellaria (Burm. f.) Fosb. (Cultivated as hedge plant.)

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Centella asiatica (L.) Urb., no. 35

Ochrosia oppositifolia (Lam.) K. Schum., nos. 17, 38 (No. 38 is sterile, determination doubtful.)

Plumeria rubra L.

Ipomoea batatas L.

* Messerschmidia argentea (L. f.) Johnst., no. 3

Clerodendrum speciosissimum Van Geert, no. 20

Asystasia blumei Nees, no. 26

* Scaevola frutescens (Mill.) Krause, no. 2

Wedelia biflora (L.) DC., no. 30

An unidentified seedling, no. 31

ATOLL RESEARCH BULLETIN

No. 22

Summary of Information on Atoll Soils

by
E. L. Stone, Jr.

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SUMMARY OF INFORMATION ON ATOLL SOILS

by

E. L. Stone, Jr.

Our knowledge of atoll soils is still fragmentary and the following relates particularly to wet atolls, which have been more extensively studied than dry atolls. The nature of atoll soils is closely linked to the geological material on which they formed. These soils are extremely immature, usually having A-C profiles dominated by calcium and magnesium carbonates and with texture but little modified from that of the original material. This immaturity is in part a consequence of their limited age, which is presumably less than that of the xerothermic period, and of the continual disturbance by storms and typhoons. The frequent rejuvenation by storms is one of the major features of the land surface. Thus there has been little soil development in the usual sense, and the characteristics of the well-drained soils, in so far as they differ from geological materials, are due chiefly to organic matter accumulation and associated chemical changes.

I General: Despite immaturity, the differences in soils and physiography are sufficient to give rise to a variety of habitats. The expression of these in the vegetation, however, is in part concealed by the limited flora. This sometimes leads to a specious appearance of uniformity.

II Physical Nature of the Parent Material: The primary sources of land material are, of course, the reef organisms but in at least a few instances foreign material may occur. On Rose Atoll basalt has been found and pumice has been reported common on a number of atolls.

The mode of land formation has been treated more fully by geologists and need not be repeated here although it is obvious that particle size distribution and elevation of the land surface strongly influence subsequent soil development. Frequently materials deposited along the seaward shores are coarse-textured and porous. Consequently, as the data of Cox indicate, the ground water lens may have a lower head and greater salinity on the seaward side as contrasted with the lagoon shore, which is commonly composed of finer materials.

Although differences in texture of the deposits affect ground water movement and plant growth, all are sufficiently coarse to be freely pervious to air and water. The moisture holding capacity of the mineral soil is low, increasing the effect of rainfall distribution and ground water. Where fresh water is available at shallow depths textural considerations obviously do not have the significance for deep-rooted plants that they often have elsewhere. Furthermore, it is probable that the porosity of weathered coral and reef rock increases their moisture-holding capacity, as compared with that of solid fragments of similar size.

III Chemical Nature of the Parent Material: Analyses of the reef organisms, as by Clark and Wheeler, indicate that calcium carbonate, while predominant, is by no means the only compound of importance in their composition. Some of the Lithothamnion group may contain up to 25% magnesium carbonate and some of the Foraminifera up to 11%. Although phosphorus is generally low, some of the Crustacea may contain up to 27% calcium phosphate in their skeletons and there are appreciable amounts in some of the Alcyonarian corals. Nine samples of non-phosphatic subsoils from Arno contain from .01 to .02% phosphorus. Soluble potassium is found in moderate amounts whenever appreciable exchange capacity is present. Traces of most elements are of course to be expected by reason of their presence in sea water.

As a source of plant nutrients these materials have certain apparent advantages and disadvantages. The calcareous medium tends to be favorable for some nitrogen-fixing legumes and Azotobacter. However, it limits availability of certain nutrients such as iron, of which there is a conspicuous deficiency whenever organic matter content in the soil is low.

IV Soil Formation and Properties: These can not be considered apart from climatic influences, particularly those of rainfall. Not only the amount but the constancy of rainfall is of prime importance, with the effect of variation being more drastic the lesser the amount. The effects of variation are of particular consequence on narrow islands where the nature of the ground water lens is more readily affected by short droughts. Rainfall obviously affects the composition of the ground water and the rapidity of leaching of salts formed in the soil and those added by spray. To date conductivity measurements seldom show sufficient concentration of salts in the surface soil to be injurious to the plants, although these do not represent the temporary conditions that may result from flooding or heavy spray during severe storms.

Mere descriptions and analyses of a variety of profiles are often of limited value until the soils can be classified and arranged into an actual or inferred sequence related to time or developmental stages. Many of the data for well-drained soils on Arno and Onotoa can be described by such a sequence:

It is evident that the initial development of vegetation is somewhat analogous to lifting one's self by the bootstraps; plant growth is required to create organic matter which in turn supplies nitrogen, renders certain nutrients available, etc., to permit additional growth. In the early stages following colonization by hardy plants, each gain in amount of organic substance tends to favor greater and more diverse vegetational development. Ultimately the extent of this development is reflected in the soil profile. Thus a sequence may be observed extending from the wholly unaffected beach sand or boulder rampart of the island margins to the dark surface soils beneath the lush vegetation of the island interiors. Although in any one transect such a sequence is usually associated with time of development, other factors such as exposure, rainfall, groundwater, etc., surely influence the rate and presumably the maximum stage of development attainable. The conventional soil type designations employed tentatively on Arno can be used to designate various bands in this hypothetical developmental sequence on moist atolls. Figure 1 shows some features of profiles representing successive positions in such a sequence.

Figure 2 illustrates the inferred sequence from shore to interior and the effects associated with increasing organic matter content. In the synthetic transect the Onotoa profile appears to agree generally with those from Arno atoll.

The consideration of organic matter is almost inseparable from that of nitrogen since the two are linked in the soil with an OM/N ration of between 20:1 and 30:1. Apart from growth effects, in the absence of nitrogen additions of organic substance alone do not result in formation of "humus" and hence organic matter accumulation. The very considerable accumulations illustrated by Figure 2 direct attention to the sources of nitrogen. Apart from rainfall four are known: (1) Flotsam and dead marine organisms are presumably of significance only to the early stages of strand vegetation. (2) Legumes, <u>Sophora</u>, <u>Canavalia</u>, and <u>Vigna</u> are often common in the earlier stages of the sequence but only <u>Intsia</u> persists in quantity in the dense forest. (3) The contribution of nitrogen-fixing blue-green algae is unknown although certain terrestial algae are abundant. Azotobacter is common in certain Arno collections (Lochhead) and presumably would be favored by the highly organic calcareous substrate. (4) Observations suggest that sea-birds may add appreciable amounts of nitrogen to the land surface generally, apart from the marked guano or phosphate areas. High amounts of nitrogen and phosphorus found in sparsely vegetated areas on dry Canton Island are attributed to nesting birds (MacDaniels, Hatheway).

There are no systematic studies of organic matter decomposition but vigorous faunal activity by termites, snails, earthworms, crustacea, etc., (Usinger and LaRivers) rapidly reduce organic residues. Incorporation of organic matter may also be accomplished by grasses and the dense root mat of the coconut. Well-drained atoll soils seem to be marked by a sharply delimited zone of mixing, with slight organic staining of the deeper layers only in the older profiles. Darker layers occuring at depth usually indicate profile burial, as by dunes, typhoon debris, etc. Deep profiles may originate by continuous additions, as of wind-blown sand to a vegetated surface, and probably also in certain imperfectly drained situations.

As indicated by Figures 1 and 2, the depth of the organic layer tends to increase with age but the most marked effect is in percentage composition. Rather rough estimates indicate that the dark soils from Arno contain at least 2,000,000 lbs. organic matter per acre. It appears likely that a few centuries may have been required for such accumulation and there is no evidence of any rapid decline in the long occupied areas of Arno Island.

In non-saline atoll soils reaction commonly ranges between pH 7 and 9, with the higher values presumably influenced by magnesium carbonate. Moderate but consistent shifts in soil reaction are associated with the effects of organic matter. Species unsuited to an alkaline substrate may be favored further by localized pockets of organic matter, decaying wood, etc., of lower reaction. A slightly acid reaction also characterizes some peats.

Of the mineral nutrients phosphorus occupies a special position because of the probable significance of sea-birds in the phosphorus cycle of land areas, as well as in numerous localized accumulations. A possible role of phosphorus deficiency in the "laora" disturbance of coconut has been conjectured but evidence is as yet incomplete. An effect of copra cropping on phosphorus removal from the land has been suggested.

Fosberg's study of the ecological factors involved in phosphorus accumulation may solve a number of questions on phosphate "rock" and "hardpan", and perhaps on nitrogen accumulation in the dark soils also. In addition to their effects in situ, such deposits might well be reworked, notably enriching new beach materials.

Exchangeable (or extractable) potassium tends to increase with the exchange capacity of organic matter but it is markedly affected by leaching and by contact with salt water. Under dry conditions evaporation may concentrate potassium, as well as nitrate nitrogen, at the soil surface but the high values of such samples (e.g. Bikini) are not indicative of the entire soil.

Of the other plant nutrients calcium and magnesium are, of course, abundant, and little is known of the precise status of many "minor" elements. Iron deficiency is common in many plants, and symptoms on introduced plants suggest their susceptibility to other deficiencies.

Observations on soil organisms from Arno Atoll show appreciable numbers and the expected relationships between numbers and organic matter content. Determination of species and groups (Lochhead, Martin) indicate that the fungal and bacterial flora are cosmopolitan.

Losses from leaching can be assumed except on the driest atolls. Some recovery from the groundwater by vegetation is probable but is limited by the level of maximum evaporation, (presumably about 60") and the selectivity of plant roots. A continuing loss of calcium and magnesium carbonates is obvious but visible solution seems limited to the surface layers. Softening and reduction of large fragments is marked in the surface layers of the older soils.

Although the undisturbed well-drained type of profile is taken as a model, numerous exceptions and anomolies occur as a result of typhoons, shoreline activity, etc. Freshwater and mangrove peats, phosphate rock, exposed beach rock, etc. provide numerous specialized situations for vegetational development.

Students of atoll soils and ecology must add to their interest of vegetational succession a recognition of the frequent and drastic affects of catastrophe, of the influence of primitive man and his recent congeners, and of the self-limiting nature of many formative process.

The economic aspects of atoll soils are obvious, at least in outline. Within the limits set by climate, groundwater and exposure (as to spray) the productive capabilities and responsiveness of soils are set by texture, organic matter status, phosphate influences and perhaps by certain effects of age or history such as are associated with the "laora" disease. Many of these are subject to mapping, description or interpretation for use in any appraisal of atoll land productivity.

Figure 1.--Characteristics of Some Atoll Profiles

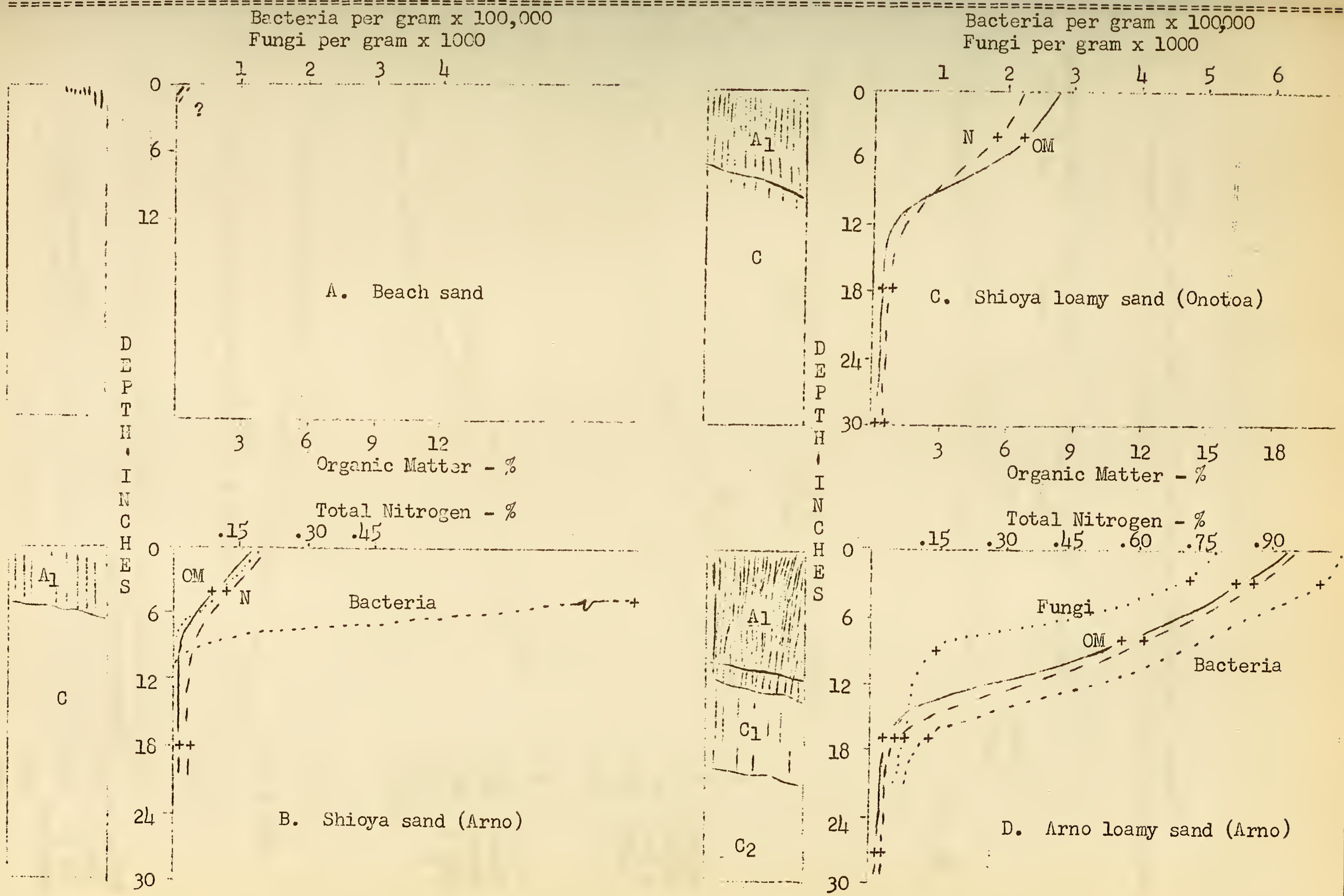
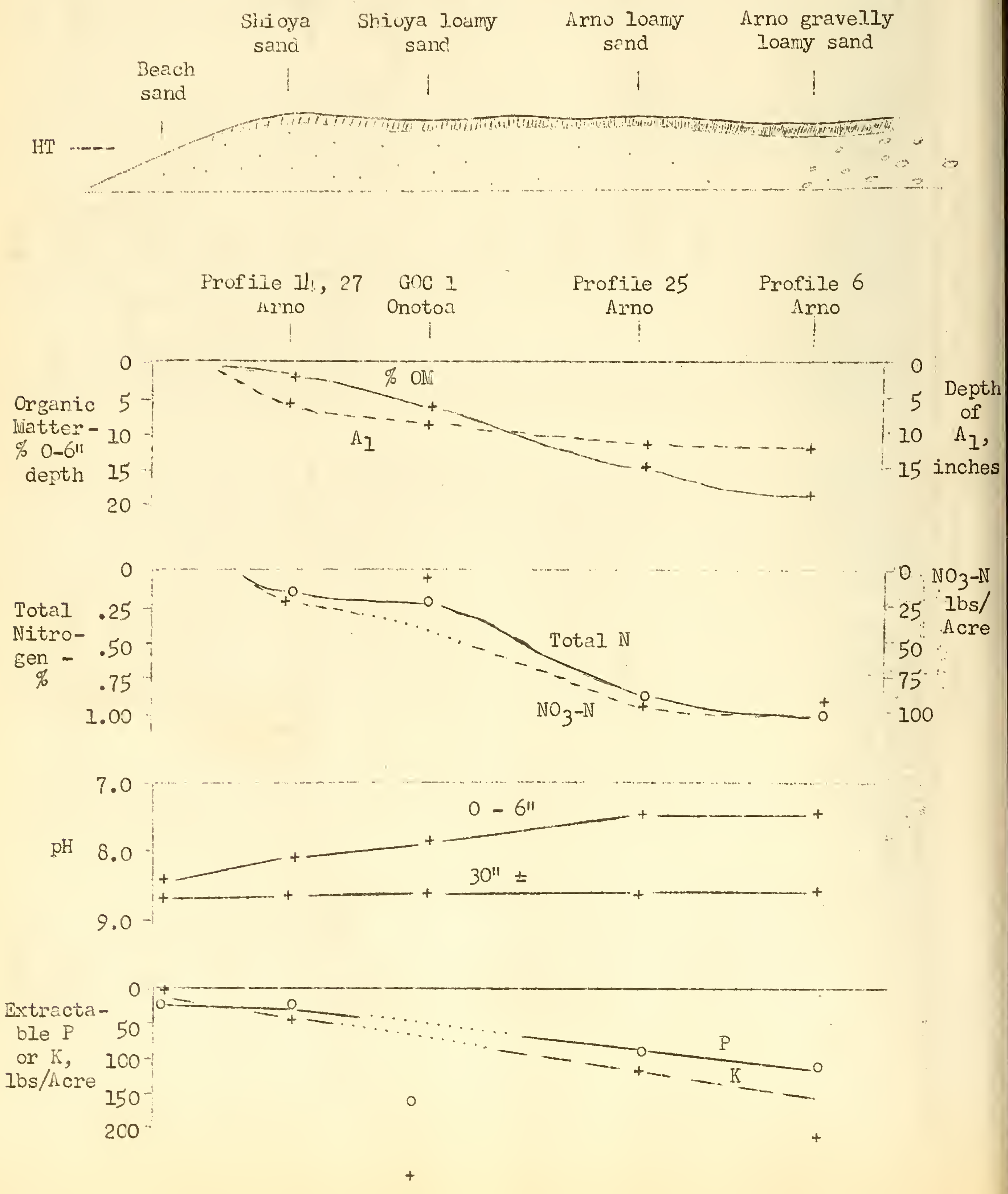


Figure 2.--Synthetic sequence of soil development and soil properties.



ATOLL RESEARCH BULLETIN

No. 23

Vegetation of Central Pacific Atolls, A Brief Summary

by

F. R. Fosberg

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VEGETATION OF CENTRAL PACIFIC ATOLLS, A BRIEF SUMMARY[1]

by
F. R. Fosberg[2]

[1] Publication authorized by the Director, U. S. Geological Survey.

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Contents

VEGETATION OF CENTRAL PACIFIC ATOLLS, A BRIEF SUMMARY[1]

by F. R. Fosberg[2]

Introduction

One of the primary purposes of the meeting on Atoll Soils and Vegetation, held in St. Louis in December, 1952, was to summarize the results, insofar as vegetation is concerned, of the three Pacific Science Board atoll investigations, undertaken on Arno, Onotoa, and Raroia atolls, along with results of recent expeditions to the Marshall Islands by William Randolph Taylor and F. R. Fosberg. Formal papers were not prepared for this meeting, nor was a verbatim record kept of the discussion. It seems worth-while to briefly summarize what is known of Pacific atoll vegetation in light of the results of the St. Louis meeting and of other significant studies that have been made. No attempt will be made, however, at this time to digest the complete literature on the subject. Work is being done on such a project, but it will require much more time.

Unfortunately the reports on the vegetation of Onotoa and Raroia have not yet been submitted, so that the greater part of the following summary is based on studies in the Marshall Islands. The vegetation of some of these islands has been observed by Bryan in 1944, Taylor in 1946, Stone and Anderson in 1950, Hatheway in 1952, and Fosberg in 1946, 1950, 1951, and 1952. Detailed notes are available for Arno, Bikini, Eniwetok, Rongerik, Rongelap, Pokak, Bikar, Utirik, Taka, Ailuk, Jemo, Likiep, Lae, Ujae, Wotho, Ujelang, and parts of Kwajalein, with less satisfactory observations on Majuro, Jaluit, and Ailinglapalap. Fairly good information is available on Nomwin, Kapingamarangi, Nukuoro, Satawan, and Lukunor in the Carolines, also some on Kayangel and Pingelap. The only comprehensive modern study of atoll vegetation, other than those mentioned above, whose results are available, is that of Christophersen on the Whippoorwill Expedition in 1924 (Christophersen 1927). Incidental to other work some notes on vegetation on the southeastern Pacific and a few central Pacific atolls were made by St. John and Fosberg in 1934 and on Christmas Island by Fosberg in 1936. Only a few of these are published (St. John and Fosberg 1937, Fosberg 1937, Fosberg and St. John 1952). Hatheway investigated Canton Island on short visits in 1950 and 1951 and prepared an account that is still unpublished.

The Atoll Habitat

Atolls are reefs of organic limestone that are partly, intermittently, or completely covered with water, and on which there are islets or islands made up of accumulations of limestone debris, loose or consolidated, and occasional remnants of former higher reef surfaces. These islets are usually not more than two or three meters above high-tide level, sometimes

[1] Publication authorized by the Director, U. S. Geological Survey.

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much less than this; occasionally storm-built rubble or boulder ridges and wind-deposited dunes rise to somewhat higher elevations. The highest of these wind-deposited features is Joe's Hill, a dune on Christmas Island, which is variously reported to be as much as fifteen meters. Where the surface of these islets is more than a few dm. above mean tide level the drainage is perfect, down to this level. From a few cm. above mean tide to somewhat below it, lens-shaped bodies of fresh to brackish ground water lie in the porous material of the islands, floating on the surface of the salt water which otherwise permeates these structures and held there in equilibrium by friction with the solid material.

Since the atolls are practically entirely within the tropics, and also are surrounded by water, there is not much temperature variation. Rainfall and winds, however, show quite a diversity. Rainfall ranges from extremely scanty in the belt of atolls along the equator and in the northern Marshalls and southern Gilberts to very heavy in the southern Marshalls and Caroline atolls. Most of the atolls, of course, have a moderately wet climate. In some, though the total average rainfall may be moderate, the erratic precipitation makes the total figures give a false impression. Also, the porous nature of the substratum makes comparison with regions of ordinary soil difficult. For example, Pokak Atoll, with rainfall comparable to that of parts of the eastern United States, has the aspect, vegetationally, of a semidesert. Winds are important in three main respects. The drying power of a steady fairly strong breeze, even after it has blown over the sea for great distances, is extreme, and the effects of wind on the vegetation in the trade wind belts are very obvious. It is never difficult to tell which side of an atoll islet is the windward side, as the vegetation is commonly "wind-sheared" (probably more correctly spray-sheared in many cases) in an inclined plane down to the top of the beach. On the leeward side the edge of the vegetation is usually perpendicular or rounded. The salt carried in spray by winds undoubtedly has a very important effect on the vegetation. There have been no actual measurements of this, either as to quantity or effects, however. The absence or rarity of certain species of plants on the windward sides of islets in windy belts may very well be due to this salt accumulation. The third climatic factor of great significance is the occurrence of typhoons or hurricanes. These powerful storms create and destroy land, drench the land with salt water, remove vegetation, modify it, and indirectly affect it through changing the human population. They create a type of long-term instability of the habitat that is reflected in the character of the vegetation in several ways which are apparent to the observer, but which must be studied more critically than they have yet been to be understood. In some of the Marshalls, considerable areas have been denuded of their vegetation or most of it by relatively recent typhoons.

The age of these islands is an important consideration, ecologically. It is possibly ascertainable, within certain limits, through knowledge of the relatively recent eustatic fluctuations of sea level, though there is some difference of opinion on both the time and nature of these fluctuations. The current idea seems to be that a period of higher levels, perhaps two meters above the present stand, occurred several thousand or up to five thousand years ago, during the so-called post-glacial "xerothermic period" or "climatic optimum." If such a higher sea level did exist, it might not

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be necessary to regard ecological reasons only, as responsible for the impoverished floras of coral atolls. It may well be that dry land did not exist on most atolls at that period, and that these floras have come into existence through accumulation of chance seaborne and airborne colonists in a period as short as five thousand years.

In the biotic environment, sea-birds, land-crustacea, and man are the three most conspicuous groups and probably the most important, ecologically. The birds played a most important part in making the habitat favorable for plants and in maintaining it so, by additions of phosphatic and nitrogenous material, until they were driven away from most places by man. Land crabs and hermit crabs, present in myriads on most atolls, promptly reduce organic matter of most sorts to soil, tending to make the habitat suitable for other than the most extreme pioneer species of plants. They must also play an important role in mixing soils, because of their burrowing habits, bringing up deposited and unaltered materials and burying vegetable debris (Wood-Jones, 1910). Dr. Otto Degener (conversation, 1950) contends, also, that the hermit crabs are important in devouring seedlings of plants and thus impoverishing the vegetation. This has not been noted by other investigators, though they have been seen occasionally eating leaves from living plants. Man has, ever since his arrival, been an extremely destructive agent, especially toward indigenous forest vegetation. He has, of course, replaced it with coconut and breadfruit plantations and their attendant weed species; he has contributed a host of exotic weeds; and he has upset the phosphate balance both by driving away the sea-birds and by exporting untold quantities of copra, which has a high phosphorous content. He also, in many places, burns the organic matter which would ordinarily go to build up the soil. Where he exists in large populations, he may reverse these processes to some extent by composting and fertilizing.

Colonization by Plants

Plant seeds may be brought to an atoll islet by water, wind, on the feet, plumage, or in the stomachs of birds, or by man, accidentally or deliberately. One case has been observed by Dr. Kenneth Emory on Kapingamarangi of a portion of a tree drifting ashore while still alive and taking root. An examination of the floras indicates that, before the coming of Europeans, the water was probably much the most effective means of transport. Most of the plants possess adaptations for floating their seeds across even large expanses of water.

The plants that make up almost the entire indigenous floras of atolls are those that constitute the strand floras of high islands, continents, and other coral islands, and they are mostly very widespread. There are very few species confined to or even principally found on atolls.

Contrasted with the probable situation on high islands, successful establishment of transported plants on atoll islands is a very frequent affair. Abundant seedlings from drift seeds may be seen during almost any walk along the beaches of an atoll. These are, of course, mainly the same series of pioneer species, over and over again. The following species were seen as drift seedlings in the northern Marshalls:

Abundantly establishing themselves in drift:

Messerschmidia argentea
Scaevola frutescens
Lepturus repens
Guettarda speciosa

Rather frequently seen:

Pandanus tectorius
Portulaca lutea (in drift situations but not positively of drift origin)
Triumfetta procumbens
Vigna marina

Rarely seen in drift:

Cocos nucifera
Ipomoea pes-caprae
Hernandia sonora
Calophyllum inophyllum
Intsia bijuga
Morinda citrifolia
Barringtonia asiatica
Suriana maritima
Terminalia samoensis
Wedelia biflora
Ipomoea tuba

Seen as seedlings, once each, but never seen to persist:

Caesalpinia majus
Caesalpinia crista

A number of kinds of seeds frequently drift ashore but were not seen germinating. Among these were Entada and several species of Mucuna.

Although not directly observed, colonization by many other species unquestionably takes place. Many species do not seem to be able to survive on open beaches and bars, but need either the protection from wind and salt or shade from the sun provided by already established vegetation or the presence of at least a small amount of humus in the soil. Some deeprooted species doubtless require a certain degree of freshness in the ground water. The species that require the presence or influence of other plants, as well as those that need fresh ground water, are commonly found in the interior of islets, though they often may be much nearer the lagoon than the seaward beaches.

How their seeds are carried to such situations is not always apparent. Unquestionably Pisonia is carried around by birds. Its fruits are exceedingly sticky and a noddy (Anous) was seen on Wotho literally plastered with them. Several species of birds seem to prefer to roost and nest in Pisonia trees. Boerhavia and Peperomia, as well as Adenostemma, also have sticky fruits and may be transported by birds. Cassytha and Pipturus have small fleshy fruits, which doubtless are eaten by birds and the stones transported in birds' stomachs. Which birds would do this is not demonstrated. Scaevola is, without question, carried around in this way in addition to floating, as the droppings of curlews were seen to be commonly packed with the stones of this plant. Ximenia might be carried in the same way, though its fleshy fruits

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are quite large, resembling small plums. Another aspect of this, not previously suspected, was discovered on Arno by Marshall (1951). He found in the stomach of a fairy tern (Gygis) the seed of Ipomoea pes-caprae, a plant not even growing on Arno, but common on Majuro, a few miles away. Why the bird had eaten this is not apparent, as terns are fish-eaters. Perhaps the seed was picked up to serve as a gizzard-stone. Wind doubtless accounts for some small-seeded species, but there are few indigenous atoll plants that seem especially adapted for this method of transport, except the ferns, mosses, and other cryptogams. Plants with floating fruits or seeds, such as Ochrosia, Thuarea, Cordia, and the ones mentioned above as pioneer species, since they may be found growing back of or far from the beach, must sometimes be carried inland by storm waves, as is the occasional pumice found scattered on the ground surface far inside the beach. Man must not be disregarded as an agent of distribution, even of apparently indigenous plants, as well as of his cultivated ones and camp-followers. Sida fallax is planted about houses in the Marshalls and Carolines, as well as growing wild. Evidence seems to be accumulating that the mangroves, at least Bruguiera, found in landlocked pools and muddy depressions have been deliberately introduced and planted by the Marshallese. And in addition to planting the various obviously useful and ornamental plants, the Gilbertese, at least, (Luomala m.s.) pick up and plant any seeds that happen to be cast up on the beach. A further influence is exerted by man in the creation of habitats for species which otherwise might seldom find a place to get a foothold. Such are especially the taro-pits, dug down to ground water and filled with vegetable muck. Several weeds, such as Eleocharis, Cyperus, Jussiaea, and a number of ferns are found only or usually in such situations. The coconut plantation is also a rather special habitat and may, at least, give some plants enormously more opportunities or "lebensraum" than they normally would have. Willis and Gardner (1901) give a much more comprehensive discussion of these matters for the Indian Ocean atolls.

Little is known about the reasons for the small numbers of species in atoll floras. These range from three (Christophersen 1931, Fosberg 1937) to perhaps 150 in Pacific atolls and as many as 284 (Willis and Gardner 1901) in those close to continents as the Maldives in the Indian Ocean. Distance from sources of colonists and the effectiveness of the ocean as a barrier are obviously of primary importance. Shortness of the history of land availability on atolls may well be another consideration. The scarcity of endemic species results from this. Lack of topographic or altitudinal diversity is another obvious factor. However, the difficulty in getting many of the commonly tried cultivated species to grow in these islands and the large number that simply will not grow there, at all, point to the importance of edaphic considerations, though these have not been much analyzed as yet. Salinity and the highly calcareous nature of the soils are two unquestionably controlling factors. Such observations as the distribution of species in relation to ground and aerial salinity, the death of breadfruit trees where washed by typhoon waves or where the ground water becomes saline (Cloud 1952), and the native practice of leaving a protective strip of forest on the windward sides of coconut plantations are at least indicative in this direction, though systematic studies remain to be done. Certainly one of the most striking systematic variations observed is the increase in number of species from atolls with a dry climate to those with a wet climate. Pokak and Bikar,

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in the dry extreme north of the Marshalls, have 9 species of vascular plants each, while from Arno, in the wet south of the same group are recorded 129 species (Anderson 1951, Stone 1951). This discrepancy is not due to inadequate collecting, as Pokak and Bikar have been very thoroughly examined. Any further collecting may result in increasing the difference, as more plants may possibly be found on Arno while this is not likely on the others. There are doubtless other limiting or controlling factors and combinations of factors influencing the sizes and compositions of atoll floras, but to discover and understand them will require further study and further correlation of available information.

Succession or Vegetational Change

No coral atoll has had sufficient study for even the principal vegetational successions to be well known. No single succession, from bare ground to a relatively stable vegetation, can be described in anything like a complete fashion. Only locally are relatively stable (climax) vegetation types known with certainty. But it is possible to outline, however roughly, some probable successional trends, and to point out with some confidence certain successional relationships that are more than accidental. In this paper any change in vegetation that seems to proceed in a definite direction is regarded as a succession. This is in contrast with fluctuations around a point of equilibrium. And if the latter, over a period of time, result in a directional change in the equilibrium, that also is regarded as a succession. Such changes as are known or suspected are described below under several categories.

1. Usual development of vegetation:

As noted above, under Colonization, bare sand and gravel bars are soon covered by seedlings of a small number of pioneer species. These are able to stand full and very bright sun and high salinity, also considerable dryness. Of these, a large proportion are tree species, and, in an ordinary mixed stand of pioneer species, many will be trees. In most sites scrub is the first vegetation to appear, and if tree seedlings form an important component, these soon overtop the others, developing a low forest. Growth, even under quite dry conditions, is extremely rapid. On Wake Island, with an annual rainfall of 650-1370 mm., *Messerschmidia* has been observed to grow almost two meters in a year. The simplest forests thus formed are pure stands of *Messerschmidia*, mixtures of *Messerschmidia* and *Guettarda* alone, or with *Pandanus tectorius* and a varying smaller proportion of a number of other trees. *Terminalia samoensis*, *Intsia bijuga*, *Barringtonia asiatica*, and possibly *Cordia subcordata* are pioneer species and may make up a part of the original composition of such a stand. There is no doubt, however, that they, as well as *Guettarda* and *Pandanus* are also capable of increasing in number in mixed stands. *Pisonia grandis*, *Allophylus timorensis*, *Pipturus argenteus*, *Soulamea amara*, *Ochrosia oppositifolia*, and other species are, so far as known, added only after the original stand has become established and usually after it has assumed the character of forest. The resulting mixed forest is the commonest type of native forest existing in the Marshalls today. The same type apparently develops following clearing by man. In the northern Marshalls there is no particular pattern in the arrangement of

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species in this type of forest, but Hatheway (1953) reports that in the southern Marshalls the trees commonly occur in small clumps or groves of a single species.

The shrub and herb species present in the original stand persist for a long time in these forests as undergrowth and ground cover. Eventually, however, they may be almost entirely eliminated. Lepturus, curiously enough one of the first and most abundant pioneers to appear, often persists longest, forming a thin grass ground cover in all but the most dense mixed forests. With it is usually Thuarea, which was not seen as a true pioneer on new habitats in the northern Marshalls. Fimbristylis, also one of the pioneers, often persists a long time, especially if the canopy is not too dense. Wedelia and Ipomoea tuba may persist a long time, the latter probably becoming more abundant as time goes on. It is an important part of the canopy in many mixed forests. In rocky places Fleurya ruderalis persists a long time if the canopy is at all thin.

Whether this mixed forest ever reaches stability is not known. Its widespread occurrence suggests that it may, as does the structure of the most mature and well-developed stands, with large trunks, dense canopy, thin or absent undergrowth, and seedlings of some of the dominant species. It seems certain that Messerschmidia, one of the most abundant early constituents, drops out after one generation. Healthy seedlings of it are never seen in full shade, and when it is present in a very well developed mixed forest the trees are all old and very large. Messerschmidia logs are often seen lying in this type of forest where there are no living trees. Observation of Pisonia, with its habit of sending up root sprouts and of usually taking root wherever it touches the ground when blown down, suggests that it may gradually take over mixed forest if left long enough. Common occurrence of pure stands of Pisonia may be due to this process. These may, however, result also from colonization of Pisonia in Lepturus grassland, as seen on Pokak Atoll. This might more commonly be the case on drier islands, where stands of Lepturus, or Lepturus and Sida fallax often persist for a long time.

There seems little question that, at least under conditions of moderate rainfall, such as in the central Marshalls, Ochrosia oppositifolia may eventually dominate mixed forest once it gets started, and often will take over completely, forming extensive pure stands. The best areas seen of this type are on Wotho Atoll, but it is a common occurrence on Lae, Ujae, Kwajalein, and Erikub, at least. There is good evidence that it will eventually crowd out even Pisonia. Pure stands of Ochrosia are relatively permanent and stable as shown by the normal occurrence of a dense ground cover of seedlings several dm. tall, which shoot right up if even a little light is available. One puzzling circumstance about these stands of Ochrosia is the presence of persistent yellow spots, seen in the same locations on photos taken in 1944 and on the ground in 1951. The trees are chlorotic and in some cases there are a few dead ones, and in these places Allophylus and even other trees seem able to come in. There is no obvious difference in soil or other environmental factors in these spots.

Frequency of pure stands of various species is a peculiarity of atoll vegetation, at least in the northern Marshalls; pure stands of Pandanus and Pisonia and perhaps others are also found in central and southeastern Polynesia. How this is related to the general successional picture is not

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apparent, except perhaps in the cases of Pisonia and Ochrosia. These and at least some of the other pure stand types may very possibly be end stages of successions under certain conditions. This is certainly not the case, though, with such pure stands as those of Lepturus, Portulaca, Scaevola, Messerschmidia, Pemphis, and other strictly pioneer plants. Pure Pandanus forests, while rare in the Marshalls, seem to occur more commonly in the Tuamotus, also on Maria Atoll, Austral Group. Their origin is a matter of great interest and curiosity.

On bare rock, especially rough conglomerate or pitted beach rock, Pemphis acidula is ordinarily the first plant to appear, though actual seedlings colonizing such habitats have seldom been observed. Hatheway (1953) says that small pockets of sand on such rock surfaces are the seed beds for this species. Once established on rocky places, these trees persist, often or usually in pure stands, even where their roots are bathed in pure sea water at high tide. Such stands were not observed to be succeeded by anything else.

2. Effects of catastrophe and instability:

Natural catastrophes on coral atolls are mainly of two sorts, typhoons (hurricanes) and tsunamis (so-called tidal waves). The former are, of course, much more frequent than the latter, and their frequency varies much more in different parts of the world. Typhoons are almost unknown, for example, in the Gilberts, somewhat more frequent in the Marshalls, and common in the western Carolines. Statistics on typhoon incidence would be very valuable in interpreting vegetation differences.

Both typhoons and tsunamis are capable of sending salt water completely over atoll islets. There are apparently no actual records of the effects of tsunamis on atolls, but they have poured water onto high island shores to a much greater height than the total altitude of most atolls. Certain plants would undoubtedly be killed by this, but few facts are available. Breadfruit, at least, has been observed to be so killed by salt storm waves (Cloud 1952).

Typhoons, in addition, commonly uproot trees of all sizes. They defoliate trees both by actually tearing the leaves off and by "burning" them off by driven salt spray, and perhaps by drying at the same time. They profoundly alter both the character and topography of the substratum, and change the actual outline of islands. Large areas of land surface on Arno Atoll were actually removed during the typhoons of 1905 and 1918, vegetation and all. Some of these places have been extremely slow to becoming revegetated. In others Pemphis has taken over effectively. There is no doubt that, in many areas, instability of substratum owing to typhoons is a major ecological factor in the determination of the character of the vegetation. Even where trees are not actually blown down, soil may be removed from around their roots, or rubble or sand may be piled up around the bases, smothering smaller vegetation and possibly eliminating certain larger species. Trees blown down make openings in the canopy in which species may appear that cannot establish themselves in its shade when unbroken. Defoliation of the canopy may allow temporary undergrowth to come in.

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Effects of typhoons on the vegetation are quite evident to the observer on most atolls, but a careful assessment of these effects has not been attempted, at least in recent times. Considerable information is recorded, but most of it by casual and nonbotanical observers. The thing that is most lacking is an actual eye-witness account, by a botanist, of a severe typhoon on an atoll. Accounts by others are usually conflicting and show evidence of very unreliable observation.

Effects on the vegetation maintained by man are sometimes recorded. The coconut trees were removed, along with the rest of the vegetation, on Arno in the typhoons mentioned above. Hundreds of coconut trees were blown down on Utirik, and many on some of the other atolls in the Marshalls, especially Aur and Maloelap, by "Typhoon Georgia" in March 1951. Likiep was completely devastated and apparently rendered temporarily unfit for human habitation by a typhoon sometime after the middle of the nineteenth century. In German colonial literature are many accounts of natives on the Caroline atolls being moved because their islands were rendered temporarily unable to support them by typhoons. One of the important effects was the filling in of taro pits with sand and salt water. Many accounts of hurricanes in the Tuamotus exist, but they give very little information on the effects on the vegetation. In places, however, the coconut groves were actually swept away.

3. Effects of climatic fluctuations:

Although there are atolls with the same annual rainfall with and without pronounced yearly dry seasons, no comparisons have been made of their vegetation. So the effect of simple annual fluctuation is not known. It would probably result, at least, in less epiphytes and a smaller total flora, probably in less overall luxuriance. Pisonia and possibly some other trees would show brief defoliation during the dry season. A strong dry season in 1951 in the northern Marshalls showed in some places partial defoliation of some other trees, such as Cordia and Terminalia. Whether this was normal or only the result of an extreme fluctuation is not known. The general aspect of the more northern atolls during this particular season became quite drab, where a few months earlier it was green.

In many atolls, especially those just south of the equator--the southern Gilberts, Phoenix, Howland and Baker, Jarvis, and Malden--one of the most potent factors influencing the vegetation is the extreme fluctuation in rainfall from year to year. Sometimes more than a year may elapse with no rain at all. In other times, more than the annual average may fall in one month. Under such conditions the general aspect is much drier than the average annual rainfall would suggest. And the luxuriance may vary so much from time to time that descriptions written several years apart scarcely sound as though the same island were described. Canton Island, in the Phoenix Group, has been described as having a general growth, principally Sida fallax, up to two m. tall during a wet period, but when visited in 1949, seven or eight years later, it had the aspect of a desert. On islands with large populations of sea-birds the injurious effects of high concentrations of guano seem to be greatly accentuated by these severe dry periods. Trees may be severely damaged or even killed. This has been seen on Pokak, in the Marshalls, Canton, in the Phoenix, and Christmas Island.

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The theory, advanced by Hutchinson (1950) that phosphate deposits on islands that are at present wooded indicate a major shifting of climatic belts in the recent geologic past, so that these islands would have formerly been barren, does not seem in any way justified by the facts. Phosphate is formed on these islands at present under forest conditions, and only under such.

4. Changes caused by Man:

Alterations by Man's activities have affected the vegetation far more profoundly than typhoons, droughts, or any other natural phenomena. These have occurred in the Marshall Islands in three stages, the pre-European Marshallese period, the copra commerce period, and the Second World War. Comparable periods, or variations of them, have occurred on many other atolls. On some of the drier ones the copra commerce period has been replaced by a guano-digging period. On many the war had little or no effect. On a few, such as the Line Islands, the pre-European period was omitted, as the atolls were not inhabited when discovered by Europeans.

After the arrival of aboriginal man, the process of clearing the forests began. It could never have been very extensive, on most atolls, because of the lack of metal for clearing tools. It is probable that Pisonia forest may have been the principal type cleared, as the wood of Pisonia is soft enough to be cut by shell or stone implements. It is also possible that there was actually not much clearing, because coconut and breadfruit trees could be grown in the forests without clearing. In the case of the coconuts, at least, it might take longer for them to reach bearing age. Breadfruit, in wet climates, can shade out practically anything else likely to be found on atolls. In any event, there were probably over the centuries, fairly substantial areas dominated by coconut and breadfruit groves. Hatheway (1953) has estimated that in pre-European times perhaps fifteen percent of the land area was given over to agriculture. A part of this, on most Micronesian atolls except the driest, was used for taro pits. Marshy and swampy places were probably used for this purpose at first, then enlarged and enriched by addition of vegetable refuse. A few weeds probably came with the aborigines, as well as ornamental, medicinal, and food plants. The principal food plants brought along were coconut, breadfruit, several taro-like plants, possibly Tacca, and possibly Pandanus, though it is probable that at least some varieties of Pandanus were on most atolls already.

The drier atolls were probably mostly never permanently inhabited. Most of them were not when discovered by Europeans, though some showed signs of former habitations. Populations on the more favorable atolls varied, and the intensity of utilization of the land fluctuated accordingly. Typhoons, warfare, and losses at sea probably prevented overpopulation. If these failed, migration solved the problem. The more resistent types of forest and the less productive parts of the islands were probably not much disturbed.

With the coming of the Europeans this changed drastically. The demand for copra and the introduction of axes and machetes of steel caused the rapid replacement of the larger part of the native vegetation by coconut plantations, except on the driest atolls. And on these, enormous quantities of guano were dug up and exported, altering the vegetation, though it is

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not easy to know how much. On the wetter atolls coconut plantations so completely dominate the vegetational picture that, ordinarily, coconut forest is regarded as the natural vegetation of such islands. It is, indeed, hard to dispel the idea that the coconut is indigenous and the dominant tree in the natural vegetation of these South Sea Islands. Now it is mostly the smallest islets, the exposed or very narrow ends of islets, and the seaward strip on the windward islets which show any native vegetation at all.

This change vastly increased the available habitat for some native plant species, however. Some of the undergrowth and ground cover plants, such as Euphorbia chamissonis, Clerodendrum inerme, Thuarea involuta, Fimbristylis cymosa, and Wedelia biflora, as well as such second-story trees as Pipturus argenteus, Morinda citrifolia, and Pandanus tectorius found this new habitat much to their liking and are now characteristic of such situations. Now, on fairly moist to wet atolls, dense undergrowth soon develops into thickets that choke the plantation. Keeping the plantations free from undergrowth is a major item of labor in this form of agriculture, even greater in places than harvesting the crop. Many new weeds and a few new cultivated plants, mostly ornamentals, came during this period. Papayas and bananas existed in many atolls previous to extensive coconut plantation, and were brought to others subsequently. Papayas, of course, are American in origin and did not exist in the Pacific prior to early European voyages. Most of the weeds are commonest around villages and paths, but some are ubiquitous, especially in plantations.

Long-continued harvest and export of large quantities of copra are beginning to show their effects. One of these seems to be phosphate deficiency, probably the cause of the gradual dying out of sizable areas of coconut plantation in the Marshalls. Similar symptoms are found in other regions.

Another effect of copra economy in some areas, notably the northern Marshalls, has been the abandonment of taro culture. Throughout the northern Marshalls there are extensive evidences of former taro pits that have not been used for many years. This phenomenon is most marked in what were probably the marginal areas of taro culture but is becoming evident also in the southern Marshalls, where both Colocasia and Cyrtosperma, the two taro-type plants grow very well. The culture and utilization of Tacca, also, has been almost abandoned in many islands, except when, after a typhoon, there is no copra to trade for rice or flour. Tacca, however, is still abundant as a spontaneous plant in the coconut groves in many atolls.

The war profoundly affected many of the atolls, especially in the Marshalls, Gilberts, and the central Pacific. Actual war, with the complete or partial destruction of the existing vegetation, took place on some islets of such atolls as Tarawa, Funafuti, Majuro, Kwajalein, Eniwetok, Wotje, and Wake Island. Here, in many places, were produced completely bare areas. These were soon covered by a blanket of Ipomoea pes-caprae, Vigna marina, Wedelia biflora, Pluchea odorata, Cenchrus echinatus, and other weeds. The Ipomoea and Wedelia in many places formed such a heavy mat that little else was able to gain a foothold, and many of the other weeds were smothered out. In other places Messerschmidia, Scaevola, and other pioneer woody plants

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quickly became dominant. Only in relatively dry islands, such as Wake, has anything like the original vegetation come back. There *Messerschmidia*, *Pemphis*, and *Cordia* were the principal original woody plants, and in 1951 these dominated the scene again, in spite of almost complete obliteration in 1941-1945.

Another effect of the war was the construction of huge military establishments, especially air fields, on many atolls, even completely outside the area of actual military activity. This commonly involved complete destruction of vegetation. The bulldozer scraped the land clean, destroyed what soil had been developed, and smoothed down all topographic irregularities. Afterward, when the absolute desolation of such establishments became apparent, attempts were made to reestablish vegetation and to landscape these bases. Many of these have since been abandoned, but some are maintained and have even been extended and developed.

A further effect, though localized, has been the utilization of the atolls of Eniwetok and Bikini for testing atomic weapons. The effects of this were undoubtedly both destructive and otherwise. Although the bombs destroyed some areas of vegetation, these atolls had their native populations removed, and revegetation and succession have been able to proceed in most areas undisturbed. Some studies of these effects have been made, but no results have, as yet, been released, subsequent to the publication of the surveys made prior to the tests.

A great number of additional weeds have been introduced and spread during and since the War. Some of them, such as *Pluchea odorata*, *Pluchea indica*, *Paspalum conjugatum*, and *Chloris inflata* have been very aggressive, and have covered large areas in a short time. But over a period of a few years it has become evident that *Wedelia biflora* and *Ipomoea pes-caprae* will in most situations dominate and probably eventually smother out all of these, if disturbance is not continued. Another interesting point is that evidence points to the probability that *Ipomoea pes-caprae* is an introduced plant, at least in the Marshall Islands. Previous to the war it was only known from Jaluit, the headquarters of German and Japanese occupations. Now it is abundant in Kwajalein, Majuro, and Eniwetok, all sites of extensive military activity. This point has not yet been investigated for other Pacific atolls, though much evidence is available.

Probable future effects of man on the vegetation are hard to predict accurately. Undoubtedly populations will increase, and any available land will be planted to coconuts. This will not be much, however, as most of it is used at present--if it will raise even poor crops of nuts. Programs for economic development of coral atolls are under way and will unquestionably take the form of attempts to improve and extend agriculture. Attempts will likely be made to introduce new agricultural and horticultural plants, some of which might possibly be successful. New weeds will doubtless come in. There will unquestionably be further and accelerated vegetational change, most of it destructive to what little native vegetation is left. It is important that sample areas of all existing types be set aside for continued study. It is also very important that much more extensive general surveys be carried out to describe what is left before it is too late.

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Principal Types of Vegetation and their Variations.

Short descriptions of the principal vegetation types that have been recognized as occurring repeatedly or over large areas on Pacific atolls follow. The account is based again largely on studies in the Marshall Islands, but with the little available information from other areas brought in wherever possible. Some types that are conspicuous are treated here as variants of a widespread Mixed Forest type, as they really seem to be extremes of a rather continuously varying association of trees that characterize ordinary atoll habitats. Some of the kinds of vegetation described below have definite habitat relations and also successional relations with other types. These relationships are pointed out briefly and brought out again in the following section, where the pattern is integrated as far as is possible with present knowledge.

1. Coconut groves and plantations:

These are artificial forests of coconut palms planted, often in geometrical arrangement, five to six meters or less apart. In moist areas the crowns touch and interlace, forming a rather complete canopy; in drier places, they are well separated. In height an old plantation may reach an average of 25 m. The ground cover is varied, usually Lepturus, Thuarea, and Fimbristylis are fairly general in pure stands or mixtures, with Polypodium scolopendria, Tacca, Cassytha, Boerhavia, Fleurya, and other herbs locally common, extensive patches of Euphorbia chamissonis, Clerodendrum inerme, and Triumfetta procumbens, as well as mats of Wedelia biflora, Ipomoea tuba, Vigna marina, and Canavalia microcarpa. Pandanus, Morinda, Premna, Pipturus, Guettarda, and other trees may form a scattered understory, or, if clearing out of the undergrowth has not been kept up, these with Wedelia, Ipomoea, and Canavalia may form a dense tangled thicket, in which seedling coconut trees are likely to be quite abundant, making walking almost impossible. Breadfruit trees are often scattered through parts of the plantation near villages.

2. Breadfruit groves:

Although breadfruit (Artocarpus altilis) trees are commonly seen around villages and scattered in coconut plantations, in the wetter atolls especially in the Carolines and southern Marshalls are areas completely dominated by them. These groves are commonly made up of enormous trees, towering even above the coconut palms and with dense crowns that form a complete canopy through which very little light penetrates. On the floor of such a forest few other plants can survive. Seedlings of Morinda citrifolia occasionally maintain themselves where conditions are not too extreme, and in the Carolines an as yet undetermined species of Piper may form a mat on the ground. Several ferns are also occasional in such situations. Varieties of breadfruit both with and without seeds are present in these forests, the latter being undoubtedly originally planted by man. Both may increase by root sprouts, but the seeded varieties spread very readily by seed. Seedlings may be abundant beneath the parent trees if the light is not too scanty. The possibility should be investigated that these may occasionally be pollinated by seedless trees, and that some seedless ones may be offspring in this way of the seeded varieties. The trunks of large breadfruit trees may be two or three meters in diameter and unbranched to a height of 10 or 15 meters.

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3. Mixed forest:

The most generally distributed native forest on coral islands is a variable mixture that, in one place or another, may include practically all tree species found on atolls. It is, in fact, so diversified that its principal common feature is that it is a mixture. It usually includes, among its components, Pandanus, Guettarda, Pisonia, Messerschmidia, Intsia, Cordia, and Ochrosia, frequently, also, Terminalia, Allophylus, Soulamea, Hernandia, Barringtonia, Pipturus, and Ficus. This I have called Mixed Forest. Hatheway 1953 calls it Scrub Forest, which term is often appropriate, as its stature varies from scrub to tall forest 25 m. high. In density it varies from close enough to form a complete canopy to sparse and open. If sparse, there is ordinarily a tangled scrubby undergrowth, which, with low branches of the trees, makes it almost impenetrable. The undergrowth consists of seedlings of the trees, with Scaevola, Suriana, Achyranthes, Wedelia, Clerodendrum, and Ximenia, the whole tangled and laced with lianas of Ipomoea tuba and Canavalia. On rocky places there may be Pemphis acidula. Coconuts may be scattered here and there from nuts planted by the natives or dropped by accident.

In the northern Marshalls there is no particular organization to this mixture, except that when tall and dense, there is little or no undergrowth. In the southern Marshalls, Hatheway reports that the trees usually occur in small groups of one species, rather than mixed as individuals. What seems essentially the same forest may result from second growth after clearing and from new colonization on new land. There seems to be no special correlation with any of the several types of substratum. On the seaward sides, if they are to the windward, there is a transition to a dense scrub. In the interior of well developed Mixed Forest, Messerschmidia tends to drop out gradually, not reproducing itself in the shade.

Most of the recognizable forest types on atolls seem to be extreme variations of Mixed Forest consisting principally or entirely of one of the component species of this forest. Because the intergradation between all of these types and Mixed Forest seems to be complete, and since their actual developmental relations are not fully understood, they are, for the purposes of this review and to emphasize their lack of sharp limits, here regarded simply as variants. The principal ones are as follows:

a. Pisonia Forest--Pure stands of Pisonia grandis are a very common and widespread phenomenon on coral islands throughout the Indo-Pacific region. The distribution and some data on the occurrence of this species has been reviewed, recently, both by St. John (1951) and by Shaw (1952). Shaw suggests that bird guano may be required for the growth of this species, or at least for germination and establishment of its seedlings. However, healthy trees have been observed in absence of any noticeable guano. Germination of seeds must be a rather infrequent occurrence, as no seedlings of this species were seen in the northern Marshalls investigation.

A characteristic of many or most of these groves or forests is a layer of highly acid raw humus on the surface of the ground, and often, just beneath this, a layer of phosphatic sandstone or hardpan. There seems little doubt that this is a phenomenon dependent upon the presence of the Pisonia

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(together with sea-birds), rather than controlling the distribution of the Pisonia. This relationship will be discussed in detail elsewhere. It has already been touched upon by Hatheway 1953.

This forest, up to 25-30 m. tall, commonly has a dense canopy, elephantine white trunks, spreading at the base into twisted root platforms, and little or no undergrowth except for Pisonia root sprouts. These are of quite irregular distribution, some trees having them, others not, even in the same grove. Fallen trees usually, but not always, take root wherever they touch ground, sending up a number of erect branches that become trunks. In dry regions Pisonia is more or less deciduous in the dry season, allowing more than usual light to enter. Birds tend to favor this forest for roosting and nesting; there are often hundreds or thousands of fairy terns, noddies of two kinds, red-footed boobies, and frigate birds nesting in the branches of a grove, and white-tailed tropic birds have been found nesting in cavities.

b. Ochrosia forest: One of the most striking atoll forest types is a pure dense stand of Ochrosia oppositifolia. These trees are up to 20-25 m. tall, with clean slender trunks, seldom more than 3 dm. through, and umbrella-shaped crowns of broad dark green leaves. These grow in contact, forming a canopy so dense that there is perpetual twilight beneath it. There are few seedlings of any other species on the ground, but those of Ochrosia are there in millions. The egg-like bristly fruits form a continuous layer on the ground, and the seedlings are of more or less even height, usually 3-4 dm., evidently reaching this height, dying and being replaced or not growing much further. If an opening of any kind is formed in the canopy, the seedlings beneath quickly grow up and fill it.

This forest does not seem to be found especially on any one type of substratum, being seen on sand, gravel, or broken coral rock. It has been observed particularly, as a continuous stand, in islands with a moderate rainfall. Apparently, once started, Ochrosia is able to replace most, if not all other species, at least in the moderate rainfall belt in the northern Marshalls. It has not been described from anywhere outside the Marshall Islands, though the tree is widely distributed in the Pacific.

c. Pandanus forest: In the Marshalls pure stands of Pandanus tectorius are uncommon and not of large extent. A solid stand was seen on Maria Atoll, Austral Islands, that covered an entire islet. Such stands have also been reported from the uninhabited atolls of the Tuamotus. Though Pandanus commonly branches toward the base, in dense forests the trunks are usually rather tall and straight before branching, with conspicuous prop roots holding up the bases and making walking difficult where the trees are close together. The crowns are pyramidal in shape, composed of enormously long sword-like leaves imbricated on the stem in three close spirals which give the tree one of its common names, "screw-pine." These leaves are provided with a row of stiff spines on the midrib and others along the margins. The leaves form a loose accumulation on the ground beneath the trees, where they retard the appearance of seedlings or herbaceous plants. Pandanus seedlings are able to start in denser shade than in Pandanus forest, but are not common in this type of forest, though they often form a carpet under isolated trees where leaves have not accumulated. Pandanus seems equally at home in almost any atoll habitat.

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d. Messerschmidia forest: On some of the drier atolls, such as Pokak and Wake, low forest of Messerschmidia argentea is the dominant vegetation. The trees are not very close together and commonly preserve their perfect hemispherical shape. Their silvery gray-green leaves are fleshy and in extreme dry weather all but the youngest on the twigs drop off. Pure stands of this species often colonize new islets and may remain uninvaded by other species for a long time. On some islands a strip of this type, but of very much taller trees, closer together, and open beneath, may occur just back of the beach scrub. The trees sometimes, but rarely, reach 20 m. tall. Their trunks are twisted and freely branched. They are seldom dense enough to exclude a ground cover, which may be of grass (Lepturus, Thuarea, Stenotaphrum), Triumfetta procumbens, or Boerhavia, or, on rocky substrata, Fleurya. Underbrush is not so common in this type, though Scaevola frutescens may be present, or Sida fallax. Ipomoea tuba lianas are frequently tangled abundantly in this forest, even in its driest manifestations. This type, also, seems to have little or no preference in substratum, but it is a pioneer type and will only persist under conditions which do not favor its more mesophytic competitors.

e. Cordia forest: In drier atolls Cordia subcordata often forms pure forests, though not of large extent. The trees may be close set and reasonably tall, but are commonly farther apart, at least the trunks, and with low, long widespreading branches that drag on the ground, become tangled and entwined, and make an impenetrable thicket. Often there is no undergrowth or ground cover at all. In the dry season this species may be briefly deciduous.

f. Barringtonia forest: Only one area of this has been observed, on Lae Islet, Lae Atoll, but it is such a striking type that it is worth looking for elsewhere. The trees were of enormous diameter, massive, 20-25 m. tall, canopy complete and dense, nothing on the ground except a colony of Peperomia. The ground in this forest had been covered, subsequent to the trees reaching a large size, by a deposit of large boulders to a depth of up to a meter. This should be looked for elsewhere, as the species is found everywhere in the tropical Pacific and Indonesia.

4. Pemphis forest:

On rock at or above high tide level, whether elevated reef rock, coral conglomerate, or beachrock, pure stands of Pemphis acidula, a densely branched small-leafed tree, are common. The trees are able to grow where pure sea water wets their roots at high tide. They reach 6-8 m. tall, are commonly gnarled and twisted, with trunks up to 2-3 dm. thick, rarely much more, of extremely hard and heavy wood. The lower branches, even though dead, are persistent and rigid, and as the trees grow very closely, the stand may be fairly impenetrable. Usually nothing grows beneath it. The general color of this forest, from a distance, is a soft bluish green, and the texture of the trees leads persons unfamiliar with Pemphis to describe it as looking like a conifer. This type is a fairly reliable indicator of rock substratum, but occasionally may be found on sand. Possibly these cases have rock at shallow depths, but this has not been investigated thoroughly.

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5. Mangrove Forest:

Mangroves of a number of kinds may be found in shallow lagoon margins, in tidal ponds or swamps with outlets, and in depressions with no outlets. In open lagoons Sonneratia or Rhizophora are found, rarely Bruguiera conjugata. The latter is much more common in the depressions, either mud bottomed or rock bottomed, where it may be accompanied by Lumnitzera, Intsia, or Pemphis. The latter two are usually found on rock bottoms. In the ponds with outlets Rhizophora is commonest. In the Marshalls, where the depressions without outlets are commonest, there is some evidence that Bruguiera may have been placed there deliberately by man. This is certainly true in some cases (Schnee 1904). The fruits are used in making a dye.

6. Beach Scrub:

Generally along the seaward sides of islets, especially on the windward sides, on the ends, and to a lesser extent along the lagoon beaches, beach scrub may be found on scrub vegetation. This is usually preponderantly Scaevola frutescens, but with varying admixtures of small bushy specimens of Messerschmidia, Guettarda, Terminalia, Suriana, Pemphis, and, on lagoon beaches, sometimes Cordia, Sophora tomentosa, and Allophylus. In different situations this has a vastly different appearance. On both beaches it commonly forms a fringe, principally Scaevola, along the edge of the forest at the top of the beach, merging with the forest on the landward side. If this is a lagoon beach or seaward beach on the leeward side its margin is abrupt, vertical or rounded, and it may be several meters tall. On the windward outer beaches, especially in the trade-wind belts, the top surface of the scrub slopes down in an inclined plane, continuous with the similarly "wind-sheared" top of the forest, to the top of the beach. Occasionally the edge of this has a scalloped appearance and the upper surface is grooved in the direction of the prevailing wind, the groves gradually disappearing landward. Depending on the physiography of the ends of the islands, the scrub found there may be merely a continuation of the fringe on the seaward side if it is a boulder beach, or, if it is a sand or gravel spit, a scattered to dense growth, principally Scaevola may be quite extensive, resulting from original colonization. On the lagoon side of such a spit, or lagoonward of the forest, a row of Scaevola or mixed scrub may catch windblown sand and form a low dune ridge.

7. Miscellaneous scrub types:

In the interiors of islands, especially of drier ones, different sorts of scrub vegetation may occasionally be found. On Pokak Atoll are areas of Scaevola 1-2 m. tall, often on exposed rock substratum. Such areas, on most atolls, would probably be occupied by Pemphis scrub or forest, but this plant does not occur on Pokak. A similar inland scrub has been reported by Christophersen (1927) from Christmas Island.

A thin scrub of Sida fallax, usually with Lepturus and other herbs, occurs in fairly large areas on Pokak and on Christmas Island, Canton, and other dry central Pacific atolls. This seems to fluctuate a great deal with wet and dry periods, the individual bushes partially dying during dry cycles, but with some branches continuing to flower. In some favorable localities this may reach almost 2 m. in height and be so dense as to somewhat impede walking. Small patches of this are found on dry islets in other atolls of

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the northern Marshalls, often surrounded by forest. In places, as on Christmas Island, Messerschmidia trees, perfectly rounded on top, are more or less thickly scattered in the Sida scrub to form a park-land or savanna.

Hedyotis romanzoffiensis and Heliotropium anomalum form a dwarf scrub, usually rather sparse, on Christmas Island. In places Sida and Suriana may be added to this to form a mixed dwarf scrub. Herbs, such as Lepturus, Portulaca, and Boerhavia are commonly associated with this. It is usually not more than about 0.5 m. tall. Something similar occurs in openings in the Tuamotus, but little is known about it.

On Christmas Island, and perhaps, Jarvis, are small areas of loose scrub made up of Abutilon indicum. The bushes grow to 1-2 m. tall.

8. Lepturus Grassland:

On most of the drier atolls are patches, and on Pokak and Christmas large areas, of a bunchgrass vegetation of Lepturus repens, sometimes with admixtures of Heliotropium anomalum, Portulaca, Boerhavia, and other herbs. These seem, invariably, to have sand or fine gravel as a substratum, either pure or between the rocks. The bunches may be so close together as to form a continuous cover or may be widely separated, and may be very small to as much as 3-4 dm. tall. On Pokak this type of area is invariably undermined by the burrows of enormous numbers of wedge-tailed shearwaters. On Christmas Island there may be a scattering of Messerschmidia trees, giving a savanna effect. This is also somewhat true on Pokak. On some atolls, these Lepturus patches are often extensively parasitized by mats of Cassytha filiformis. On Christmas Island Lepturus is locally mixed with Tribulus cistoides or with Heliotropium anomalum.

9. Other Natural Herb Types:

On some atolls, as Taka, Bikar, Jarvis, and other rather dry ones, are areas where Portulaca lutea is dominant or in pure stands. The cover is ordinarily not complete. These are usually on rather freshly formed sand or gravel surfaces, and are probably short-lived, being invaded by other species rather promptly.

Mixtures of Portulaca, Boerhavia, and Lepturus may cover the ground sparsely to rather densely. On Christmas Island Christophersen (1927) described, also, areas of a pure stand of Boerhavia, which he said had grown over and killed the other plants.

On highly saline flats, usually near the lagoon, at practically high tide level, the vegetation is of scattered mats of Sesuvium portulacastrum. This vegetation has been noted on Wake Island, Canton Island, and Christmas Island, and probably occurs more widely, at least in the dry Pacific Equatorial and Phoenix groups.

10. Secondary Herbaceous Types:

During the war large areas on such atolls as Kwajalein, Eniwetok, Wotje, Jaluit, and others were denuded of their vegetation. Most of these

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have scarcely been studied, but on Kwajalein and to a much lesser extent, Jaluit and Eniwetok, observations have been made. These areas seem, usually, to be occupied by mats of Ipomoea pes-caprae, Wedelia biflora, or Vigna marina. These may become so dense that invasion by woody species is greatly retarded. Wedelia tends to dominate in many such occurrences, and may form a dense mat one or even two m. thick, sometimes mixed with Ipomoea. On Lae Islet, Lae Atoll, a similar mat of pure Wedelia occupies an open meadow-like place of unknown origin in the forest. This did not change significantly between 1944 and 1952. The substratum was fine broken coral.

On abandoned compacted coral air strips, Fimbristylis cymosa (or atollensis) may get started as a pure stand and persist for some time, as on Bikej Islet, Kwajalein.

In 1945 an attempt was made to revegetate Kwajalein Islet and some others that were being used as active military establishments, by planting Cynodon dactylon. This has persisted in some places, but soon became invaded by other species, especially by Paspalum vaginatum, a similar sod-forming grass. The latter is now the commonest grass on Kwajalein Islet. Heavy traffic tends to discourage such plants as Wedelia and to favor such temporary weeds as the obnoxious Cenchrus echinatus, Eragrostis amabilis, Eleusine indica, and several species of Euphorbia. The weedy vegetation around such establishments is complicated by the great influx of new weeds brought in accidentally. Pluchea odorata and P. indica have become very abundant around most military bases, and for a while there seemed a probability that they would dominate the vegetation. However, where left reasonably undisturbed, Wedelia seems very able to smother them out.

11. Bogs and Marshes:

For present purposes bogs and marshes may be distinguished by defining the former as having a substratum of a spongy peat, the latter a substratum of soft muck.

Pits, artificially established for cultivation of taro-like plants, usually Cyrtosperma and Colocasia, occasionally sugar cane and other things, even ornamentals such as Hibiscus rosa-sinensis, are the commonest kind of marshes found on atolls. These are essentially pits dug down to below the water table in the centers of islets, then filled in up to the surface of the fresh or brackish water with vegetable refuse or compost, which rots and forms the muck substratum. Such pits vary from a few square meters to many hectares in extent. Cyrtosperma, a gigantic herb with great arrow-shaped leaves up to three meters or more tall, usually dominates these pits. This tends to crowd out Colocasia, which is often preferred as food. The starchy corms of these plants are the parts utilized, the tops of these being broken off and replanted. Many weeds occur in such places, the most aggressive being Alocasia, a giant aroid similar in appearance to Cyrtosperma but inedible, and Paspalum vaginatum. The latter, introduced recently in the northern Marshalls, has completely taken possession of many of these pits on Likiep and Ailuk. Other common weeds are Cyperus odoratus, Eleocharis geniculata, Jussiaea suffruticosa, Polygonum sp., and Athyrium sp.

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Natural marshes occur on many atolls, being places where, for one or another reason, the ground surface dips beneath the water table. The bottom is a soft mud whose composition has not been investigated. Cyperus javanicus, Jussiaea, and various weeds are commonly found here.

On Washington Island, at one end of the freshwater lake, is a peat bog of some extent. The vegetation of this is a solid stand of Scirpus riparius, invaded around the edges by Cyrtosperma and Polypodium scolopendria. This is a rather rare or possibly unique occurrence on an atoll and has been well described by Wentworth (1931) and Christophersen (1927).

12. Terrestrial algal vegetation:

The land algae have been little investigated on atolls. There are, of course, the usual epiphytic unicellular green and blue-green algae on tree trunks and in lichen association with fungi, and microscopic algae on moist ground. There are algal mats in pools, both blue-green and green. On the wet bottom of a depression on Wake Island was noted a luxuriant fur-like growth of Enteromorpha. Almost nothing is known of the composition of most of the algal vegetation. Two physiognomic types are apparently so widespread as to be almost universal in their respective habitats. These have attracted some attention from other than vegetation students. They are as follows:

a. Surface discoloration on limestone rocks: Rocks exposed above high-tide level, whether consolidated material or loose boulders and cobbles, though white, pinkish, or very pale brown in color within, are ordinarily colored from a blue-gray to black. On close examination this is found to result from a layer as much as several mm. thick in which the rock is green in freshly broken cross section. Often the inner margin of this layer is more strongly colored than the intermediate depths, while the outer surface seems black. When the limestone is dissolved away in acid this color is found to be due to unicellular blue-green algae belonging to the Chroococcales. There have been various observations on its effect on the hardness and decomposition of the surface layers of the limestone, but no one, as yet, has separated out the effects which are due to the algae from those with other causes. Also, nothing is definitely known as to the origin and differences in intensity of color. It has been suggested by Teichert (1947) that the color is in proportion to the age of exposure, and that this might be a means of dating, relatively, the shingle deposits. Not enough is understood about this, as yet, to make any such conclusions dependable. It has been noticed, on Pokak Atoll, that where there is much abrasion by rolling around of loose material the algal layer is kept worn thin or is absent.

b. Algal crust on coral sand: On most areas where there is open sand, either with no other vegetation or between bushes of sparse scrub or tufts of sparse bunch grass, the surface of the sand for the first few millimeters is caked into a crust, held together by gelatinous blue-green algae. The general color is gray to blackish, but appears greenish when moist. When very dry such a crust, if well developed, may crack and curl up or wrinkle. The algae forming this crust are, so far as known, principally, Hassallia byssoidea, Scytomema ocellatum, and Porphyrosiphon fuscus, all filamentous Myxophycae, and Gloeocapsa alpicola, a gelatinous colonial form (Taylor 1950).

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This crust has attracted some attention as a possible source of fixed nitrogen in atoll soils, since it has been demonstrated that certain blue-green algae are able to fix atmospheric nitrogen. A limited amount of work has been done toward finding out if this is actually the case, but not enough has been done to yield any definite results. The crust undoubtedly serves an important function in retarding wind drift of find sand.

13. Marine Seed-plant Vegetation:

On sandy, quiet-water shores in the western Pacific, Indian Ocean, and Caribbean Sea several genera of marine spermatophytes, commonly called "sea-grasses" tend to form a sod-like vegetation, holding the surface layers of sand in place by their entangled rhizomes. This type of vegetation is probably not unusual in the lagoons of atolls, but has scarcely been reported from them. Two occurrences are known. One is a tiny patch of Thalassea hemprichii at the outlet of a mangrove swamp on Ailinglapalap Atoll; the other is a long strip of sod of the same species at low tide level on the lagoon beach of Ujelang Islet, Ujelang Atoll, both in the Marshalls. Undoubtedly this will be found to be more widespread, especially in the Caroline atolls when they are more adequately investigated. It is a common feature of barrier reef lagoons around high islands in Micronesia.

This vegetation is often referred to as "turtle-grass" and is said to be the principal food of the green turtle. It is rather difficult to account for the abundance of turtles in the northern Marshalls when there is so little "turtle-grass" without assuming either other foods or extensive migrations. Such migrations are known in the western Indian Ocean, where the turtles breed on some of the atolls, but migrate to the Mozambique Channel, hundreds of kilometers away, to feed during a part of the year. Their stored fat apparently keeps them alive during the breeding season. It would be very interesting to know if there are such migrations of turtles in the Pacific.

14. Marine Algal Vegetation:

The actual algal communities of atolls have not been sufficiently studied to enable a very significant summary to be made. A zonation is observed, even by the casual collector, which will be outlined below, beginning with the outer edge of the reef. The problem is complicated by the fact that the zonation is by no means the same on windward and leeward sides, by seasonal fluctuations in abundance of species, and by fluctuations in response to available nutrient material dissolved in the water. An excellent example of this is given by Taylor (1950), when he notes that Enteromorpha was scarcely seen when he arrived on Bikini in 1946 but had become very abundant during the time the party spent there, presumably in response to the pollution of the lagoon by sewage and refuse from the large establishment set up there for the atomic-bomb tests. There is also much difference in algal floras, at least as to relative abundance of species, from atoll to atoll.

a. Algal ridge (Lithothamnion ridge of most authors): At the outer edge of the seaward reef, especially on the windward side, calcareous red algae of the genus Porolithon and possibly other genera form a massive accumulation

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of limestone that is generally built up several feet above the general level of the reef flat. It is of a bright pink color, rough to rather smooth, and is very resistent to the pounding of the waves. Many people believe that the strength of this indurated edge of the reef protects the whole structure from pulverization by the breakers. The height to which this ridge is developed is more or less in proportion to the constancy and roughness with which waves break against it. Frequently it is entirely absent on the leeward sides of atolls. On the leeward sides, also, there may occasionally be a small such ridge developed on the edge of the lagoon reef, in response to lagoon waves.

b. The moat: The depressed area or trough dipping below low tide level just behind the algal ridge, landward, sometimes represented by numerous tidepools, is usually filled with corals and has a considerable diversity of algae. There may be Laurencia in abundance, Liagora, Avrainvillea, Codium, Halimeda, and many other genera. They do not, however, form a continuous layer, except sometimes in the case of Codium.

c. The reef flat: This relatively smooth, gently sloping area, sometimes very broad, extending from high-tide level to low-tide level, is mostly covered by a continuous layer of algae, sometimes very thin, and little else. Over large areas Cladophoropsis is dominant, forming a dense felt which catches fine calcareous sand. Over other areas this is replaced by a fur of Jania, also a collector of sand. Padina is common in other places, though not very frequent in the northern Marshalls. In more restricted areas, near high-tide level, may be putty-like masses of silt held together by the very fine filamentous Schizothrix. In still other places there is only a slimy film of microscopic algae of several sorts. On the under sides of boulders strewn on this flat Microdictyon is common, and there is some Dictyosphaeria. In certain places the bottom is covered by a crust of a thin encrusting calcareous red algae, or by small pebbles so encrusted (nodular). There may be a rough correlation in the distribution of these communities with the duration of exposure above water, but it has not been worked out very well, as yet.

d. The lagoon reef flat: The lagoon reef flat, the shallow shelf extending out a short distance from the inner shore of the islets, is not generally a region of abundant algae. It is usually either sandy or covered by rubble. In the northern Marshalls, Halimeda stuposa and a species of Udotea of similar habit grow in sandy places as scattered tufts, with their curious "pseudostipes" buried in the sand. Between the boulders of rubble deposits a little Caulerpa may be found. Tiny tufts of small filamentous red algae also grow here, sometimes on the sea anemones that are common here.

e. The passage between islets: Here water is usually flowing in one direction or another. Luxuriant colonies of Halimeda, several species of Caulerpa, and, rarely, Turbinaria ornata grows at or below low tide level. The rocks, both above and below low-tide level are slippery with a film of very small algae.

f. The leeward reef where there are no islands: Where this is not exposed at low tide, except for coral heads and boulders, coral is very abundant and algae are scarce. On Ailuk only a species of Liagora seemed to be common in such a place, forming scattered tufts growing on the coral and boulders. Where the leeward reef is exactly at low-tide level or slightly

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above it, it is often covered by a platform of Porolithon, bordered by a slight Lithothamnion ridge. In cavities in this are Halimeda and Caulerpa.

g. The lagoon bottom: This has not been studied much, but in the northern Marshalls it is known to be covered at least in some areas, by a stand of Halimeda growing in such abundance that the lagoon bottom sediments are in places almost entirely made up of its calcareous skeletons. In Ailuk a species of Caulerpa was snagged from the lagoon bottom by a fishline, so there may be some areas where it is abundant.

Vegetational Patterns

The original arrangement of the various types of vegetation on atolls has been very largely obscured because coconuts have been planted indiscriminately almost everywhere. The present pattern is for the greater part of the larger islets to be covered by coconut plantations, leaving a belt of scrub and scrub forest on the windward sides of islets on the windward sides of atolls. This protects the coconut trees from excess wind and salt spray. The outer edge of this belt is usually a fringe of Scaevola, which gradually merges with the mixed forest which lines the coconut groves. Very narrow islets and parts of islets, such as sand spits on their ends, seldom have coconuts, but usually have mixed scrub, usually dominantly Scaevola and Messerschmidia, or if the narrow place is rock, the vegetation may be Pemphis scrub. Along the lagoon sides of the coconut groves, there is usually a thin line of scrub or a row of trees.

From the remnants of native forest remaining here and there, and from a consideration of the present distribution of trees on the islets mostly occupied by coconut groves (Hatheway 1953), some idea may be obtained of the original patterns. It is apparent that some species of plants--and consequently, where there are so many types dominated by single species--some vegetation types are less halophytic than others. Such are Ochrosia, Pisonia, and mixtures of these with Intsia, Allophylus, Pandanus, Pipturus, Guettarda, and others, but lacking Messerschmidia. These types tend to be toward the interior of islets, and surrounded by more halophytic and scrubby forest and beach scrub, dominated by Messerschmidia, Scaevola, Pandanus, Terminalia, and Guettarda. The width of this more halophytic belt, especially of the outer beach scrub, is greater on the seaward and especially the windward sides. In the wetter atolls, after they are largely in coconuts, breadfruit groves and solid breadfruit forest seem to coincide in distribution with those parts of the islets where the more mesophytic forests formerly occurred. It has been suggested (Fosberg 1948, 1949) that the distribution of the more mesophytic types might be correlated with a lens of relatively fresh ground water, better developed on the wider islets. The existence of such a lens and its correlation with the distribution of some plants, such as breadfruit, has been amply demonstrated since, though there seems reason to think that the influence of salt spray and wind is much greater than previously suspected. And too little is yet known about the seasonal fluctuation in salinity in these shallow ground water lenses.

On very dry islands the occurrence of Lepturus grassland seems to coincide somewhat with sandy areas, completely rocky places being more likely to be occupied by scrubby forest of Messerschmidia, or, in places, Cordia or Pisonia.

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Pemphis forest or scrub is practically always found on rock surfaces at or above high-tide level. Suriana, which sometimes forms a rather pure scrub, but more often is a component of mixed beach scrub, has only once or twice been seen or recorded from anything but sand. Sophora tomentosa is usually found on sandy lagoon beach ridges.

Entirely too few atolls have been at all carefully studied to make more than the roughest generalizations possible. The only vegetation maps of atolls that exist are those of Arno (Hatheway 1953). Without such maps, similarities in distribution patterns are hard to see.

Most needed future studies

The most urgent need is for information on the few remaining bits of native vegetation on atolls in various parts of the world. Such studies of the more remote atolls in the northern Marshalls during 1951 and 1952, though very brief, yielded a great deal of information. And remnants of original vegetation will disappear extremely rapidly.

All opportunities should be taken advantage of to look into the salinity relations of the different vegetation types and of individual species of plants. Any ground water study should be accompanied by careful notes on the vegetation. Information is especially desired on the effects of seasonal fluctuations in salinity.

Anything contributing to an understanding of successional relations of these vegetation types will also be important. Observations as to what species can establish themselves in the shade of what others, as to what common species are seen dying out or lacking in some types, and as to changes taking place over the years in areas completely devastated during the war, are all especial desiderata.

Whether or not the prominence of types consisting of single species is a general atoll phenomenon or only characteristic of the relatively dry northern Marshalls is not known. And in any event, the explanation for this is of great interest. Whether it is a function of the extreme habitat, or of the very small floras, or of both should be looked into.

The cause for the areas of unhealthy or dying coconut plantations in the Marshalls, and whether such a phenomenon is found elsewhere, are matters of more than academic importance.

Whether pure Ochrosia forest is found elsewhere than in the northern Marshalls is not known. The nature of the yellow patches in this forest, also, seems of fundamental importance. This is especially so if it can be shown that it is an effect of the vegetation on the habitat.

Any influence exerted by the vegetation on the habitat is of great interest. The only clear-cut case familiar at present is the formation of phosphate rock under the influence of Pisonia forest. Phosphate exhaustion in coconut groves is suspected. Influence of beach scrub in the piling up of sand dunes is also probable. Protection of the land surface against mild typhoons is another possibility. Binding of sand by blue-green algae against

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wind erosion is still another. The effect, if any, of algae, in the formation of beach or reef sandstone needs to be determined. There are many others, but most studies have been so hurried that it was not possible to gain more than an inkling that something was happening. The careful study of any ecological process is one of the most important things that can be done to gain the understanding of atoll ecology. The student must, however, be cautioned against the tendency to explain everything in terms of the one process intensively studied. The vegetation is an expression of the interaction of many such processes, and the unraveling of their effects is the ultimate, though probably unattainable objective of the study of vegetation.

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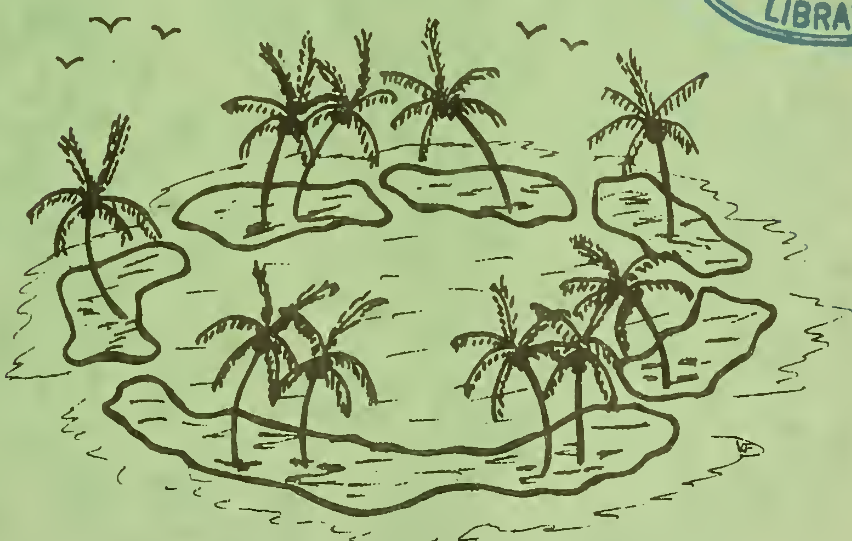

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It is a pleasure to commend the far-sighted policy of the Office of Naval Research, with its emphasis on basic research, as a result of which a grant has made possible the continuation of the Coral Atoll Program of the Pacific Science Board.

It is of interest to note, historically, that much of the fundamental information on atolls of the Pacific was gathered by the U. S. Navy's South Pacific Exploring Expedition, over one hundred years ago, under the command of Captain Charles Wilkes. The continuing nature of such scientific interest by the Navy is shown by the support for the Pacific Science Board's research programs, CIMA, SIM, and ICCP, during the past six years. The Coral Atoll Program is a part of SIM.

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Invertebrate Consultants Committee for the Pacific

Enumeration of the Decapod and Stomatopod Crustacea from Pacific Coral Islands

L. B. Holthuis

Rijksmuseum van Natuurlijke Historie

Leiden, The Netherlands

June 5, 1953

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INTRODUCTION

The present enumeration lists the Decapod and Stomatopod Crustacea collected during the first three years of the Pacific Science Board's Coral Atoll Program. The collections include those made at Arno Atoll, Marshall Islands, in 1950; at Onotoa Atoll, Gilbert Islands, in 1951; in the Marshall Islands in 1951-1952; and at Raroia Atoll, Tuamotu Islands, in 1952. Also included are the Decapoda and Stomatopoda collected by Dr. Preston E. Cloud, Jr. and his associates in 1949 at Saipan during ecological investigations of the Saipan reefs under a project sponsored by the U. S. Geological Survey.

The work of the author on this enumeration was made possible by a contract between the Office of Naval Research, Department of the Navy, and the National Academy of Sciences (NR160 175).

The list of species given here is not annotated and is intended only to furnish the ecologists, who collected the material, with the names of their specimens. Since the number of scientists involved is rather large, it was not feasible to provide each with a typed copy. Therefore, it was decided to present this list in the present mimeographed form. A duly annotated report on the Decapoda Macrura will be published in the near future.

The present enumeration is not complete insofar as the crabs of the family Trapeziidae are excluded. The material of this group has been turned over to Dr. Fenner A. Chace, Jr., curator of the Division of Marine Invertebrates of the U. S. National Museum, who is preparing a revision of this family. Through lack of time, only one species each of the families Galatheidae and Porcellanidae have been dealt with here.

Full station data generally are given with each record. The location of the 1949 P. E. Cloud Saipan stations may be seen on map No. 1. The data associated with R. W. Hiatt's material collected during the 1950 Arno Atoll Expedition are given as a supplement at the end of this paper, at least for the non-Macruran Decapods. Dr. Hiatt's station data for the Macrura are given under each species. Albert H. Banner's 1951 Onotoa localities are to be found on map No. 2. Several of these localities are discussed by Dr. Banner in Atoll Research Bulletin No. 13, Pt. I (1952).

DECAPODA

I. Brachyura

DROMIACEA

Family Dromiidae

Cryptodromia canaliculata Stimpson

a. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A. I-II: 1 spec.

b. Homohomo Island, Raroia Atoll, Tuamotu Islands; from under rocks, etc., near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 1 spec.

c. Homohomo Island, Raroia Atoll, Tuamotu Islands; from under rocks near shore in pavement pool zone; July 21, 1952; J. P. E. Morrison; Loc. 1963: 1 spec.

Family Dynomenidae

Dynomene spinosa Rathbun

a. Homohomo Island, Raroia Atoll, Tuamotu Islands; from under rocks near shore in pavement pool zone; July 21, 1952; J. P. E. Morrison; Loc. 1963: 1 spec.

OXYSTOMATA

Family Calappidae

Calappa hepatica (L.)

a. Ine Village, Arno Atoll, Marshall Islands; sand near shore of lagoon; July 25, 1950; J. W. Wells; Loc. 60: 1 spec.

b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 2-164: 3 spec.

c. Onotoa, Gilbert Islands; July - August, 1951; A. H. Banner: 1 spec.

d. Onotoa, Gilbert Islands; July - August, 1951; A. H. Banner; Loc. B: 1 juv.

e. Onotoa, Gilbert Islands; July 26, 1951; A. H. Banner; Loc. B 1-6: 3 spec.

f. Onotoa, Gilbert Islands; clean limesand flat in the vicinity of a point about 3000 ft. E. of Aonteuma, NW. Onotoa, area exposed at mid-tide; August 21, 1951; P. E. Cloud; Loc. GOC-42: 1 spec.

g. Leeward reef, Ailuk Atoll, Marshall Islands, just west of Ailuk Island; leeward side; 1951-1952; F. S. MacNeil; Loc. 846: 1 spec.

h. West end of Ailuk Island, Ailuk Atoll, Marshall Islands; leeward reef; 1951-1952; F. S. MacNeil; Loc. 853: 2 spec.

i. Lae Island, Lae Atoll, Marshall Islands; windward side, under rocks; 1951-1952; F. S. MacNeil; Loc. 877: 1 juv.

j. Island north of Lae Island, Lae Atoll, Marshall Islands; lagoon side; 1951-1952; F. S. MacNeil; Loc. 879: 1 spec.

Matuta banksi Leach
  a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 2-144: 1 spec.

Family Leucosiidae

Nucia speciosa Dana
  a. Lagoon west of Saipan, Marianas Islands; May 4, 1949; P. E. Cloud; Loc. E-8; from coral rock: 1 spec.
  b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4; 500 yds. NNE of Managaha Island: 1 spec.

OXYRHYNCHA

Family Majidae
Subfamily Acanthonychinae

Menaethius monoceros (Latreille)
  a. Lagoon west of Saipan, Marianas Islands; April 8, 1949; P. E. Cloud; Loc. B-2; taken from vegetation and sand brought up by diving with face plate: 6 spec.
  b. Lagoon west of Saipan, Marianas Islands; April 9, 1949; P. E. Cloud; Loc. C-1: 1 spec.
  c. Lagoon west of Saipan, Marianas Islands; April 6, 1949; P. E. Cloud; Loc. D-5: 4 spec.
  d. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4; 500 yds. NNE of Managaha Island: 3 spec.
  e. Onotoa, Gilbert Islands; SE end of reef area known as Rakai Ati, S. side of big windward point of reef near center of atoll. Collected in ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.
  f. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer part of old wharf along lagoon beach at village; August 29, 1952; J. P. E. Morrison; Loc. 2224: 1 spec.

Trigonothir obtusirostris Miers
  a. Lagoon west of Saipan, Marianas Islands; April 19, 1949; P. E. Cloud; Loc. F-X: 1 spec.

Xenocarcinus depressus Miers
  a. Onotoa, Gilbert Islands; about 9200 ft. S. 72° W. from offshore end of Government Station jetty (on S. portion of northern main island) just S. of main passage out of lagoon (Rawa ni Karoro) where coral shoals, known as Aon te ra Bata, begin to deepen. From area where patch reefs rise above the limesand bottom at 16 ft. depth; July 29, 1951; P. E. Cloud; Loc. GOC-27: 1 spec.

Subfamily Pisinae

Tylocarcinus styx (Herbst)
  a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C.-7A: 2 spec.
  b. Lagoon west of Saipan, Marianas Islands; April 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.

Subfamily Hyasteninae

Micippoides angustifrons A. Milne Edwards

a. N. of Kahongi Island, Raroia Atoll, Tuamotu Islands; from outer end of channel, and from outer beach pavement flats of outer reef in same area; July 25, 1952; J. P. E. Morrison; Loc. 1994: 1 spec.

Perinea tumida Dana

a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 3 spec.
b. Ine Anchorage, Arno Atoll, Marshall Islands; from coral rock on reef flat; August and July, 1950; J. H. Wells; Loc. 6: 1 spec.
c. Onotoa, Gilbert Islands; August 20, 1951; P. E. Cloud: 1 spec.
d. Onotoa, Gilbert Islands; from Pocillopora coral, ocean shelf, 25 feet deep; August 10, 1951; A. H. Banner; Loc A-X: 1 spec.
e. Onotoa, Gilbert Islands; from Pocillopora; August 6, 1951; A. H. Banner; Loc. A-14: 3 spec.
f. Onotoa, Gilbert Islands; on sponges; August 6, 1951; A. H. Banner; Loc. A-17: 2 spec.

Subfamily Majinae

Cyclax suborbicularis (Stimpson)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 1-702: 1 ovig. female.

Subfamily Mithracinae

Micippa parca Alcock

a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 1 spec.

Micippa platipes Rüppell

a. Donkolo Agingan, Saipan, Marianas Islands; in pool at edge of low tide; May 4, 1949; collector, Mrs. David; P. E. Cloud: 1 spec.
b. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-7: 1 spec.
c. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-8-9: 1 spec.
d. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A. I-II: 4 spec.

Family Parthenopidae
Subfamily Parthenopinae

Daldorfia horrida (L.)

a. Lagoon west of Saipan, Marianas; May 13, 1949; P. E. Cloud; Loc. D-7: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-171: 1 spec.

Subfamily Eumedoninae

Eumedonus convictor Bouvier & Seurat
- a. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; commensal on anal plate region of Banded Spined Poison Sea Urchins (Echinothrix diadema (L.)), one on each Urchin of good size; from pockets (sandy bottom, etc.) in inner reef only, near lagoon edge of reef in transect area at night; September 2, 1952; J. P. E. Morrison; Loc. 2246: 2 spec.

Harrovia purpurea Gordon
- a. Kwadak, Kwajalein Atoll, Marshall Islands; on Comanthus bennetti (J. Muller), 3-4 fms. deep; July 1, 1951; P. E. Cloud: 4 spec.

BRACHYRHYNCHA

Family Portunidae
Subfamily Caphyrinae

Caphyra rotundifrons (A. Milne Edwards)
- a. Lagoon north of Matuis Beach, NW. Saipan, Marianas Islands; picked from head of brown Acropora; December 12, 1948; P. E. Cloud: 1 spec.

Lissocarcinus orbicularis Dana
- a. Matuis Beach, NW. Saipan, Marianas Islands; commensal in black holothurian, 5 crabs in 100 host specimens, four of them found within host at oral end, fifth had crawled out; color alive, black with white spots; December 19, 1948; P. E. Cloud: 5 spec.

Subfamily Portuninae

Charybdis erythrodactyla (Lamarck)
- a. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef, fishing at night; July 22, 1952; J. P. E. Morrison; Loc. 1972, 1973: 4 spec.
- b. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef, fishing at night; mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 22, 1952; J. P. E. Morrison; Loc. 1979-1983: 3 spec.
- c. Oneroa Island, Raroia Atoll, Tuamotu Islands; outer reef, zone just behind the Lithothamnion ridge or in it, at night; August 4, 1952; J. P. E. Morrison; Loc. 2042: 1 spec.

Portunus (Cycloachelous) granulatus (H. Milne Edwards)
- a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 1-16: 1 spec.
- b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 1-435: 1 spec.
- c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 2-21: 1 spec.
- d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 2-457: 1 spec.

e. Onotoa, Gilbert Islands; clean limesand flat in the vicinity of a point about 3000 ft. E. of Aonteuma, NW. Onotoa; area exposed at mid-tide; August 21, 1951; P. E. Cloud; Loc. GOC-42: 1 spec.
f. South end of Oneroa Island, Raroia Atoll, Tuamotu Islands; white swimming crab hiding in the fine white sand; August 7, 1952; J. P. E. Morrison; Loc. 2078: 1 spec.

Portunus (Hellenus) longispinosus (Dana)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 2-505: 2 juv.
b. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec. (q.)
c. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A. I-II: 3 spec.
d. Opakea Island, Raroia Atoll, Tuamotu Islands; small and fragile sand crabs from sandy bottom of shallow tide pool remaining at low tide, at night; at SE. point of island; August 26, 1952; J. P. E. Morrison; Loc. 2196: 2 spec. (1 ovig. female).

Thalamita admete (Herbst)
a. Saipan, Marianas Islands; from a single large head of Acropora leptocyathus; April 7, 1949; P. E. Cloud: 1 spec.
b. Matuis Beach, NW. Saipan, Marianas Islands; taken mostly from clump of brown Acropora and partly from Pocillopora damicornis cespitosa; December 17, 1948; P. E. Cloud: 5 spec.
c. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud: Loc. A-5: 2 spec.
d. Lagoon west of Saipan, Marianas Islands; April 27, 1949; P. E. Cloud; Loc. A-7: 2 spec.
e. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 26 spec.
f. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 7 spec. (q.)
g. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-7: 1 spec.
h. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-Z (=2?): 6 spec.
i. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A. I-II: 41 spec.
j. Onotoa, Gilbert Islands; NW. Onotoa about 1300 ft. NE. from Namokoro, in an area of gravelly sand bottom with maximum depths of about 12-14 ins. at low tide and with occasional heads of digitate Porites lobata; August 21, 1951; P. E. Cloud; Loc. GOC-39: 2 spec.

Thalamita coeruleipes Jacquinot
a. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 3 spec.
b. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 1 spec.

Thalamita danae Stimpson

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-306: 1 ovig. female.

Thalamita ? edwardsi Borradaile

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-47: 3 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-308: 1 ovig. female.

Thalamita ? intermedia Miers

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-503: 1 spec.

Thalamita picta Stimpson

a. Lagoon west of Saipan, Marianas Islands; April 7, 1949; P. E. Cloud; Loc. A.-11; from coral heads in 4 to 6 ft. water: 1 spec.
b. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 12 spec.
c. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec. (q.)
d. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A 8-9: 1 spec.
e. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A 10-12: 1 spec.
f. Onotoa, Gilbert Islands; July 20, 1951; A. H. Banner; Loc. A 11: 3 spec.
g. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A. I-II: 7 spec.
h. Onotoa, Gilbert Islands; SE. end of reef area known as Rakai Ati, S. side of big windward point of reef near center of the atoll; collected from $\frac{1}{2}$ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.
i. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; sandy pavement flats near shore; July 23, 1952; J. P. E. Morrison; Loc. 1977: 1 spec.

Thalamita pilumnoides Borradaile

a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 2 spec.
b. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 5 spec.
c. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 6 spec.
d. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 spec.

Thalamita prymna (Herbst)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-5: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-151: 4 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-307: 1 spec.

Thalamita quadrilobata Miers

a. Onotoa, Gilbert Islands; toward S. end of a lee reef stretch known as Rakai Ati, in an area of small coral patches fairly thickly interspersed on limesand and coral debris. The bottom is at depths of 3-4 ft. at low tide; July 26, 1951; P. E. Cloud; Loc. GOC-24: 1 spec.

Thalamita wood-masoni Alcock

a. Lagoon west of Saipan, Marianas Islands; April 8, 1949; P. E. Cloud; Loc. B-2; taken from vegetation and sand brought up by diving with face plate: 2 spec.

Thalamita spec.

a. Saipan, Marianas Islands; 1949; P. E. Cloud; Loc. D.-8: 1 juv.
b. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 8, 1952; J. P. E. Morrison; Loc. 1885: 1 spec.

Thalamitoides quadridens (A. Milne Edwards)

a. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 9 spec.
b. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7A: 3 spec.
c. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 5 spec.
d. Lagoon west of Saipan, Marianas Islands; May 5, 1949; P. E. Cloud; Loc. E-7; from coral rock: 2 spec.
e. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 2 spec.
f. Onotoa, Gilbert Islands; about 9200 ft. S. 72° W. from offshore end of Government Station jetty (on S. portion of northern main island) just S. of main passage out of lagoon (Rawa ni Karoro) where coral shoals known as Aon te ra Bata begin to deepen. From area where patch reefs rise above the limesand bottom at 16 ft. depth; July 29, 1951; P. E. Cloud; Loc. GOC-27: 1 spec.
g. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon. Patch reefs rising above limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 1 spec.
h. Onotoa, Gilbert Islands; about 9300 ft. N. 30° W. from Tabuarorae Maneaba in S. part of Te Rawa Tekatobibi, a pass through the S. end of the leeward reef. Collected from patch reefs rising to an occasional maximum of within 4 ft. of the surface from a bottom sounded at 18 ft.; August 23, 1951; P. E. Cloud; Loc. GOC-53: 1 spec.
i. Onotoa, Gilbert Islands; about 13,400 ft. S. 75° W. from Aiaki Maneaba in the deep central part of the lagoon. The bottom is of low scattered dead and living coral patches on intervening limemud and limesand about 30-40% seds. and 60-70% coral; August 25, 1951; P. E. Cloud; Loc. GOC-55: 1 spec.

Subfamily Catoptrinae

Carupa laeviuscula Heller

a. Homohomo Island, Raroia Atoll, Tuamotu Islands; under rocks near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 1 spec.

Catoptrus nitidus A. Milne Edwards
a. Onotoa, Gilbert Islands; tidepool in Heliopora flat, 2 ft. deep; August 1, 1951; A. H. Banner: 1 spec.

Libystes spec.
a. Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. A-8, taken from dead coral and algal rock at a depth of about 10 ft.: 1 spec.

Family Atelecyclidae
Subfamily Thiinae

Kraussia rugulosa (Krauss)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E. 1-44: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 7, 1949; P. E. Cloud; Loc. A-11, from coral head in 4-6 ft. of water: 1 spec.
c. Onotoa, Gilbert Islands; Heliopora flat, tidepool, 2 ft. deep; August 1, 1951; A. H. Banner: 1 spec.

Family Xanthidae

Actaea cavipes (Dana)
a. Saipan, Marianas Islands; January 30, 1949; P. E. Cloud: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 3 spec.
c. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.
d. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 4 spec.
e. Onotoa, Gilbert Islands; S. part of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the PSB campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 1 spec.
f. Butaritari Atoll, Gilbert Islands; about $\frac{1}{3}$ mile E. offshore from the central part of Bikati Island, in pocket of broad area of Heliopora reef, NW. Butaritari; September 3, 1951; P. E. Cloud; Loc. GBC-2: 1 spec.
g. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from coralline algae from outer reef margin, N. end of island; September 3, 1952; J. P. E. Morrison; Loc. 2252: 1 spec.

Actaea hirsutissima (Rüppell)
a. Saipan, Marianas Islands; P. E. Cloud; Loc. C-IX: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 2 spec.
c. Lagoon west of Saipan, Marianas Islands; May 3, 1949; P. E. Cloud; Loc. E-4: 2 spec.

Actaea lata Borradaile
a. Lagoon west of Saipan, Marianas Islands; April 9, 1949; P. E. Cloud; Loc. C-1: 1 ovig. female.
b. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 2 spec.

c. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.
d. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 spec.
e. Nado Island, Likiep Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 827: 1 spec.

Actaea polyacantha (Heller)
a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 3 spec.
c. Onotoa, Gilbert Islands; back ridge trough, about 600 ft. offshore from Pacific Science Board camp at the outer margin of the windward reef, just inshore from the algal ridge and surge channels. This part of the reef never dries even at low tide and generally has at least a foot or two of water above it; August 1, 1951; P. E. Cloud; Loc. GOC-32: 1 spec.
d. Onotoa, Gilbert Islands; SE. end of reef area known as Rakai Ati, S. side of big windward point of reef near center of atoll. Collected from ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.
e. South Loi Island, Kwajalein Atoll, Marshall Islands; windward reef flat; 1951-1952; F. S. MacNeil; Loc. 894: 1 spec.

Actaea rufopunctata (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E- 1-386: 1 spec.
b. Onotoa, Gilbert Islands; about 3½ miles N. 31° W. from Tabuarorae Naneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef. From thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within 8 ft. - 10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 spec. (with Rhizocephalan).
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef; July 7, 1952; J. P. E. Morrison; Loc. 1877: 1 spec.

Actaea speciosa (Dana)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-390: 4 spec.

Actaea spec. aff. speciosa (Dana)
a. Onotoa, Gilbert Islands; about 3½ miles N. 31° W from Tabuarorae Naneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef. From thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within 8 ft. - 10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 2 spec.

Actaea superciliaris Odhner
a. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 spec.

c. Homohomo Island, Raroia Atoll, Tuamotu Islands; from under rocks, etc., near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 3 spec.

Actaea tomentosa (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-175: 1 spec.

Atergatis ? dilatatus De Haan
a. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 1 spec.

Atergatis floridus (L.)
a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 4 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-386: 1 juv.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-3: 3 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-170: 3 spec.
e. Bikati Island, Butaritari Atoll, Gilbert Islands; about ½ mile E. offshore from the central part of Bikati Island in pocket of broad area of Heliopora reef, NW. Butaritari; September 3, 1951; P. E. Cloud; Loc. GBC-2: 1 spec.

Atergatopsis signatus (Adams & White)
a. South end Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef, fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 1 spec.

Carpilius convexus (Forskål)
a. South end Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef, fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 4 spec.

Carpilius maculatus (L.)
a. Onotoa, Gilbert Islands; tidepool in Heliopora flat, 2 feet deep; August 1, 1951; A. H. Banner: 1 juv.
b. South end Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef, fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 5 spec.

Carpilodes bellus (Dana)
a. Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. A-8; taken from dead coral and algal rock, ca. 10 ft. deep: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 4 spec.
c. Lagoon west of Saipan, Marianas Islands; April 27, 1949; P. E. Cloud; Loc. A-7: 1 spec.
d. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 11 spec.

e. Onotoa, Gilbert Islands; tidepool in Heliopora flat, 2 ft. deep; August 1, 1951; A. H. Banner: 1 spec.
f. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 5 spec.
g. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon. Patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 1 spec.
h. Onotoa, Gilbert Islands; about 13,400 ft. S. 75° W. from Aiaki Maneaba in the deep central part of the lagoon. The bottom is of low scattered dead and living coral patches on intervening limemud and limesand about 30-40% seds. and 60-70% coral; August 25, 1951; P. E. Cloud; Loc. GOC-55: 4 spec.

Carpilodes edwardsi (Kossmann)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-651: 1 spec.

Carpilodes monticulosus A. Milne Edwards
a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 1 spec.
b. Onotoa, Gilbert Islands; August 24, 1951; A. H. Banner; Loc. A-XVI: 1 spec.
c. Onotoa, Gilbert Islands; about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawi ni Bao, a pass in the S. part of the leeward reef. Collected from thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within about 8 ft. - 10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 spec.
d. Onotoa, Gilbert Islands; about 9300 ft. N. 30° W. from Tabuarorae Maneaba in S. part of Te Rawa Tekatobibi, a pass through the S. end of the leeward reef. Collected from patch reefs rising to an occasional maximum of within 4 feet of the surface from a bottom sounded at 18 ft.; August 23, 1951; P. E. Cloud; Loc. GOC-53: 2 spec.

Carpilodes rugatus (H. Milne Edwards)
a. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from coralline algae from outer reef margin; September 3, 1952; J. P. E. Morrison; Loc. 2252: 1 ovig. female.

Carpilodes semigranosus (De Man)
a. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 spec.

Carpilodes tristis Dana
a. Lagoon west of Saipan, Marianas Islands; April 27, 1949; P. E. Cloud; Loc. A-7: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-622: 1 spec.
d. Onotoa, Gilbert Islands; in coral ?; August 9, 1951; A. H. Banner; Loc. B-5: 2 spec.

e. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 1 spec.

Chlorodiella barbata (Borradaile)

a. Saipan, Marianas Islands; 1949; P. E. Cloud; Loc. C-IX: 9 spec.
b. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 4 spec.
c. Lagoon west of Saipan, Marianas Islands; April 8, 1949; P. E. Cloud; Loc. B-2; taken from vegetation and sand brought up by diving with faceplate: 67 spec.
d. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 18 spec.
e. Lagoon west of Saipan, Marianas Islands; May 3, 1949; P. E. Cloud; Loc. E-4: 2 spec.
f. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 23 spec.
g. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 4 spec.
h. Onotoa, Gilbert Islands; about 1 mile S. 32° W. from Tekawa church at lagoon margin of S. end of Aon te Baba reef stretch. From patch reefs rising above 9 ft. (reduced to mean low tide) limesand bottom to within 1 ft. of the surface; July 31, 1951; P. E. Cloud; Loc. GOC-29: 2 spec.
i. Onotoa, Gilbert Islands; NW. Onotoa about 1300 ft. NE. from Namokoro, in an area of gravelly sand bottom with maximum depths of 12-14 ins. at low tide and with occasional heads of digitate Porites lobata; August 21, 1951; P. E. Cloud; Loc. GOC-39: 2 spec.
j. Onotoa, Gilbert Islands; about 13,400 ft. S. 75° W. from Aiaki Maneaba in the deep central part of the lagoon. The bottom is of low scattered dead and living coral patches on intervening limemud and limesand about 30-40% seds. and 60-70% coral; August 25, 1951; P. E. Cloud; Loc. GOC-55: 1 spec.
k. Bikati Island, Butaritari Atoll, Gilbert Islands; about ¼ mile E. offshore from the central part of Bikati Island in pocket of broad area of Heliopora reef. NW. Butaritari; September 3, 1951; P. E. Cloud; Loc. GBC-2: 3 spec.

Chlorodiella cytherea (Dana)

a. Saipan, Marianas Islands; from a single large head of Acropora leptocyathus; April 7, 1949; P. E. Cloud: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 7, 1949; P. E. Cloud; Loc. A-11; from coral heads, 4-6 ft. deep: 1 spec.
c. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 2 spec.
d. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 4 spec.

e. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 2 spec.
f. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 17 spec.
g. Bikati Island, Butaritari Atoll, Gilbert Islands; about ½ mile E. offshore from the central part of Bikati Island in pocket of broad area of Heliopora reef, NW. Butaritari; September 3, 1951; P. E. Cloud; Loc. GBC-2: 1 spec.
h. Onotoa, Gilbert Islands; about 1 mile S. 32° W. from Tekawa church at lagoon margin of S. end of reef stretch known as Aon te Baba; from patch reefs rising above 9 ft. (reduced to mean low tide) limesand bottom to within 1 ft. of the surface; July 31, 1951; P. E. Cloud; Loc. GOC-29: 1 spec.

Chlorodiella laevissima (Dana)
a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 7 spec.
b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 17 spec.
c. Onotoa, Gilbert Islands; about 8600 ft. N. 18° W. from Tabuarorae Maneaba in 17 ft. water mean low tide; August 10, 1951; P. E. Cloud; Loc. GOC-35: 1 spec.
d. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area, S. side of big windward point of reef near center of atoll. Collected from ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.
e. Onotoa, Gilbert Islands; about 3½ miles N. 31° W. from Tabuarorae Maneaba near center of Te Rawa ni Bao, a pass in the S. part of the leeward reef. Collected from thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within about 8 ft. - 10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 3 spec.

Chlorodiella nigra (Forskål)
a. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 19 spec.
b. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 13 spec.
c. Onotoa, Gilbert Islands; about 1 mile S. 32° W. from Tekawa church at lagoon margin of S. end of reef stretch known as Aon te Baba. Collected from patch reefs rising above 9 ft. (reduced to mean low tide) limesand bottom to within 1 ft. of the surface; July 31, 1951; P. E. Cloud; Loc. GOC-29: 1 spec.
d. Onotoa, Gilbert Islands; about 13,400 ft. S. 75° W. from Aiaki Maneaba in the deep central part of the lagoon. The bottom is of low scattered dead and living coral patches on intervening limemud and limesand about 30-40% seds. and 60-70% coral; August 25, 1951; P. E. Cloud; Loc. GOC-55: 12 spec.

Chlorodopsis areolata (H. Milne Edwards)
a. Onotoa, Gilbert Islands; tidepool in Heliopora flat, 2 ft. deep; August 1, 1951; A. H. Banner: 1 spec.

b. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-7: 2 spec.
c. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-8-9: 4 spec.
d. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A-10-12: 3 spec.
e. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 1 spec.
f. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 1 spec.
g. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 1 juv.
h. Onotoa, Gilbert Islands; SE. end of reef area known as Rakai Ati. S. side of big windward point of reef near center of the atoll. From a ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 3 spec.
i. Homohomo Island, Raroia Atoll, Tuamotu Islands; from under rocks; near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 1 spec.

<u>Chlorodopsis melanodactylus</u> A. Milne Edwards
a. Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. A-8; taken from dead coral and algal rock at a depth of about 10 ft: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 10 spec.
c. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 4 spec.
d. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 17 spec.
e. Onotoa, Gilbert Islands; July 26, 1951; A. H. Banner; Loc. A-6: 3 spec.
f. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A-10-12: 2 spec.
g. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 5 spec.
h. Onotoa, Gilbert Islands; <u>Heliopora</u> flat, tidepool, 2 ft. deep; August 1, 1951; A. H. Banner: 2 spec.
i. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 1 spec.
j. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area. S. side of big windward point of reef near center of the atoll. From ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.
k. Onotoa, Gilbert Islands; NW. Onotoa, about 1300 ft. NE. from Nanokoro, in an area of gravelly sand bottom with maximum depths of about 12-14 ins. at low tide and with occasional heads of digitate <u>Porites lobata</u>; August 21, 1951; P. E. Cloud; Loc. GOC-39: 1 spec.

<u>Chlorodopsis pilumnoides</u> (White)
a. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a; 1 spec.
b. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 1 spec.

c. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area. S. side of big windward point of reef near center of the atoll; from $\frac{1}{2}$ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 3 spec.

d. Onotoa, Gilbert Islands; about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef; from thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within about 8 ft. - 10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 spec.

e. Onotoa, Gilbert Islands; about 9300 ft. N. 30° W. from Tabuarorae Maneaba in S. part of Te Rawa Tekatobibi, a pass through the S. end of the leeward reef; from patch reefs rising to an occasional maximum of within 4 ft. of the surface from a bottom sounded at 18 ft.; August 23, 1951; P. E. Cloud; Loc. GOC-53: 1 spec.

Chlorodopsis pugil (Dana)

a. Saipan, Marianas Islands; from a single large head of Acropora leptocyathus; April 7, 1949; P. E. Cloud: 2 spec.

b. Saipan, Marianas Islands; P. E. Cloud; Loc. C-IX: 1 spec.

c. Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. A-8, taken from dead coral and algal rock at a depth of about 10 ft.: 3 spec.

d. Lagoon west of Saipan, Marianas Islands; April 27, 1949; P. E. Cloud; Loc. A-7: 7 spec.

e. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 17 spec.

f. Lagoon west of Saipan, Marianas Islands; April 9, 1949; P. E. Cloud; Loc. C-1: 2 spec.

g. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 8 spec.

h. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 1 spec.

i. Lagoon west of Saipan, Marianas Islands; April 19, 1949; P. E. Cloud; Loc. F-X: 2 spec.

j. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 8 spec.

k. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 2 spec.

l. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 3 spec.

m. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon; patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 4 spec.

n. Onotoa, Gilbert Islands; about 1 mile S. 32° W. from Tekawa church at lagoon margin of S. end of Aon te Baba reef stretch; from patch reefs rising above 9 ft. (reduced to mean low tide) limesand bottom to within 1 ft. of the surface; July 31, 1951; P. E. Cloud; GOC-29: 7 spec.

o. Onotoa, Gilbert Islands; NW. Onotoa, about 1300 ft. NE. from Nanokoro, in an area of gravelly sand bottom with maximum depths of about 12-14 ins. at low tide and with occasional heads of digitate Porites lobata; August 21, 1951; P. E. Cloud; Loc. GOC-39: 1 spec.
p. Onotoa, Gilbert Islands; about 13,400 ft. S. 75° W. from Aiaki Maneaba in the deep central part of the lagoon; bottom of low scattered dead and living coral patches on intervening limemud and limesand about 30-40% seds. and 60-70% coral; August 25, 1951; P. E. Cloud; Loc. GOC-55: 10 spec.

Cyclodius ornatus Dana
a. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 1 spec.
b. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 1 spec.
c. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area; S. side of big windward point of reef near center of atoll; from ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.
d. Likiep Atoll, Marshall Islands; from corals growing on submerged sandy sediment on inner edge of reef between Nado and Likiep Islands; December, 1951; F. S. MacNeil; Loc. 830: 1 spec.

Cymo andreossyi (Audouin)
a. Matuis Beach, NW. Saipan, Marianas Islands; taken mostly from clump of brown Acropora and partly from Pocillopora damicornis cespitosa; December 17, 1948; P. E. Cloud: 2 spec.
b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 4 spec.
c. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 1 spec.
d. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from offshore end of Government Station jetty and 1200 ft. directly offshore from lagoon end of Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 3 spec.
e. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon; patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 1 spec.
f. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area, S. side of big windward point of reef near center of atoll; from ½ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.

Cymo deplanatus A. Milne Edwards
a. Oneroa Island, Raroia Atoll, Tuamotu Islands; from outer reef pavement area or zone near shore at night; August 4, 1952; J. P. E. Morrison; Loc. 2040: 2 spec.

Cymo quadrilobatus Miers
- a. Onotoa, Gilbert Islands; ocean shelf, from Pocillopora, 25 ft. deep; August 4, 1951; A. H. Banner; Loc. A-4: 1 spec.
- b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-620: 3 spec.

Dacryopilumnus rathbunae Balss
- a. Hagman Point, Saipan, Marianas Islands; under rock; December 26, 1948; P. E. Cloud: 3 spec.

Daira perlata (Herbst)
- a. Lagoon west of Saipan, Marianas Islands; April 9, 1949; P. E. Cloud; Loc. C-1: 1 spec.
- b. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 2 spec.
- c. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.
- d. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 6 spec.
- e. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 4 spec.
- f. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 7 spec.
- g. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A-16: 1 spec.
- h. Onotoa, Gilbert Islands; August 6, 1951; A. H. Banner; Loc. A-17: 1 spec.
- i. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; the small purplish knobby crabs (= Daira) from holes in the boring sea urchin zone of dissected pavement (algae covered); edge of outer reef, a little behind the Lithothamnion ridge; fishing at night; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 16 spec.
- j. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night; July 22, 1952; J. P. E. Morrison; Loc. 1972-1973: 1 spec.
- k. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-411: 1 spec.

Domecia glabra Alcock
- a. Lagoon west of Saipan, Marianas Islands; April 7, 1949; P. E. Cloud; Loc. A-11, from coral heads in 4-6 ft. of water: 1 spec.
- b. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area, S. side of big windward point of reef near center of atoll; from $\frac{1}{2}$ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.

Domecia hispida Eydoux & Souleyet
- a. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A-4: 3 spec.
- b. Onotoa, Gilbert Islands; August 6, 1951; A. H. Banner; Loc. A-14: 1 spec. (from Pocillopora).
- c. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area, S. side of big windward point of reef near center of atoll; from $\frac{1}{2}$ mile strip across the reef; August 20, 1951; P. E. Cloud; Loc GOC-36: 3 spec.

d. Onotoa, Gilbert Islands, about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef; from thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within about 8 ft. - 10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 3 spec.

Eriphia scabricula Dana
- a. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 2 spec.
- b. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec. (qu.)
- c. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-7: 1 spec.
- d. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-8-9: 3 spec.
- e. Onotoa, Gilbert Islands; July 20, 1951; A. H. Banner; Loc. A-11: 1 spec.
- f. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A-10-12: 1 spec.
- g. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 4 spec.
- h. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 4 spec.
- i. North end of Ngarumaoa Island, Raroia Atoll Tuamotu Islands; inner reef flats near shore, mostly around larger rocks, active at night; September 2, 1952; J. P. E. Morrison; Loc. 2245: 1 spec.

Eriphia sebana (Shaw & Nodder)
- a. Onotoa, Gilbert Islands; July-August, 1951; A. H. Banner: 1 spec.
- b. Onotoa, Gilbert Islands; August 9, 1951; A. H. Banner; Loc. B-3: 7 spec.
- c. Likiep Atoll, Marshall Islands; from reef between Nado Island and Likiep Island; at night by flashlight, low tide; December 14, 1951; F. S. MacNeil; Loc. 815: 3 spec.
- d. Oneroa Island, Raroia Atoll, Tuamotu Islands; from under rock just below low tide line at night on inner reef flats, S. end of island; August 7, 1952; J. P. E. Morrison; Loc. 2077: 1 spec.
- e. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef, fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; S. end of Island; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 1 spec.
- f. North of Kahongi Island, Raroia Atoll, Tuamotu Islands; from outer end of channel and from outer beach pavement flats of outer reef in same area; red eyed crab; July 25, 1952; J. P. E. Morrison; Loc. 1994: 1 spec.
- g. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; red eyed rock crab from pavement pool zone of outer reef, eating a Conus sponsalis (crushing it in crushing claw when caught) at just about dusk, at low tide, out of water and active on reef flat at low tide at night apparently; August 31, 1952; J. P. E. Morrison; Loc. 2232: 1 spec.

h. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-4: 1 spec.
i. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-6: 1 spec.
j. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-666: 1 spec.
k. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-185: 1 spec.
l. Southwest corner of Opakea Island, Raroia Atoll, Tuamotu Islands; red eyed rock crab from shore of channel at outer reef flat; August 27, 1952; J. P. E. Morrison; Loc. 2197: 1 spec.

Etisus (Etisodes) electra (Herbst)
a. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 1 spec.
b. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 2 spec.
c. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon; patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 2 spec.

Etisus (Etisodes) molokaiensis (Rathbun)
a. Saipan, Marianas Islands; 1949; P. E. Cloud; Loc. D-9: 1 spec.

Etisus (Etisodes) dentatus (Herbst)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-7: 1 spec.
b. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 1 spec.

Etisus (Etisodes) splendidus Rathbun
a. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night; July 22, 1952; J. P. E. Morrison; Loc. 1972, 1973: 1 spec.
b. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1981: 1 spec.
c. South end of Opeaka Island, Raroia Atoll, Tuamotu Islands; red crab from inner reef off the S. end; August 17, 1952; J. P. E. Morrison; Loc. 2135: 1 spec.

Etisus (Etisodes) spec.
a. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 1 spec.

Etisus (Etisus) laevimanus Randall
a. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 1 spec.

Globopilumnus globosus (Dana)
a. Nado Island, Likiep Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 827: 1 spec.

b. West of Ailuk Island, Ailuk Atoll, Marshall Islands; leeward reef seaward side; 1951-1952; F. S. MacNeil; Loc. 847: 1 spec.
c. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from holes in reef near Lithothamnion ridge; July 9, 1952; J. P. E. Morrison; Loc. 1904: 4 spec.
d. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef flats; July 11, 1952; J. P. E. Morrison; Loc. 1920: 1 spec.

Heteropilumnus integer (Miers)
a. Lagoon west of Saipan, Marianas Islands; May 4, 1949; P. E. Cloud; E-8, from coral rock: 2 spec.

Juxtaxanthias tetraodon (Heller)
a. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 4 spec.
b. Oneroa Island, Raroia Atoll, Tuamotu Islands; from outer reef, zone just behind the Lithothamnion ridge or in it, at night; August 4, 1952; J. P. E. Morrison; Loc. 2042: 1 spec.

Lachnopodus tahitensis (De Man)
a. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 2 spec.

Liocarpilodes armiger pacificus Balss
a. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 13 spec.
b. Lagoon west of Saipan, Marianas Islands; April 27, 1949; P. E. Cloud; Loc. A-7: 2 spec.
c. Lagoon west of Saipan, Marianas Islands; April 9, 1949; P. E. Cloud; Loc. C-1: 1 spec.
d. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 4 spec.
e. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.
f. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 3 spec.
g. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 5 spec.

Liocarpilodes integerrimus (Dana)
a. Lagoon west of Saipan, Marianas Islands; April 27, 1949; P. E. Cloud; Loc. A-7: 2 spec.
b. Lagoon west of Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. A-8, taken from dead coral at a depth of about 10 ft.: 2 spec.
c. Lagoon west of Saipan, Marianas Islands; April 9, 1949; P. E. Cloud; Loc. C-1: 6 spec.
d. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 1 spec.

e. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 3 spec.
f. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 6 spec.
g. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 1 spec.
h. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 13 spec.
i. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 12 spec.
j. Saipan, Marianas Islands; 1949; P. E. Cloud; Loc. C-IX: 1 spec.
k. Ine Anchorage, Arno Atoll, Marshall Islands; from coral rock of reef flat; July-August 1950; J. H. Wells; Loc. 6: 1 spec.
l. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon; patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 1 spec.

Lophozozymus pulchellus A. Milne Edwards
a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. C-7a: 1 spec.

Lophozozymus superbus (Dana)
a. Homohomo Island, Raroia Atoll, Tuamotu Islands; from under rocks, etc., near the shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 1 spec.

Lybia tesselata (Latreille)
a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.
b. Onotoa, Gilbert Islands; from Pocillopora; August 6, 1951; A. H. Banner; Loc. A-14: 1 spec.
c. Homohomo Island, Raroia Atoll, Tuamotu Islands; under rocks, etc., near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 2 spec.

Lydia annulipes (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-508: 1 spec.
b. South Loi Island, Kwajalein Atoll; Marshall Islands; windward reef flat; 1951-1952; F. S. MacNeil; Loc. 894: 1 spec.
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; edge of water at low tide; outer reef flats opposite the village; August 23, 1952; J. P. E. Morrison; Loc. 2176: 3 spec.
d. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; at night at low tide on gravelly lagoon shore near beach rocks; August 2, 1952; J. P. E. Morrison; Loc. 2035: 1 spec.
e. Puka Puka Island, Raroia Atoll, Tuamotu Islands; landward edge of outer reef flats on and under rocks; August 28, 1952; J. P. E. Morrison; Loc. 2209: 1 spec.

Medaeus elegans A. Milne Edwards
a. Onotoa, Gilbert Islands; toward S. end of Rakai Ati lee reef stretch, in an area of small coral patches fairly thickly interspersed on limesand and coral debris, the bottom is at depths of 3-4 ft. at low tide; July 26, 1951; P. E. Cloud: Loc. GOC-24: 1 spec.

Medaeus ? ornatus Dana

a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-7: 2 spec.

Paraxanthias notatus (Dana)

a. Unai, Finauchuluga, Saipan, Marianas Islands; January 30, 1949; P. E. Cloud: 1 spec.
b. Lagoon N. of Matuis Beach, NW. Saipan, Marianas Islands; from head of brown Acropora; December 12, 1948; P. E. Cloud: 1 spec.
c. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 6 spec.
d. Onotoa, Gilbert Islands; from Pocillopora; August 6, 1951; A. H. Banner; Loc. A-14: 2 spec.
e. Onotoa, Gilbert Islands; back ridge trough, about 600 ft. offshore from Pacific Science Board camp at the outer margin of the windward reef, just inshore from the algal ridge and surge channels; this part of the reef never dries even at low tide and generally has at least a foot or two of water above it; August 1, 1951; P. E. Cloud; Loc. GOC-32: 2 spec.
f. Nado Island, Likiep Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 827: 8 spec.
g. South Loi Island, Kwajalein Atoll, Marshall Islands; windward reef flat; 1951-1952; F. S. MacNeil; Loc. 894: 2 spec.

Paraxanthias parvus (Borradaile)

a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 22 spec.
b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 4 spec.

Paraxanthias ponapensis (Rathbun)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-20: 2 spec.

Phymodius laysani Rathbun

a. Onotoa, Gilbert Islands; about 9300 ft. N. 30° W. from Tabuarorae Maneaba in S. part of Te Rawa Tekatobibi, a pass through the south end of the leeward reef; from patch reefs rising to an occasional maximum of within 4 ft. of the surface from a bottom sounded at 18 ft.; August 23, 1951; P. E. Cloud; Loc. GOC-53: 1 spec.
b. Nado Island, Likiep Atoll, Marshall Islands; 1951-1952: F. S. MacNeil; Loc. 827: 1 spec.
c. West of Ailuk Island, Ailuk Atoll, Marshall Islands; seaward side of leeward reef; 1951-1952; F. S. MacNeil; Loc. 847: 1 spec.

Phymodius nitidus (Dana)

a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 3 spec.

Phymodius obscurus (Lucas)

a. Onotoa, Gilbert Islands; July-August, 1951; A. H. Banner; Loc. B-5: 2 spec.

Phymodius ungulatus (H. Milne Edwards)

a. Saipan, Marianas Islands; from single large head of Acropora leptocyathus; April 7, 1949; P. E. Cloud: 1 spec.
b. Matuis Beach, NW. Saipan, Marianas Islands; taken mostly from clump of brown Acropora and partly from Pocillopora damicornis cespitosa; December 17, 1948; P. E. Cloud: 1 spec.
c. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 3 spec.
d. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 4 spec.
e. Bikati Island, Butaritari Atoll, Gilbert Islands; about ½ mile E. offshore from the central part of Bikati Island in pocket of broad area of Heliopora reef, NW. Butaritari; September 3, 1951; P. E. Cloud; Loc. GBC-2: 1 spec.
f. Otikaheru Island, Raroia Atoll, Tuamotu Islands; brackish enclosed lagoon on lagoon side of island; July 29, 1952; J. P. E. Morrison; Loc. 2015: 2 juv.

Pilodius paumotensis Rathbun

a. Nado Island, Likiep Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 827: 9 spec.

Pilumnus cursor A. Milne Edwards

a. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 1 spec.
c. Lagoon west of Saipan, Marianas Islands; May 4, 1949; P. E. Cloud; Loc. E-8, from coral rock: 1 spec.
d. Lagoon west of Saipan, Marianas Islands; April 28, 1949; P. E. Cloud; Loc. 2, from ½ ton block of dead coral-algal rock taken on anchor of LT. 535: 1 spec.

Pilumnus forskali coerulescens A. Milne Edwards

a. Onotoa, Gilbert Islands; July 26, 1951; A. H. Banner; Loc. A-6: 1 spec.
b. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-8-9: 1 spec.
c. Onotoa, Gilbert Islands; tidepool in Heliopora flat, 2 ft. deep; August 1, 1951; A. H. Banner: 2 spec.

Pilumnus tahitensis De Man

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-515: 1 spec.

Platypodia granulosa (Rüppell)

a. Onotoa, Gilbert Islands; August 8, 1952; A. H. Banner; Loc. B-4: 3 spec.
b. Onotoa, Gilbert Islands; S. portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board campstrip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 1 spec.

Platypodia semigranosa (Heller)
a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 spec.

Pseudozius caystrus (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-668: 1 spec.
b. South Loi Island, Kwajalein Atoll, Marshall Islands; windward reef flat; 1951-1952; F. S. MacNeil; Loc. 894: 1 skin.
c. Takoke Island, Raroia Atoll, Tuamotu Islands; under stones about high tide line or a little below; July 22, 1952; J. P. E. Morrison; Loc. 1968: 1 spec.

Xanthias lamarcki (H. Milne Edwards)
a. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 7, 1949; P. E. Cloud; Loc. A-11, from coral heads, 4-6 ft. water: 1 spec.
c. Lagoon west of Saipan, Marianas Islands; April 19, 1949; P. E. Cloud; Loc. F-X: 2 spec.
d. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 3 spec.
e. Onotoa, Gilbert Islands; July 12, 1951; A. H. Banner; Loc. A-1: 1 spec.
f. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 4 spec.
g. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec. (qu.)
h. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-8-9: 2 spec.
i. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A-10-12: 3 spec.
j. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 7 spec.
k. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 1 spec.
l. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg: 1 spec.
m. Homohemo Island, Raroia Atoll, Tuamotu Islands; from under rocks, etc., near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 1 spec.
n. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 1 spec.
o. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a: 1 spec.

Xanthias punctatus (H. Milne Edwards)
a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-6: 1 spec.

Xantho exaratus (H. Milne Edwards)

a. Onotoa, Gilbert Islands; July 12, 1951; A. H. Banner; Loc. A-1: 6 spec.
b. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-2: 1 spec.
c. South end of Oneroa Island, Raroia Atoll, Tuamotu Islands; white rock crab from inner reef flats just below low tide line; August 7, 1952; J. P. E. Morrison; Loc. 2078: 1 spec.

Xantho gracilis (Dana)

a. Opakea Island, Raroia Atoll, Tuamotu Islands; speckled crab under rocks below low tide, SE. point of island; August 26, 1952; J. P. E. Morrison; Loc. 2196: 1 spec.

Xantho sanguineus (H. Milne Edwards)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-46: 4 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-48: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-667: 3 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-7: 1 spec.
e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-192: 1 spec.
f. Onotoa, Gilbert Islands; July 12, 1951; A. H. Banner; Loc. A-1: 6 spec.
g. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-2: 16 spec.
h. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 6 spec. (qu.)
i. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 16 spec.
j. Onotoa, Gilbert Islands; July 26, 1951; A. H. Banner; Loc. A-6: 1 spec.
k. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-7: 1 spec.
l. Onotoa, Gilbert Islands; August 7, 1951; A. H. Banner; Loc. B-3: 2 spec.
m. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 35 spec.
n. Lae Island, Lae Atoll, Marshall Islands; windward side under rocks; 1951-1952; F. S. MacNeil; Loc. 877: 2 spec.

Zosimus aeneus (L.)

a. Ailuk Atoll, Marshall Islands; native collectors; 1951-1952; F. S. MacNeil; Loc. 855: 1 spec.
b. Leeward side of Ailuk Island, Ailuk Atoll, Marshall Islands; near west end of island; 1951-1952; F. S. MacNeil; Loc. 841: 2 spec.
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; spotted rock crabs brought in from the outer reef; July 18, 1952; J. P. E. Morrison; Loc. 1950: 2 spec.

d. Honohono Island, Raroia Atoll, Tuamotu Islands; spotted crab from pool in boring sea urchin zone of outer reef flats; July 21, 1952; J. P. E. Morrison; Loc. 1963: 1 spec.
e. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef fishing at night; July 22, 1952; J. P. E. Morrison; Loc. 1972, 1973: 3 spec.
f. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 14 spec.
g. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-503: 1 spec.
h. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-512: 1 spec.

Family Goneplacidae
Subfamily Pseudorhombilinae

Litocheira aranea Tesch
a. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 1 spec.

Family Pinnotheridae

Xanthasia murigera White
a. Ujae lagoon, Ujae Atoll, Marshall Islands; from inside of the shell of a large live Tridacna; 1951, 1952; F. S. MacNeil; Loc. 923: 2 females, 1 male.

Family Ocypodidae

Macrophthalmus bosci (Audouin)
a. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 3 spec.
b. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 9 spec.

Ocypode ceratophthalma (Pallas)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-680: 1 spec.
b. Onotoa, Gilbert Islands; July 26, 1951; A. H. Banner; Loc. B 1-6: 2 spec.
c. Onotoa, Gilbert Islands; sand beach, ocean side; August 1951; A. H. Banner: 4 spec.
d. Ailuk Island, Ailuk Atoll, Marshall Islands; from inner rubble flat on seaward reef, at night; December 24, 1951; F. S. MacNeil; Loc. 835: 1 spec.
e. Taka Atoll, Marshall Islands; gray land crab; December 5-9, 1951; F. R. Fosberg; Loc. 58: 1 spec.
f. Englanij Island, Ujae Atoll, Marshall Islands; running on sandflat above high tide level; March 9, 1952; F. R. Fosberg; Loc. 20: 1 spec.

g. Bikar Island, Bikar Atoll, Marshall Islands; above high tide level on sand at night; August 6, 1952; F. R. Fosberg; Loc. 1078: 2 spec.
h. Bikar Island, Bikar Atoll, Marshall Islands; on sand above high tide level; August 8, 1952; F. R. Fosberg; Loc. 1083, 1084: 2 spec.
i. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; ghost crab dug out of sand beach (intertidal) in daytime, lagoon shore; August 7, 1952; J. P. E. Morrison; Loc. 2080: 2 spec.

Ocypode cordimana Desmarest
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-149: 1 spec.
b. Onotoa, Gilbert Islands; sand beach, ocean side; August 1951; A. H. Banner: 1 spec.
c. Utirik Island, Utirik Atoll, Marshall Islands; burrowing white land crab, dug out of burrows in the sand flat, west part of island; December 1, 1951; F. R. Fosberg; Loc. 49: 3 spec.
d. Jemo Island, Marshall Islands; land crab found generally over the island; December 18-22, 1951; F. R. Fosberg; Loc. 71: 2 spec.
e. Ulika Island, Ailuk Atoll, Marshall Islands; gray land crab attracted to coconut meat in coconut plantation; December 29, 1951; F. R. Fosberg; Loc. 79: 1 spec.
f. Almeni Island, Bikar Atoll, Marshall Islands; on sand; August 9, 1952; F. R. Fosberg; Loc. 1082: 1 spec.

Ocypode spec. (juv.)
a. Bikar Island, Bikar Atoll, Marshall Islands; above high tide level on sand at night; August 6, 1952; F. R. Fosberg; Loc. 1076: 1 juv.
b. Ailuk Atoll, Marshall Islands; islet N. of Baojen; on top of beach; December 30-31, 1951; F. R. Fosberg; Loc. 503: 1 juv.

Uca gaimardi (H. Milne Edwards)
a. West of Port Phaeton, on S. side of Taravao Isthmus, Tahiti, Society Islands; grassy and fern covered edge of swamp, black mud, water brackish or incomplete salt; June 21, 1952; J. P. E. Morrison; Loc. 1816: 1 spec.

Uca tetragonon (Herbst)
a. Onotoa, Gilbert Islands; August 10, 1951; A. H. Banner; Loc. B-6: 9 spec.
b. South end of Oneroa Island, Raroia Atoll, Tuamotu Islands; fiddler crabs from holes in white sand covered (filmed) pavement rock (intertidal), rock flats on lagoon side; August 7, 1952; J. P. E. Morrison; Loc. 2081: 31 spec.

Family Grapsidae
Subfamily Grapsinae

Geograpsus crinipes Dana
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-3: 1 spec.
b. Bock Island, Ujae Atoll, Marshall Islands; gray crab in hole in Pisonia trunk; February 23, 1952; F. R. Fosberg; Loc. 7: 1 spec.

c. Alle Island, Ujae Atoll, Marshall Islands; large gray crab under loose bark of rotten coconut log; March 10, 1952; F. R. Fosberg; Loc. 11: 1 spec.
d. Bock Island, Ujae Atoll, Marshall Islands; gray crab in coconut trash; February 17-20, 1952; F. R. Fosberg; Loc. 21: 1 spec.
e. Utirik Island, Utirik Atoll, Marshall Islands; land crab; December 1, 1951; F. R. Fosberg; Loc. 50: 1 spec.
f. Jemo Island, Marshall Islands; gray land crab in burrows under guano layer in Pisonia grove; December 18-22, 1951; F. R. Fosberg; Loc. 72: 2 spec.
g. Islet N. of Baojen, Ailuk Atoll, Marshall Islands; flat gray crab, well above high tide mark; December 31, 1951; F. R. Fosberg; Loc. 78: 1 spec.
h. Lae Atoll, Marshall Islands; gray crab; January 6-10, 1952; F. R. Fosberg; Loc. 88: 1 spec.
i. Bikar Island, Bikar Atoll, Marshall Islands; above high tide level on sand at night; August 6, 1952; F. R. Fosberg; Loc. 1079: 1 spec.
j. Bikar Island, Bikar Atoll, Marshall Islands; in small Messerschmidia tree; August 6, 1952; F. R. Fosberg; Loc. 1080: 1 spec.
k. Takoke Island, Raroia Atoll, Tuamotu Islands; July 22, 1952; J. P. E. Morrison; Loc. 1968: 1 juv.
l. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; brown rock crab of lagoon shore, in contrast to red painted one of hard outer reef rocks; August 8, 1952; J. P. E. Morrison; Loc. 2095: 2 spec.

Geograpsus grayi (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-416: 1 juv.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-507: 2 spec.
c. Alle Island, Ujae Atoll, Marshall Islands; land crab; March 10, 1952; F. R. Fosberg; Loc. 19: 2 spec.
d. Bock Island, Ujae Atoll, Marshall Islands; small gray crabs; February 17-20, 1952; F. R. Fosberg; Loc. 22: 2 spec.
e. Wotho Island, Wotho Atoll, Marshall Islands; purple land crab in coconut trash, judging by number of holes must be common all over island; February 14-15, 1952; F. R. Fosberg; Loc. 29: 1 spec.
f. Lojiren Island, Taka Atoll, Marshall Islands; dark purple land crab under boulder in Pisonia grove; December 7, 1951; F. R. Fosberg; Loc. 54: 1 spec.
g. Watwerok Island, Taka Atoll, Marshall Islands; land crab, gray brown, legs banded with lighter gray, under rotting coconut log; December 9, 1951; F. R. Fosberg; Loc 56: 1 juv.
h. Lae Atoll, Marshall Islands; land crabs in openings under stones; January 6-10, 1952; F. R. Fosberg; Loc. 87: 4 spec.
i. Wake Island, Wake Atoll; under sticks and stones in wooded area; April 20, 1952; F. R. Fosberg; Loc. 91: 4 spec.
j. Takoke Island, Raroia Atoll, Tuamotu Islands; true land crab from under rock on floor of open forest; July 11, 1952; J. P. E. Morrison; Loc. 1912: 1 spec.
k. Mataira Island, Raroia Atoll, Tuamotu Islands; small land crab at night; July 16, 1952; J. P. E. Morrison; Loc. 1945: 1 spec.

Geograpsus lividus storni De Man
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-399: 1 spec.

Grapsus longitarsis Dana
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-400: 1 spec.
b. Onotoa, Gilbert Islands; July-August 1951; A. H. Banner: 4 spec.
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; smaller species of shore rock crab, edge of water at low tide, outer reef flats opposite the village; August 23, 1952; J. P. E. Morrison; Loc. 2176: 10 spec.
d. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; inner reef flats near shore mostly around larger rocks, active at night; September 2, 1952; J. P. E. Morrison; Loc. 2245: 2 spec. (1 ovig.).

Grapsus tenuicrustatus (Herbst)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-704: 1 spec.
b. Onotoa, Gilbert Islands; seaward reef; July-August, 1951; A. H. Banner: 3 spec.
c. Onotoa, Gilbert Islands; windward reef; August 30, 1951; P. E. Cloud: 3 spec.
d. Bock Island, Ujae Atoll, Marshall Islands; in hole in Messerschmidia trunk; February 20, 1952; F. R. Fosberg; Loc. 6: 1 spec.
e. Jemo Island, Marshall Islands; on rocks above high tide level; December 18-22, 1951; F. R. Fosberg; Loc. 65: 1 spec.
f. Passage between Kamome and Brije, Pokak Atoll, Marshall Islands; above high tide on rocks; July 23, 1952; F. R. Fosberg; Loc. 1067: 1 spec.
g. South Island, Pokak Atoll, Marshall Islands; abundant on rocks just above water, seeming to avoid going into water except when pursued; often seen above high tide level; July 26, 1952; F. R. Fosberg; Loc. 1068: 1 spec.
h. Passage between Almeni and Jaliklik, Bikar Atoll, Marshall Islands; on beach rock just above high tide; August 9, 1952; F. R. Fosberg; Loc. 1081: 1 spec.
i. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; young red shore rock crab, edge of water at low tide; outer reef flats opposite the village; August 23, 1952; J. P. E. Morrison; Loc. 2176: 3 spec.

Metopograpsus thukuhar (Owen)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-400: 5 spec.

Pachygrapsus minutus A. Milne Edwards
a. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec.

Pachygrapsus planifrons De Man
a. Onotoa, Gilbert Islands; July 12, 1951; A. H. Banner; Loc. A-1: 1 spec.

b. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 5 spec. (qu.)
c. Onotoa, Gilbert Islands; July 26, 1951; A. H. Banner; Loc. A-6: 1 spec.
d. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-7: 1 spec.
e. Onotoa, Gilbert Islands; November 16, 1951; D. E. Strasburg; Loc. A-I-II: 34 spec.
f. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; rocks and gravel just below low tide line on gravel flats along inner reef near lagoon shore; August 6, 1952; J. P. E. Morrison; Loc. 2073: 1 spec.

Pachygrapsus plicatus (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-665: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-666: 6 spec.
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef flats; July 11, 1952; J. P. E. Morrison; Loc. 1920: 3 spec.
d. Onerao Island, Raroia Atoll, Tuamotu Islands; small rock crabs from low tide line or just above (wet area) on large reef block about 40 yds. out on reef pavement area from shore, collected at night; August 5, 1952; J. P. E. Morrison; Loc. 2055: 9 spec.

Pachygrapsus spec.
a. Homohomo Island, Raroia Atoll, Tuamotu Islands; under rocks, etc., near shore; July 21, 1952; J. P. E. Morrison; Loc. 1962: 1 spec.

Subfamily Varuninae

Pseudograpsus albus Stimpson
a. Takoke Island, Raroia Atoll, Tuamotu Islands; under stones about high tide line, or little below; July 22, 1952; J. P. E. Morrison; Loc. 1968: 7 spec.

Subfamily Sesarminae

Cyclograpsus longipes Stimpson
a. Takoke Island, Raroia Atoll, Tuamotu Islands; under stones about high tide line, or little below; July 22, 1952; J. P. E. Morrison; Loc. 1968: 4 spec.
b. Ohava Island, Raroia Atoll, Tuamotu Islands; under rocks, etc., on lagoon side of channel or incomplete channel; July 27, 1952; J. P. E. Morrison; Loc. 1997: 3 spec.

Cyclograpsus parvulus De Man
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt: 5 spec.
b. Ohava Island, Raroia Atoll, Tuamotu Islands; under rocks, etc., on lagoon side of channel or incomplete channel; July 27, 1952; J. P. E. Morrison; Loc. 1997: 5 spec.

Metasesarma aubryi A. Milne Edwards

a. Arno Atoll; 1950; R. W. Hiatt; Loc. E 1-65a: 2 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-418: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-424: 2 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt: 2 spec.
e. Bock Island, Ujae Atoll, Marshall Islands; from 4-6 ins. beneath rubble surface in interstices between coconut trash, near lagoon; February 20, 1952; F. R. Fosberg; Loc. 950: 1 spec.

Metasesarma rousseauxi H. Milne Edwards

a. Matuis Beach, NW. Saipan, Marianas Islands; December 19, 1948; P. E. Cloud: 2 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-418: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-662: 3 spec.
d. Lato Island, Likiep Atoll, Marshall Islands; small gray land crabs in beach drift well above high tide mark; December 12-15, 1951; F. R. Fosberg; Loc. 63: 2 spec.
e. Lojjaiong Island, Kwajalein Atoll, Marshall Islands; in interstices in cut bank of small pebbles above high tide level; January 15, 1952; F. R. Fosberg; Loc. 664: 18 spec.
f. Lojjairok Island, Kwajalein Atoll, Marshall Islands; from decayed spot in trunk of Messerschmidia argentea tree about 2 m from ground; January 15, 1952; F. R. Fosberg; Loc. 682: 1 spec.
g. Tepaturea, E. side (windward shore) of Taravao Isthmus, Tahiti, Society Islands; under cobbles; June 21, 1952; J. P. E. Morrison; Loc. 1815: 4 spec.

Sesarma rotundatum Hess

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-413: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-18: 2 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-172: 1 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt: 3 spec.
e. Ujae Island, Ujae Atoll, Marshall Islands; orange-gray crab from hole in live coconut trunk; March 13, 1952; F. R. Fosberg; Loc. 16: 1 spec.

Subfamily Plagusinae

Percnon abbreviatum (Dana)

a. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night, mostly from near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 1 spec.

Percnon planissimum (Herbst)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-10: 1 spec.

b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-42: 6 spec.
c. Onotoa, Gilbert Islands; July 20, 1951; A. H. Banner; Loc. A-11: 4 spec.
d. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-8-9: 1 spec.

Plagusia speciosa Dana
a. West of Ailuk Island, Ailuk Atoll, Marshall Islands; seaward side of leeward reef; 1951-1952; F. S. MacNeil; Loc. 847: 1 spec.
b. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from outer reef fishing at night, mostly near edge of outer reef, a little behind the Lithothamnion ridge; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 5 spec.
c. Tenuku Haupapatea Island, Raroia Atoll, Tuamotu Islands; from algae zone just behind outer reef edge (boring urchin zone), outer reef flats; September 5, 1952; J. P. E. Morrison; Loc. 2269: 1 spec.

Family Gecarcinidae

Cardisoma carnifex (Herbst)
a. Onotoa, Gilbert Islands; land crab; July-August, 1951; A. H. Banner: 1 spec.
b. Tehakapikipiki Island, Raroia Atoll, Tuamotu Islands; Pemphis land crabs (Papaka Tupa) from land at night; July 28, 1952; J. P. E. Morrison; Loc. 2010: 6 spec.
c. North end Oneroa Island, Raroia Atoll, Tuamotu Islands; small true land crab collected at night; August 7, 1952; J. P. E. Morrison; Loc. 2080: 1 spec.
d. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; Pemphis crabs (Papaka Tupa) from camp area near lagoon; August 8, 1952; J. P. E. Morrison: Loc. 2094: 2 spec.
e. Oteteu Island Raroia Atoll, Tuamotu Islands; Pemphis land crabs (Papaka Tupa), burrows all over lower ground under Pemphis; August 21, 1952; J. P. E. Morrison; Loc. 2152: 2 spec.

Cardisoma rotundum (Quoy & Gaimard)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-123: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-514: 1 spec.
c. Bock Island, Ujae Atoll, Marshall Islands; purple land crab from coconut trash in holes in rubble in mixed forest and edge of plantation; February 17-20, 1952; F. R. Fosberg; Loc. 23: 2 spec.

Epigrapsus politus Heller
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-665: 5 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-187: 2 spec.

c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-401: 3 spec.
d. Tepaturea, E. side (windward shore) of Taravao Isthmus, Tahiti, Society Islands; under cobbles; June 21, 1952; J. P. E. Morrison; Loc. 1815: 3 spec.

Gecarcoidea lalandei H. Milne Edwards
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-423: 1 spec.
b. Bock Island, Ujae Atoll, Marshall Islands; purple land crab in coconut trash in holes in rubble in mixed forest and edge of plantation; February 17-20, 1952; F. R. Fosberg; Loc. 23: 1 spec.

Family Hapalocarcinidae

Hapalocarcinus marsupialis Stimpson
a. Onotoa, Gilbert Islands; South portion of northern main island, about 800 ft. SW. from the offshore end of Government Station jetty and 1200 ft. directly offshore from the lagoon end of the Pacific Science Board camp strip; July 25, 1951; P. E. Cloud; Loc. GOC-22: 1 ovig. female in coral.

II. Anomura

HIPPIDEA

Family Albuneidae

Albunea elioti Benedict
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-504: 1 spec.

Family Hippidae

Hippa adactyla Fabricius
a. At mouth of Ahonu river, about 14 km. E. of Papeete, Tahiti, Society Islands; mole crabs from black volcanic sand, intertidal; September 15, 1952; J. P. E. Morrison; Loc. 2294: 1 spec.

Hippa ovalis (A. Milne Edwards)
a. At mouth of Ahonu river, about 14 km. E. of Papeete, Tahiti, Society Islands; mole crabs from black volcanic sand, intertidal; September 15, 1952; J. P. E. Morrison; Loc. 2294: 2 spec.

Hippa pacifica (Dana)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-155: 5 spec.
b. Ine lagoon, Arno Atoll, Marshall Islands; in sand on beach at high tide; June-August 1950; J. H. Wells; Loc. 32: 4 spec.

Family Coenobitidae

Birgus latro (L.)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-419: 1 spec.
b. Onotoa, Gilbert Islands; July-August 1951; A. H. Banner: 1 spec.
c. Rua Island, Ujae Atoll, Marshall Islands; in burrow under 2 inches of peat in Pisonia forest; February 23, 1952; F. R. Fosberg; Loc. 1: 1 spec.
d. Wotho Island, Wotho Atoll, Marshall Islands; in coconut trash; February 15, 1952; F. R. Fosberg; Loc. 26: 1 spec.
e. Enellap Island, Ujelang Atoll, Marshall Islands; burrowing in boulder debris; natives call it "baru" and insist that it climbs coconut trees, they say that it is common on Enellap and Kalo Islands; February 4, 1952; F. R. Fosberg; Loc. 36: 1 spec.
f. Mejurwon Island, Wotho Atoll, Marshall Islands; abundant; March 22, 1952; F. R. Fosberg; Loc. 1448: 1 spec.
g. Kahongi Island, Raroia Atoll, Tuamotu Islands; coconut crab from Pandanus fruit at night (rare at Raroia because always eaten by natives); August 12, 1952; J. P. E. Morrison; Loc. 2113: 1 spec.

Coenobita brevimanus Dana

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-417: 4 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-419: 3 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-426: 3 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-428: 2 spec.
e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-438: 3 spec.
f. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-589: 4 spec.
g. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-658: 1 spec.
h. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-660: 1 spec.
i. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-4: 1 spec.
j. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-150: 2 spec.
k. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-403: 1 spec.
l. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-513: 2 spec.
m. Bock Island, Ujae Atoll, Marshall Islands; from coconut trash; February 20, 1952; F. R. Fosberg; Loc. 10: 8 spec.
n. Alle Island, Ujae Atoll, Marshall Islands; around freshly cut coconuts and in and around rotten coconut log in daytime; March 10, 1952; F. R. Fosberg; Loc. 12-15: 1 juv.

o. Kalo Island, Ujelang Atoll, Marshall Islands; on ground; February 4, 1952; F. R. Fosberg; Loc. 41: 1 spec.
p. Mataira Island, Raroia Atoll, Tuamotu Islands; purple clawed land hermit crabs feeding at night on opened green coconuts (juice); July 16, 1952; J. P. E. Morrison; Loc. 1940-1945: 10 spec.
q. Oneroa Island, Raroia Atoll, Tuamotu Islands; purple land hermit crabs (uncommon); August 7, 1952; J. P. E. Morrison; Loc. 2079: 2 spec.

Coenobita carnescens Dana
a. Ujelang Island, Ujelang Atoll, Marshall Islands; on ground; February 6-7, 1952; F. R. Fosberg; Loc. 43: 1 spec. (juv.).

Coenobita perlatus H. Milne Edwards
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-171: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-427: 3 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-592: 1 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-4: 3 spec.
e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-17: 1 spec.
f. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-150: 1 spec.
g. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-398: 1 spec.
h. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-403: 2 spec.
i. Onotoa, Gilbert Islands; August 1951; A. H. Banner: 1 spec.
j. Onotoa, Gilbert Islands; Pacific Science Board camp area; July 30, 1951; P. E. Cloud: 96 spec.
k. Lae Island, Lae Atoll, Marshall Islands; lagoon side, beach; 1951-1952; F. S. MacNeil; Loc. 866: 12 spec. (juv.).
l. Torrutj Island, Kwajalein Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 900: 66 spec.
m. Wotho Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 913: 12 spec.
n. Rua Island, Ujae Atoll, Marshall Islands; large red hermit crabs under rotting logs; February 23, 1952; F. R. Fosberg; Loc. 2: 3 spec.
o. Rua Island, Ujae Atoll, Marshall Islands; under rotting coconut logs; February 23, 1952; F. R. Fosberg; Loc. 3: 13 juv.
p. Bock Island, Ujae Atoll, Marshall Islands; from coconut trash; February 20, 1952; F. R. Fosberg; Loc. 9: 1 spec.
q. Alle Island, Ujae Atoll, Marshall Islands; around freshly cut coconuts and in and around rotten coconut log in daytime; March 10, 1952; F. R. Fosberg; Loc. 12-15: 174 juvs.
r. Alle Island, Ujae Atoll, Marshall Islands; in and around coconut log in daytime; colors vary from scarlet to brick red to brownish-red; March 10, 1952; F. R. Fosberg; Loc. 17: 6 spec.
s. Kabben Island, Wotho Atoll, Marshall Islands; March 20, 1952; F. R. Fosberg; Loc. 25: 1 juv.

t. Wotho Island, Wotho Atoll, Marshall Islands; journeying toward sea, ready to lay eggs; February 14-15, 1952; F. R. Fosberg; Loc. 27: 1 ovig. female.

u. Wotho Island, Wotho Atoll, Marshall Islands; attracted to open nuts near camp; February 14-15, 1952; F. R. Fosberg; Loc. 32: 13 juv.

v. Jerko Island, Ujelang Atoll, Marshall Islands; climbing in Scaevola bush, 2 m.; February 4, 1952; F. R. Fosberg; Loc. 42: 1 spec.

w. Utirik Island, Utirik Atoll, Marshall Islands; eating meat from split young eating nuts; December 1, 1951; F. R. Fosberg; Loc. 47: 5 spec.

x. Utirik Island, Utirik Atoll, Marshall Islands; eating meat from split young nuts; December 1, 1952; F. R. Fosberg; Loc. 48: 12 juv.

y. Taka Island, Taka Atoll, Marshall Islands; between stilt roots of Pandanus; December 5, 1951; F. R. Fosberg; Loc. 51: 4 spec.

z. Taka Island, Taka Atoll, Marshall Islands; between stilt roots of Pandanus tree; December 5, 1951; F. R. Fosberg; Loc. 59: 2 spec. (semi-adult).

aa. Lato Island, Likiep Atoll, Marshall Islands; in beach drift, well above high tide mark; December 12-15, 1951; F. R. Fosberg; Loc. 62: 4 juv.

bb. Jemo Island, Marshall Islands; at top of beach; December 18-22, 1951; F. R. Fosberg; Loc. 66: 5 juv.

cc. Jemo Island, Marshall Islands; at top of beach; December 18-22, 1951; F. R. Fosberg; Loc. 67: 4 juv.

dd. Baojen Island, Ailuk Atoll, Marshall Islands; above high tide on sand; December 30, 1951; F. R. Fosberg; Loc. 77: 22 juv.

ee. Enobuoj Island, Kwajalein Atoll, Marshall Islands; around a sack of rotting copra thrown up on the beach; January 19, 1952; F. R. Fosberg; Loc. 82: 4 juv.

ff. Enobuoj Island, Kwajalein Atoll, Marshall Islands; around a sack of rotting copra thrown up on the beach; January 19, 1952; F. R. Fosberg; Loc. 83: 2 spec.

gg. Lae Island, Lae Atoll, Marshall Islands; attracted to open coconuts at night; January 6-10, 1952; F. R. Fosberg; Loc. 89: 2 spec.

hh. Islet N. of Baojen, Ailuk Atoll; Marshall Islands; from beating Pemphis; December 31, 1951; F. R. Fosberg; Loc. 543: 1 spec.

ii. Ailuk Island, Ailuk Atoll, Marshall Islands; from inner rubble flat on seaward reef, at night; December 24, 1951; F. R. Fosberg; Loc. 835: 2 spec. (semi-adult).

jj. Sibylla Island, Pokak Atoll, Marshall Islands; July 20-26, 1952; very common, generally nocturnal, hiding under edges of large boulders during the day, going both lagoon and seaward beaches beginning shortly before sundown, inhabiting principally Turbo lajonkairi shells; July 20-26, 1952; F. R. Fosberg; Loc. 1065: 5 spec.

kk. South Island, Pokak Atoll, Marshall Islands; in cavities and crevices in great boulders on land well above high tide level; July 26, 1952; F. R. Fosberg; Loc. 1069: 10 spec.

ll. Sibylla Island, Pokak Atoll, Marshall Islands; on land; July 27, 1952; F. R. Fosberg; Loc. 1070: 5 spec.

mm. Pokak Island, Pokak Atoll, Marshall Islands; beach above high tide; July 26, 1952; F. R. Fosberg; Loc. 1071: 10 spec.

nn. Tiny Island between Sibylla and Pokak, Pokak Atoll; in cavities and crevices in great boulders above high tide; July 26, 1952; F. R. Fosberg; Loc. 1072: 17 spec.

oo. Bikar Island, Bikar Atoll, Marshall Islands; 3 without shells taken on beach at about sunset when they were visiting the ocean; one with shell taken after dark eating baby turtle (no. 1073); August 6, 1952; F. R. Fosberg; Loc. 1074: 4 spec.

pp. Bikar Island, Bikar Atoll, Marshall Islands; climbing in Messerschmidia tree; August 7, 1952; F. R. Fosberg; Loc. 1086: 2 spec.

qq. Bikar Island, Bikar Atoll, Marshall Islands; under turtle bones and crawling about nearby on sand, well above high tide level outside forest; August 7, 1952; F. R. Fosberg; Loc. 1087-1089: 15 spec.

rr. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from middle to inner zone of outer reef flats opposite village; July 6, 1952; J. P. E. Morrison; Loc. 1866: 1 spec.

ss. Takoke Island, Raroia Atoll, Tuamotu Islands; from leaves, etc. floor of forest; July 11, 1952; J. P. E. Morrison; Loc. 1910, 1911: 38 spec.

tt. Tahuna riri Island, Raroia Atoll, Tuamotu Islands; lagoon beach, sand; Terebra shells; July 27, 1952; J. P. E. Morrison; Loc. 2004: 2 spec.

uu. Oneroa Island, Raroia Atoll, Tuamotu Islands; from native house area, small, selected for shells; August 2, 1952; J. P. E. Morrison; Loc. 2027: 68 spec.

vv. Oneroa Island, Raroia Atoll, Tuamotu Islands; large red hermit crabs (common); August 7, 1952; J. P. E. Morrison; Loc. 2079: 4 spec.

ww. Mataira Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 16, 1952; J. P. E. Morrison; Loc. 1938: 1 spec.

xx. North side of Tekatikati Island, Raroia Atoll, Tuamotu Islands; pavement and sandy patches between coral (and algae) patches in the channel from near lagoon to middle; August 8, 1952; J. P. E. Morrison; Loc. 2088: 1 spec.

yy. North end Oneroa Island, Raroia Atoll, Tuamotu Islands; outer reef and drift; August 8, 1952; J. P. E. Morrison; Loc. 2093: 1 spec.

zz. Okaea Island, Raroia Atoll, Tuamotu Islands; from rock flat just below or at (?) high tide line on wide rock flat on oceanic side; August 22, 1952; J. P. E. Morrison; Loc. 2167: 3 spec.

aaa. Southeast point of Opakea Island, Raroia Atoll, Tuamotu Islands; under rocks on sandy bottom below low tide line, lagoon shore; August 26, 1952; J. P. E. Morrison; Loc. 2194: 1 spec.

bbb. Southwest corner of Opakea Island, Raroia Atoll, Tuamotu Islands; channel and lagoon shore; August 27, 1952; J. P. E. Morrison; Loc. 2198: 1 spec.

ccc. North of Opakea Island, Raroia Atoll, Tuamotu Islands; outer reef pavement in channel just to the north of the island; August 27, 1952; J. P. E. Morrison; Loc. 2205: 1 spec.

Coenobita rugosus H. Milne Edwards

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-171: 16 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-658: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-660: 12 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-4: 16 spec.
e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-6: 7 spec.
f. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-124: 1 spec.
g. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-403: 3 spec.
h. Onotoa, Gilbert Islands; Pacific Science Board camp area; July 30, 1951; P. E. Cloud: 53 spec.
i. Torrutj Island, Kwajalein Atoll, Marshall Islands; 1951-1952; F. S. MacNeil; Loc. 900: 3 juv.
j. Lato Island, Likiep Atoll, Marshall Islands; in beach drift well above high tide mark; December 12-15, 1951; F. R. Fosberg; Loc. 2: 1 juv.
k. Rua Island, Ujae Atoll, Marshall Islands; under rotting coconut logs; February 23, 1952; F. R. Fosberg; Loc. 3: 4 juv.
l. Alle Island, Ujae Atoll, Marshall Islands; around freshly cut coconuts and in and around rotten coconut log in daytime; March 10, 1952; F. R. Fosberg; Loc. 12-15: 97 spec.
m. Wotho Island, Wotho Atoll, Marshall Islands; small hermit crab, claws not striped, darker color, large claw purple; attracted to open nuts near camp; February 14, 15, 1952; F. R. Fosberg; Loc. 31: 9 juv.
n. Ujelang Islet, Ujelang Atoll, Marshall Islands; on ground; February 6,7, 1952; F. R. Fosberg; Loc. 43: 3 juv.
o. Ujelang Island, Ujelang Atoll, Marshall Islands; on ground; February 6, 7, 1952; F. R. Fosberg; Loc. 44: 2 juv.
p. Jeno Island, Marshall Islands; at top of beach; December 18-22, 1951; F. R. Fosberg; Loc. 68: 2 juv.
q. Kwajalein Island, Kwajalein Atoll, Marshall Islands; above beach, around backdoor of officer's club; March 13, 1952; F. R. Fosberg; Loc. 80: 6 juv.
r. Enobuoj Island, Kwajalein Atoll, Marshall Islands; around a sack of rotting copra thrown up on the beach; January 19, 1952; F. R. Fosberg; Loc. 81: 1 juv.
s. Lae Island, Lae Atoll, Marshall Islands; on trail in front of camp at night, large specimen in Vasum shell, small specimen in Cerithium shell; January 6-10, 1952; F. R. Fosberg; Loc. 90: 2 spec.
t. Lojjaiong Island, Kwajalein Atoll, Marshall Islands; in interstices in cut bank of small pebbles above high tide level; January 15, 1952; F. R. Fosberg; Loc. 665: 1 juv.

u. Bikar Island, Bikar Atoll, Marshall Islands; 5 ft. up a coconut tree trunk; August 6, 1952; F. R. Fosberg; Loc. 1075: 1 spec.
v. Bikar Island, Bikar Atoll, Marshall Islands; above high tide level on sand at night; August 6, 1952; F. R. Fosberg; Loc. 1077: 1 spec.
w. Mataira Island, Raroia Atoll, Tuamotu Islands; purple clawed land hermit crabs feeding at night on opened green coconuts (juice); July 16, 1952; J. P. E. Morrison; Loc. 1940: 1 spec. (among specimens of C. brevimanus).

Coenobita spinosus H. Milne Edwards
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-420: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-440: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-661: 1 spec.
d. Bock Island, Ujae Atoll, Marshall Islands; in coconut shell, from Pisonia forest; February 20, 1952; F. R. Fosberg; Loc. 8: 1 spec.
e. Wotho Island, Wotho Atoll, Marshall Islands; in coconut trash; February 14, 15, 1952; F. R. Fosberg; Loc. 30: 2 spec.

Family Paguridae
Subfamily Dardaninae

Aniculus aniculus (Herbst)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-443: 3 spec.
b. Arno Atoll, Marshall Islands; 1950 R. W. Hiatt; Loc. E 2-498: 1 spec.
c. Nado Island, Likiep Atoll, Marshall Islands; in Turbo shells, Lithothamnion ridge, east side of island; December 14, 1951; F. S. MacNeil; Loc. 821: 2 spec.
d. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; inshore pool area of outer reef; N. end of island; July 9, 1952; J. P. E. Morrison; Loc. 1906: 2 spec.
e. Homohomo Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 21, 1952; J. P. E. Morrison; Loc. 1956: 1 spec.
f. Tahunariri Island, Raroia Atoll, Tuamotu Islands; windward outer reef edge; July 27, 1952; J. P. E. Morrison; Loc. 1999: 1 spec.
g. Oneroa Island, Raroia Atoll, Tuamotu Islands; outer reef edge; August 4, 1952; J. P. E. Morrison; Loc. 2039: 1 spec.

Calcinus elegans (H. Milne Edwards)
a. Onotoa, Gilbert Islands; back ridge trough, about 600 ft. offshore from Pacific Science Board Camp, at the outer margin of the windward reef, just inshore from the algal ridge and surge channels. This part of the reef never dries even at low tide and generally has at least a foot or two of water above it; August 1, 1951; P. E. Cloud; Loc. GOC-32: 1 spec. (identification not certain).
b. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; median section or zone of outer reef, opposite village; July 5, 1952; J. P. E. Morrison; Loc. 1836: 2 spec.

c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; near edge of outer reef, opposite village; July 6, 1952; J. P. E. Morrison; Loc. 1852: 2 spec. in Turbo argyrostomus.

d. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; middle to inner zone of outer reef flats opposite village; July 6, 1952; J. P. E. Morrison; Loc. 1863, 1864: 5 spec.

e. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 8, 1952; J. P. E. Morrison; Loc. 1885, 1886: 2 spec.

f. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef along Lithothamnion ridge; July 9, 1952; J. P. E. Morrison; Loc. 1893: 3 spec.

g. Northeast side of Tepukamaruia Island, Takume Atoll, Tuamotu Islands; oceanic reef; September 8, 1952; J. P. E. Morrison; Loc. 2275: 1 spec.

h. Tepukamaruia Island, Takume Atoll, Tuamotu Islands; oceanic reef flats; September 8, 1952; J. P. E. Morrison; Loc. 2276: 1 spec.

i. Honohomo Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 21, 1952; J. P. E. Morrison; Loc. 1956: 4 spec.

j. Honohomo Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 21, 1952; J. P. E. Morrison; Loc. 1958: 1 spec.

k. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; shore line, rock and gravel at low tide line or below, at night; July 23, 1952; J. P. E. Morrison; Loc. 1976: 2 spec.

l. Onerea Island, Raroia Atoll, Tuamotu Islands; outer reef pavement area or zone near shore at night; August 4, 1952; J. P. E. Morrison; Loc. 2040: 3 spec.

m. Onerea Island, Raroia Atoll, Tuamotu Islands; outer reef flats; August 5, 1952; J. P. E. Morrison; Loc. 2048: 1 spec.

n. Tepatahiti Island, Raroia Atoll, Tuamotu Islands; outer reef flats, here the pavement and pool zone extends almost from the shore to the outer reef edge, the boring urchin zone, however, is distinct, as is the very narrow Lithothamnion ridge; August 26, 1952; J. P. E. Morrison; Loc. 2180: 3 spec.

o. Ngavarivari Island, Raroia Atoll, Tuamotu Islands; outer reef ridge; August 26, 1952; J. P. E. Morrison; Loc. 2221: 2 spec.

p. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; pool and pavement zone near shore; September 3, 1952; J. P. E. Morrison; Loc. 2253: 1 spec.

q. Tenuku Haupapatea Island, Raroia Atoll, Tuamotu Islands; algae zone just behind outer reef edge, outer reef flats; September 5, 1952; J. P. E. Morrison; Loc. 2269: 1 spec.

Calcinus gaimardi (H. Milne Edwards)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-297: 1 spec.

b. Lagoon west of Saipan, Marianas Islands; May 6 and 13, 1949; P. E. Cloud; Loc. D-5: 2 spec.

c. Onotoa, Gilbert Islands; back ridge trough, about 600 ft. offshore from Pacific Science Board camp, at the outer margin of the windward reef, just inshore from the algal ridge and surge channels. This part of the reef never dries even at low tide and generally has at least a foot or two of water above it; August 1, 1951; P. E. Cloud; Loc. GOC-32: 3 spec.

Calcinus laevimanus Randall

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-51: 7 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-592: 2 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. 2-304: 12 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-325: 1 spec. (identification not certain).
e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-511: 2 spec.
f. Onotoa, Gilbert Islands; July 12, 1951; A. H. Banner; Loc. A-1: 1 spec.
g. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-2: 10 spec.
h. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 3 spec.
i. Onotoa, Gilbert Islands; July 25, 1951; A. H. Banner; Loc. A-5: 2 spec.
j. Onotoa, Gilbert Islands; August 9, 1951; A. H. Banner; Loc. B-3: 2 spec.
k. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 4 spec.
l. Onotoa, Gilbert Islands; July-August, 1951; A. H. Banner: 40 spec.
m. Ailuk Island, Ailuk Atoll, Marshall Islands; seaward reef; 1951-1952; F. S. MacNeil; Loc. 857: 3 spec.
n. Bock Island, Ujae Atoll, Marshall Islands; 1952; F. S. MacNeil; Loc. 921: 2 spec.
o. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; seaward side opposite the village; July 1, 1952; J. P. E. Morrison; Loc. 1829: 1 spec.
p. South edge of Motufano Island, Raroia Atoll, Tuamotu Islands; residual pools at low tide in incomplete channel near lagoon, incompletely connected to lagoon water; August 8, 1952; J. P. E. Morrison; Loc. 2086: 2 spec.
q. Northeast side of Tepukanaruia Island, Takume Atoll, Tuamotu Islands; oceanic reef; September 8, 1952; J. P. E. Morrison; Loc. 2275: 1 spec.
r. Northeast side of Tepukanaruia Island, Takume Atoll, Tuamotu Islands; oceanic beach; September 8, 1952; J. P. E. Morrison; Loc. 2277: 3 spec.
s. Mataira Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 16, 1952; J. P. E. Morrison; Loc. 1941: 2 spec.
t. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; shore line, rock and gravel at low tide line or below, at night; July 23, 1952; J. P. E. Morrison; Loc. 1976: 1 spec.
u. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; on and under rocks at and below low tide line, gravel flats on inner reef, lagoon shore; August 7, 1952; J. P. E. Morrison; Loc. 2076: 1 spec.
v. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; pavement pool habitat, outer reef near shore opposite village; August 23, 1952; J. P. E. Morrison; Loc. 2178: 31 spec.

w. Puka Puka Island, Raroia Atoll, Tuamotu Islands; under rocks and on pavement of pool zone of outer reef flats; August 28, 1952; J. P. E. Morrison; Loc. 2208: 5 spec.
x. Ngavarivari Island, Raroia Atoll, Tuamotu Islands; outer reef flat; August 26, 1952; J. P. E. Morrison; Loc. 2218: 3 spec.
y. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from under larger rocks mostly on inner (shore) half of inner reef flats; September 2, 1952; J. P. E. Morrison; Loc. 2243: 2 spec.

Calcinus latens (Randall)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-108: 5 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-153: 3 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-297: 3 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-304: 3 spec.
e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-391: 5 spec.
f. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-705: 1 spec.
g. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 8 spec.
h. Onotoa, Gilbert Islands; August 15, 1951; A. H. Banner; Loc. B-8: 4 spec.
(Arno identifications not entirely certain)
i. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; outer reef and drift; August 8, 1952; J. P. E. Morrison; Loc. 2093: 1 spec.
j. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; pavement pool habitat nearby outer reef near shore opposite village; August 23, 1952; J. P. E. Morrison; Loc. 2178: 1 spec.
k. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from under larger rocks mostly on inner (shore) half of inner reef flats; September 2, 1952; J. P. E. Morrison; Loc. 2243: 23 spec.

Calcinus seurati Forest
a. Bock Island, Ujae Atoll, Marshall Islands; 1952; F. S. MacNeil; Loc. 921: 2 spec.
b. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; median section or zone of outer reef flats a little behind outer reef edge opposite village; July 5, 1952; J. P. E. Morrison; Loc. 1836: 1 spec.
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef flat; July 8, 1952; J. P. E. Morrison; Loc. 1885: 1 spec.
d. Lagoon side of Otikaheru Island, Raroia Atoll, Tuamotu Islands; near shore of brackish enclosed lagoon, on the lagoon side of island; July 29, 1952; J. P. E. Morrison; Loc. 2015: 4 spec.
e. South edge of Motufano Island, Raroia Atoll, Tuamotu Islands; residual pools at low tide in incomplete channel near lagoon, incompletely connected to lagoon water; August 8, 1952; J. P. E. Morrison; Loc. 2086: 25 spec.

f. Northeast side of Tepukamaruia Island, Takume Atoll, Tuamotu Islands; oceanic reef; September 8, 1952; J. P. E. Morrison; Loc. 2275: 1 spec.
g. Northeast side of Tepukamaruia Island; Takume Atoll, Tuamotu Island; large "tide" pool (of reduced salt?) far back next to shore (150 yds.) line of beach rock and/or sand; September 8, 1952; J. P. E. Morrison; Loc. 2278: 11 spec.
h. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; pavement pool habitat nearby outer reef near shore opposite village; August 23, 1952; J. P. E. Morrison; Loc. 2178: 1 spec.
i. Opakea Island, Raroia Atoll, Tuamotu Islands; outer reef pavement habitat in channel just to the North of the island; August 27, 1952; J. P. E. Morrison; Loc. 2205: 1 spec.
j. Puka Puka Island, Raroia Atoll, Tuamotu Islands; under rocks and on pavement of pool zone of outer reef flats; August 28, 1952; J. P. E. Morrison; Loc. 2208: 5 spec.
k. Ngavarivari Island, Raroia Atoll, Tuamotu Islands; outer reef flat; August 26, 1952; J. P. E. Morrison; Loc. 2218: 1 spec.

Calcinus spicatus Forest ?
a. Onotoa, Gilbert Islands; about 9200 ft. S. 72° W. from offshore end of Government Station jetty (on S. portion of northern main island) just S. of main passage out of lagoon (Rawa ni Karoro) where coral shoals known as Aon te ra Bata begin to deepen; collected in area where patch reefs rise above the limesand bottom at 16 ft. depth; July 29, 1951; P. E. Cloud; Loc. GOC-27: 1 spec.

Calcinus spec.
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-516: 3 spec.
b. Onotoa, Gilbert Islands; August 24, 1951; A. H. Banner; Loc. A-XVI: 1 spec.
c. Onotoa, Gilbert Islands; back ridge trough, about 600 ft. offshore from Pacific Science Board camp, at outer margin of windward reef, just inshore from the algal ridge and surge channels. This part of the reef never dries even at low tide and generally has at least a foot or two of water above it; August 1, 1951; P. E. Cloud; Loc. GOC-32: 1 spec.

Diogenes spec.
a. Onotoa, Gilbert Islands; in coral; August 9, 1951; A. H. Banner; Loc. B-5: 1 spec.

Clibanarius corallinus (H. Milne Edwards)
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-51: 1 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-108: 6 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-153: 1 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-592: 16 spec.

e. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-4: 1 spec.
f. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-124: 2 spec.
g. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-180: 1 spec.
h. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-304: 3 spec.
i. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-325: 1 spec.
j. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-367: 1 spec.
k. Onotoa, Gilbert Islands; July-August, 1951; A. H. Banner: 1 spec.
l. Onotoa, Gilbert Islands; ocean reef; August 4, 1951; A. H. Banner: 1 spec.
m. Onotoa, Gilbert Islands; outer reef flat, from Trochus shell; July 26, 1951; A. H. Banner: 1 spec. (color: black).
n. Onotoa, Gilbert Islands; July 5, 1951; A. H. Banner; Loc. B-3: 2 spec.
o. Onotoa, Gilbert Islands; August 10, 1951; A. H. Banner; Loc. B-6: 1 spec.
p. Ailuk Island, Ailuk Atoll, Marshall Islands; seaward reef; 1951-1952; F. S. MacNeil; Loc. 857: 5 spec.
q. Bock Island, Ujae Atoll, Marshall Islands; 1952; F. S. MacNeil; Loc. 921: 3 spec.
r. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; intertidal gravel flats in incomplete channel; July 21, 1952; J. P. E. Morrison; Loc. 1964: 3 spec.
s. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; shore line, rock and gravel at low tide line or below, at night; July 23, 1952; J. P. E. Morrison; Loc. 1976: 1 spec.
t. North end Oneroa Island, Raroia Atoll, Tuamotu Islands; outer reef and drift; August 8, 1952; J. P. E. Morrison; Loc. 2093: 1 spec.
u. Ngavarivari Island, Raroia Atoll, Tuamotu Islands; at and just above the high tide line of blackened coral gravel and rocks; August 26, 1952; J. P. E. Morrison; Loc. 2222: 1 spec.

Clibanarius eurysternus Hilgendorf
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-304: 3 spec.
b. Onotoa, Gilbert Islands; July 25, 1951; A. H. Banner; Loc. A-5: 1 spec.

Clibanarius humilis Dana
a. Onotoa, Gilbert Islands; July 12, 1951; A. H. Banner; Loc. A-1: 6 spec.
b. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-2: 18 spec.
c. Onotoa, Gilbert Islands; July 11, 1951; A. H. Banner; Loc. A-4: 1 spec.

d. Onotoa, Gilbert Islands; July 25, 1951; A. H. Banner; Loc. A-5: 1 spec. (from Mitra shell).

e. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 1 spec.

f. Onotoa, Gilbert Islands; July-August, 1951; A. H. Banner: 24 spec.

Clibanarius sp.

a. Lagoon west of Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. C-7a: 2 spec.

Dardanus deformis (H. Milne Edwards)

a. Ailuk Island, Ailuk Atoll, Marshall Islands; from inner rubble flat on seaward reef at night; December 24, 1951; F. R. Fosberg; Loc. 835: 1 spec.

b. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from sandy stretches between rocks etc., inner reef flats, up to 3 ft. below low tide, collected at night at pier at village; July 5, 1952; J. P. E. Morrison; Loc. 1851: 1 spec.

c. "Les Tropiques," 2 km. W. of Papeete, Tahiti, Society Islands; muddy sand bottom from shallow water near shore, only 3 to 6 inches of water at low tide; collected at night; inner fringing reef flats; September 13, 1952; J. P. E. Morrison; Loc. 2286: 5 spec.

d. "Les Tropiques," 2 km. W. of Papeete, Tahiti, Society Islands; sea anemone carrying hermit crabs (white eyed with the flashlight, and fast moving) from inner (fringing) reef flats near shore, 1 ft. or less of water, at night; September 13, 1952; J. P. E. Morrison; Loc. 2287: 2 spec.

Dardanus euopsis (Dana)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-16: 1 spec.

b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-340: 2 spec.

c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-506: 1 spec.

d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-510: 1 spec.

e. Onotoa, Gilbert Islands; July-August, 1951; A. H. Banner: 1 spec.

f. Onotoa, Gilbert Islands; August 1, 1951; A. H. Banner; Loc. A-8: 1 spec. (identity not certain).

g. Onotoa, Gilbert Islands; about 4 1/2 miles S. 86° W. from Aiaki Maneaba on the lagoon side of the broad reef passage N. of a narrower passage called Rawa Bao, from small patch reefs rising to within 4-6 ft. of the surface from a limesand and coral gravel bottom at 2 fathoms; July 27, 1951; P. E. Cloud; Loc. GOC-25: 1 spec. (from Trochus).

h. Onotoa, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon. Patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 1 spec.

i. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area, S. side of big windward point of reef, near center of atoll. Collected from 1/2 mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 2 spec.

j. Onotoa, Gilbert Islands; about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef; from thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within about 8-10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 spec.

Dardanus fabimanus (Dana)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-398: 1 spec.

b. Onotoa, Gilbert Islands; outer reef flat; from Terebra shell; July 26, 1951; A. H. Banner; Loc. B-1b: 3 spec. (sandy color).

c. Onotoa, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 1 juv.

Dardanus gemmatus (H. Milne Edwards)

a. Onotoa, Gilbert Islands; SE. end of Rakai Ati reef area, S. side of big windward point of reef near center of atoll; from 1/2 mile strip across the reef; August 20, 1951; P. E. Cloud; Loc. GOC-36: 1 spec.

Dardanus guttatus (Olivier)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-391: 1 spec.

b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-304: 1 spec.

c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-367: 1 spec.

d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-454: 1 spec.

e. Onotoa, Gilbert Islands; about $4\frac{1}{2}$ miles S. 86° W. from Aiaki Maneaba on the lagoon side of the broad reef passage N. of a narrower passage called Rawa Bao; from small patch reefs rising to within 4-6 ft. of the surface from a limesand and coral gravel bottom at 2 fathoms; July 27, 1951; P. E. Cloud; Loc. GOC-25: 1 spec. (from Lambis chiragra).

f. Onotoa, Gilbert Islands; about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef; from thickly set coral masses rising from 15 ft. (sounded at low tide) of water to within about 8-10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 spec.

g. Between Taka and Lojiron Islands, Taka Atoll, Marshall Islands; on reef in several feet of water, inhabiting a large heavy Lambis shell; December 7, 1951; F. R. Fosberg; Loc. 55: 1 spec.

Dardanus megistos (Herbst)

a. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; large red hermit crabs from below low tide on lagoon side near pier at village, collected at night; July 5, 1952; J. P. E. Morrison; Loc. 1848: 2 spec.

b. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; on and under coralline rocks on gravel flats just below low tide line of inner reef (lagoon) shore, at night; August 6, 1952; J. P. E. Morrison; Loc. 2072: 1 spec.

Dardanus spinimanus (H. Milne Edwards)

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-325: 1 spec.

b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-339: 1 spec.

Dardanus sp. (near crassimanus [H. Milne Edwards]).

a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-506: 1 spec.

Subfamily Pagurinae

Pagurus laevimanus (Ortmann)

a. Saipan, Marianas Islands; January 30, 1949; P. E. Cloud: 1 spec.

b. Saipan, Marianas Islands; taken from dead coral and algal rock at about 10 ft.; April 6, 1949; P. E. Cloud; Loc. A-8: 1 spec.

c. Lagoon west of Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. C-7a: 2 spec.

GALATHEIDEA

(Only Partly Identified)

Family Galatheidae

Galathea elegans Adams & White

a. Kwadak Island, Kwajalein Atoll, Marshall Islands; on Comanthus bennetti (J. Muller), in 3-4 fathoms of water; July 7, 1951; P. E. Cloud: 2 spec. (Crinoid identified by Mr. Austin H. Clark).

Family Porcellanidae

Neopetrolisthes ohshimai Miyake

a. Ine village, Arno Atoll, Marshall Islands; outer sea reef slope; commensal with giant sea anemone, Disocosoma; June-September, 1950; R. W. Hiatt; Loc. E 1-673: 1 spec.

III. Macrura

SCYLLARIDEA

Family Scyllaridae

Parribacus antarcticus (Lund)

a. North of Ine village, Arno Atoll, Marshall Islands; lagoon reef flat; June-August 1950; J. W. Wells; Loc. S. 20: 1 spec.
b. Onotoa Atoll, Gilbert Islands; windward sea reef; July 1951; A. H. Banner; Loc. A-4: 1 juv.
c. Onotoa Atoll, Gilbert Islands; windward sea reef; August 2, 1951; A. H. Banner; Loc. A-8: 1 juv.
d. Onotoa Atoll, Gilbert Islands; August 7, 1951; P. E. Cloud: 1 spec.
e. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef, fishing at night; July 22, 1952; J. P. E. Morrison; Loc. 1972: 2 spec.
f. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; near edge of outer reef a little behind the Lithothamnion ridge; fishing at night; July 23, 1952; J. P. E. Morrison; Loc. 1979-1983: 2 spec.

Family Palinuridae

Panulirus versicolor (Latreille)

a. Onotoa Atoll, Gilbert Islands; July-September 1951; A. H. Banner: 1 spec.
b. Ine village, Arno Atoll, Marshall Islands; from under coral head, outer lagoon reef slope; June-September 1950; R. W. Hiatt; Loc. E 2-455: 1 spec.

Panulirus penicillatus (Olivier)

a. Ine village, Arno Atoll, Marshall Islands; from under coral head, outer lagoon reef slope; June-September 1950; R. W. Hiatt; Loc. E 2-455.
b. Onotoa Atoll, Gilbert Islands; July-September 1951; A. H. Banner: 2 spec.
c. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef; fishing at night; July 22, 1952; J. P. E. Morrison; Loc. 1974: 1 spec.
d. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; near edge of outer reef, a little behind Lithothamnion ridge; fishing at night; July 23, 1952; J. P. E. Morrison; Loc. 1983: 1 spec.
e. Oneroa Island, Raroia Atoll, Tuamotu Islands; under coral on outer reef behind reef edge in coral and pool area; at night; August 5, 1952: 1 ovig. female.

THALASSINIDEA

Family Axiidae

Axius (Neaxius) acanthus A. Milne Edwards

a. Lagoon west of Susupe, Saipan, Marianas Islands; April 24, 1949; P. E. Cloud; Loc. G-1: 2 spec.

Axiopsis (Axiopsis) serratifrons (A. Milne Edwards)

a. Onotoa, Gilbert Islands; August 2, 1951; A. H. Banner; Loc. A-9: 2 spec.
b. Onotoa, Gilbert Islands; Heliopora tidepool in sand at S. end of the northern main island at 1 ft. low tide; August 2, 1951; P. E. Cloud; Loc. GOC-30: 1 ovig. female.

Axiopsis (Paraxiopsis) bisquamosa De Mann

a. Lagoon west of Saipan; Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 2 spec.

Family Callianassidae

Upogebia amboinensis (De Man)

a. Onotoa, Gilbert Islands; about 13,400 ft. S. 75° W. from Aiaki Maneaba in the deep central part of the lagoon. Bottom of low scattered dead and living coral patches on intervening lime mud and lime sand about 30-40% seds, 60-70% coral; August 25, 1951; P. E. Cloud; Loc. GOC-55: 9 spec.

Callianassa (Trypaea) gravieri Nobili

a. Onotoa, Gilbert Islands; tide flat area south of Aonteuma; August 21, 1951; A. H. Banner: 1 ovig. female.
b. Onotoa, Gilbert Islands; clean lime sand flat in the vicinity of a point about 3000 ft. E. of Aonteuma, NW. Onotoa; area exposed at midtide; August 21, 1951; P. E. Cloud; GOC-42: 1 ovig. female.

Callianidea elongata (Guérin)

a. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec.

PENAEIDEA

Family Penaeidae

Metapenaeopsis sp.

a. Arno Atoll, Marshall Islands; June-September 1950; R. W. Hiatt; Loc. E 2-275: 1 juv.

CARIDEA

Family Pasiphaeidae

Leptochela robusta Stimpson
  a. Two hundred feet outside Ujae Atoll, Marshall Islands; skimmed from the surface of the sea at the stem of the ship under lights; 1951-1952; F. S. MacNeil; Loc. 922: 11 spec.

Family Disciadidae

Discias musicus new species
  a. Lagoon west of Saipan, Marianas Islands; immediately shoreward of barrier reef flat; April 10, 1949: P. E. Cloud; Loc. C-7a: 1 spec.

Family Processidae

Nikoides sibogae De Man
  a. Lagoon west of Saipan, Marianas Islands; immediately shoreward of barrier reef flat; P. E. Cloud; April 10, 1949; Loc. C-7a: 1 spec.

Nikoides nanus Chace
  a. Lagoon west of Saipan, Marianas Islands; seaward side of reef, bottom with abundant patches and knolls of mostly dead coral, crustose corallines, and coralline or coral rubble, with areas of coral algal concentration; depths 10-60 ft, with local coral algal shoals; May 4, 1949; P. E. Cloud; Loc. E-7: 1 ovig. female.
  b. Lagoon west of Saipan, Marianas Islands; entrance of lagoon, bottom of limesand with fairly abundantly scattered knolls and patches of mostly dead coral and/or crustose corallines; depth generally exceeding 20 ft; May 13, 1949; P. E. Cloud; Loc. D-7: 1 spec.

Family Thalassocaridae

Thalassocaris crinita (Dana)
  a. Southeast part of main lagoon, Arno Atoll, Marshall Islands; haul No. 3; 20 fms. deep; July 22, 1950; John W. Wells; Loc. 39: 3 spec.

Family Hippolytidae

Saron marmoratus (Olivier)
  a. Matuis Beach, NW. Saipan, Marianas Islands; taken mostly from clumps of brown Acropora and partly from Pocillopora damicornis cespitosa; December 1, 1948; P. E. Cloud: 1 spec.

b. Lagoon west of Saipan, Marianas Islands; immediately shoreward of barrier reef flat; May 13, 1949; P. E. Cloud; Loc. C-7a: 1 spec.

c. Ine village, Arno Atoll, Marshall Islands; from head of Acropora spec. about midway between the shore and the sea reef edge; June-September 1950; R. W. Hiatt; Loc. E 1-288: 1 spec.

d. Onotoa Atoll, Gilbert Islands; toward S. end of a lee reef stretch known as Rakai Ati, in an area of small coral patches fairly thickly interspersed on limesand and coral debris; depth at low tide 3-4 ft.; July 26, 1951; P. E. Cloud; GOC-24: 1 spec.

Saron neglectus De Man

a. Lagoon west of Saipan, Marianas Islands; immediately shoreward of barrier reef flat; May 13, 1949; P. E. Cloud; Loc. C-7a: 2 spec.

b. Ine village, Arno Atoll, Marshall Islands; from head of Acropora spec.; about midway between the shore and the sea reef edge; June-September 1950; R. W. Hiatt; Loc. E 1-288: 1 ovig. female.

c. Ine village, Arno Atoll, Marshall Islands; from head of Pocillopora spec. near outer edge of sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-624: 2 spec.

d. Ine village, Arno Atoll, Marshall Islands; from head of Acropora spec. near outer edge of lagoon reef; June-September 1950; R. W. Hiatt; Loc. E 2-375: 1 spec.

e. Onotoa Atoll, Gilbert Islands; toward S. end of a lee reef stretch known as Rakai Ati, in an area of small coral patches fairly thickly interspersed on limesand and coral debris; depth at low tide 3-4 ft.; July 26, 1951; P. E. Cloud; Loc. GOC-24: 1 spec.

f. Onotoa Atoll, Gilbert Islands; about 9200 ft. S. 72° W. from offshore end of Government Station jetty (on S. portion of northern main island) just S. of main passage out of lagoon (Rawa ni Karoro) where coral shoals known as Aon te ra Bata begin to deepen; collected from area where patch reefs rise above the limesand bottom at 16 ft. depth; July 29, 1951; P. E. Cloud; Loc. GOC-27: 1 spec.

g. Onotoa Atoll, Gilbert Islands; about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass on the S. part of the leeward reef; collected from thickly set coral masses rising 15 ft. (sounded at low tide) of water to within about 8-10 ft. of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 spec.

Thor maldivensis Borradaile

a. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 2 spec.

b. Onotoa Atoll, Gilbert Islands; about 3½ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef; from thickly set coral masses rising from 15 feet (sounded at low tide) of water to within about 8-10 feet of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 3 spec.

Thor paschalis (Heller)

a. Lagoon west of Saipan, Marianas Islands; entrance of lagoon, bottom of abundant patches and knolls of mostly dead coral, crustose corallines, and coralline and coral rubble, with areas floored by limesand around, between and locally on the areas of coral-algal concentration; depth generally exceeds 30 feet; 1949; P. E. Cloud; Loc. D-8: 1 ovig. female.
b. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a; immediately shoreward of barrier reef flat: 2 spec.
c. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 ovig. female.

Family Rhynchocinetidae

Rhynchocinetes hiatti new sp.

a. Onotoa Atoll, Gilbert Islands; August 1951; A. H. Banner: 3 spec.
b. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; from surge channels in outer reef, at and beyond Lithothamnion ridge; August 6, 1952; J. P. E. Morrison; Loc. 2064: 14 spec.

Family Palaemonidae

Subfamily Palaemoninae

Palaemon debilis Dana

a. Tehakapikipiki Island, Raroia Atoll, Tuamotu Islands; brackish enclosed lagoon, in area little below low tide line, in about 1-2 feet of water, sandy bottom around rocks and coralline gravel; July 29, 1952; J. P. E. Morrison; Loc. 2013: about 2500 spec.
b. South side of Oteteu Island, Raroia Atoll, Tuamotu Islands; just above silty sand bottom, lagoon end of incomplete channel (plugged up with sand bar); in daytime; August 21, 1952; J. P. E. Morrison; Loc. 2162: 69 spec.

Palaemon concinnus Dana

a. Harrison Smith's Place, Maitaiea District, Tahiti, Society Islands; estuarine tree swamp (Tahitiam Chestnut?), black mud bottom; June 21, 1952; J. P. E. Morrison; Loc. 1813: 92 spec.

Macrobrachium aemulum (Nobili)

a. Punaruu River, 14 km. W. of Papeete, Tahiti, Society Islands; in the rapids just above the road bridge; low water after several days without rain (dry season), June 14, 1952; J. P. E. Morrison; Loc. 1809: 1 spec.

Macrobrachium australe (Guérin)

a. Vaipoopo River, about 12 km. E. of Papeete, Tahiti, Society Islands; in quiet margin of the river; September 15, 1952; J. P. E. Morrison; Loc. 2297: 1 spec.

Macrobrachium lar (Fabricius)

a. Talofofo River, 3950 feet due west of Unai Talofofo, Saipan, Marianas Islands; in small pools in the stream-bed of the river; 1949; P. E. Cloud: 10 spec.

Brachycarpus biunguiculatus (Lucas)

a. North end of Oneroa Island, Raroia Atoll, Tuamotu Islands; from surge channels at and beyond *Lithothamnion* ridge; August 6, 1952; J. P. E. Morrison; Loc. 2063: 1 spec.

Subfamily Pontoniinae

Palaemonella tenuipes Dana

a. Ine village, Arno Atoll, Marshall Islands; from *Acropora* heads on sea reef; June-September 1950; R. W. Hiatt; Loc. El-288: 2 spec.

b. Ine village, Arno Atoll, Marshall Islands; from coral heads on sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-388: 1 spec.

c. Ine village, Arno Atoll, Marshall Islands; from coral heads on sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-307: 3 spec.

Palaemonella vestigialis Kemp

a. Lagoon west of Saipan, Marianas Islands; immediately shoreward of barrier reef flat; April 10, 1949; P. E. Cloud; Loc. C-7a: 1 ovig. female.

Palaemonella denticulata (Nobili)

a. Ine village, Arno Atoll, Marshall Islands; from *Acropora* heads in lagoon reef; June-September 1950; R. W. Hiatt; Loc. E 2-375: 2 spec.

b. Oneroa Island, Raroia Atoll, Tuamotu Islands; about 3/4 mile inside lagoon; sand film over rock pavement and coral patches on bottom; 40 ft. of water; dredge; August 9, 1952; J. P. E. Morrison; Loc. 2100: 5 spec.

Vir orientalis (Dana)

a. Lagoon west of Saipan, Marianas Islands; from coral heads in 4-6 ft. of water; April 7, 1949; P. E. Cloud; Loc. A-11: 1 ovig. female.

b. Off Unai Dikiki Matuis, NW. Saipan, Marianas Islands; near reef off Naval Magazine; collected from coral; April 20, 1949; Mrs. Alice Davis: 1 ovig. female.

Periclimenes (Harpilius) elegans (Paulson)

a. Ine village, Arno Atoll, Marshall Islands; inner region of sea reef flat; from branches of dead coral head; June-September 1950; R. W. Hiatt; Loc. E 1-139: 1 spec.

Periclimenes (Harpilius) spiniferus De Man
a. Matuis Beach, NW. Saipan, Marianas Islands; December 1, 1948; P. E. Cloud: 8 spec.
b. Lagoon west of Saipan, Marianas Islands; from coral heads in 4-6 ft. of water; April 7, 1949; P. E. Cloud; Loc. A-11: 1 ovig. female.
c. Saipan, Marianas; from a single large head of Acropora leptocyathus (Brook); July 2, 1949; P. E. Cloud: 1 spec.
d. Ine village, Arno Atoll, Marshall Islands; from coral heads on sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-388: 1 spec.
e. Ine village, Arno Atoll, Marshall Islands; from Seriatopora heads on lagoon reef; June-September 1950; R. W. Hiatt; Loc. E 2-350: 6 spec.

Periclimenes (Harpilius) bayeri n. sp.
a. Ine village, Arno Atoll, Marshall Islands; sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-207: 1 spec.
b. Ine village, Arno Atoll, Marshall Islands; outer edge of sea reef; from head of Pocillopora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-634: 1 spec.

Paranchistus biunguiculatus (Borradaile)
a. Lagoon, Onotoa Atoll, Gilbert Islands; in Tridacna gigas (L.); July 16, 1951; P. E. Cloud: 1 spec.
b. Lagoon, Ujae Atoll, Marshall Islands; from the inside of a large live Tridacna; 1951-1952; F. S. MacNeil; Loc. 923: 1 ovig. female.

Anchistus miersi (De Man)
a. Ine village, Arno Atoll, Marshall Islands; lagoon reef; commensal with the giant clam Hippopus hippopus (L.); June-September 1950; R. W. Hiatt; Loc. E 1-125: 2 spec.
b. Ine village, Arno Atoll, Marshall Islands; lagoon reef; commensal with the giant clam Hippopus hippopus (L.); June-September 1950; R. W. Hiatt; Loc. E 2-9: 1 ovig. female.

Anchistus demani Kemp
a. Ine anchorage, Arno Atoll, Marshall Islands; reef flat, coral rock; July-August 1950; J. W. Wells; Loc. 6: 1 ovig. female.

Periclimenaeus quadridentatus (Rathbun)
a. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds NNE. of Mañagaha Island: 1 ovig. female.
b. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7a, immediately shoreward of barrier reef flat: 3 spec.

Periclimenaeus tridentatus (Miers)
a. Rinai Finauchutugan, Saipan, Marianas Islands; January 30, 1949; P. E. Cloud: 1 spec.

Onycocaris stenolepis Holthuis
a. Ine village, Arno Atoll, Marshall Islands; from coral heads on sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-307: 1 ovig. female.

Philarius gerlachei (Nobili)
a. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef, on Acropora heads; June-September 1950; R. W. Hiatt; Loc. E 1-613: 2 spec.
b. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef, from coral heads; June-September 1950; R. W. Hiatt; Loc. E 1-388: 4 spec.
c. Onotoa Atoll, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon; patch reefs rising above the limesand surface at 14 ft. to within 6 ft. of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 2 spec.

Philarius imperialis (Kubo)
a. Ine village, Arno Atoll, Marshall Islands; near outer edge of lagoon reef; from Acropora heads; June-September 1950; R. W. Hiatt; Loc. E 2-375: 3 spec.

Pontoniopsis comanthi Borradaile
a. Lagoon west of Saipan, Marianas Islands; April 10, 1949; P. E. Cloud; Loc. C-7; barrier reef flat; from Comatulid Crinoid: 1 ovig. female.
b. Onotoa Atoll, Gilbert Islands; about $4\frac{1}{4}$ miles S. 86° W. from Aiaki Maneaba on the lagoon side of the broad reef passage N. of a narrower passage called Rawa Bao; from small patch reefs rising to within 4-6 ft. of the surface from a limesand and coral gravel bottom at 2 fms.; on Crinoids; July 27, 1951; P. E. Cloud; Loc. GOC-25: 1 ovig. female.

Pontonia hurii n. sp.
a. Arno Atoll, Marshall Islands; from mantle cavity of rock clam, Spondylus sp.; June-September 1950; R. W. Hiatt; Loc. E 2-389: 1 ovig. female.
b. Tepatahiti Island, Raroia Atoll, Tuamotu Islands; off patch reef in lagoon opposite island; 25-30 ft. water; from Spondylus sp.; August 27, 1952; J. P. E. Morrison; Loc. 2227: 8 spec.

Harpiliopsis beaupresi (Audouin)
a. Ine village, Arno Atoll, Marshall Islands; from coral heads on sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-307 and E 1-388: 7 spec.
b. Ine village, Arno Atoll, Marshall Islands; Pocillopora sp. on sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-618: 5 spec.

Harpiliopsis depressus (Stimpson)
a. Ine village, Arno Atoll, Marshall Islands; in coral heads of sea reef; June-September 1950; R. W. Hiatt; Loc. E. 1-307, E 1-388: 7 spec.

b. Ine village, Arno Atoll, Marshall Islands; in Pocillopora heads of sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-618, E 1-633: 5 ovig. females.
c. Ine village, Arno Atoll, Marshall Islands; in Stylophora heads of sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-649: 3 spec.
d. Ine village, Arno Atoll, Marshall Islands; in Seriatopora heads of lagoon reef; June-September 1950; R. W. Hiatt; Loc. E 2-350: 3 spec.
e. Ine village, Arno Atoll, Marshall Islands; in Acropora heads of lagoon reef; June-September 1950; R. W. Hiatt; Loc. E 2-375: 1 spec. (damaged).
f. Onotoa Atoll, Gilbert Islands; about 8600 feet N. 18° W. from Tabuarorae Maneaba in 17 ft. of water mean low tide; August 10, 1951; P. E. Cloud; Loc. GOC-35: 3 spec.

Stegopontonia commensalis Nobili
a. North end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; from pockets (sandy bottom, etc.) in inner reef only near lagoon edge of reef in transect area at night; from sea urchin No. 2238, Echinothrix diadema (L.); September 2, 1952; J. P. E. Morrison; Loc. 2246: 1 ovig female.
b. Ilot Porc Epic, ESE. of Noumea, New Caledonia; commensally on Diadema setosum (Leske); April 19, 1953; R. Catala: 1 ovig. female.

Coralliocaris graminea (Dana)
a. Ine village, Arno Atoll, Marshall Islands; from head of Acropora sp.; about midway between the shore and the sea reef; June-September, 1950; R. W. Hiatt; Loc. E 1-288: 3 spec.
b. Ine village, Arno Atoll, Marshall Islands; about half way out on sea reef flat; from sponge on base of dead coral head; June-September 1950; R. W. Hiatt; Loc. E 1-307: 4 spec.
c. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef flat; from heads of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-388: 1 spec.
d. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef; from head of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-612: 8 spec.
e. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef; from head of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-642: 2 spec.
f. Ine village, Arno Atoll, Marshall Islands; near outer edge of lagoon reef; from Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 2-375: 6 spec.

Coralliocaris superba (Dana)
a. Lagoon N. of Matuis Beach, NW. Saipan, Marianas Islands; picked from head of brown Acropora sp.; December 12, 1948; P. E. Cloud: 1 spec.
b. Saipan, Marianas Islands; from a single large head of Acropora leptocyathus (Brook); July 2, 1949; P. E. Cloud: 2 spec.

c. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef flat; from heads of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-388: 3 spec.

d. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef; from head of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-642: 1 spec.

Coralliocaris nudirostris (Heller)

a. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef; from head of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-612: 2 spec.

b. Onotoa Atoll, Gilbert Islands; slightly less than 4 miles N. 85° W. from Aiaki Maneaba in outer lagoon; patch reefs rising above limesand bottom at 14 feet to within 6 feet of the surface; July 30, 1951; P. E. Cloud; Loc. GOC-28: 1 ovig. female.

Jocaste lucina (Nobili)

a. Lagoon W. of Saipan, Marianas Islands; from coral heads in 4-6 ft. of water; April 7, 1949; P. E. Cloud; Loc. A-11: 6 spec.

b. Lagoon W. of Saipan, Marianas Islands; April 19, 1949; P. E. Cloud; Loc. F-X: 1 spec.

c. Lagoon W. of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4, 500 yds. NNE. of Mañagaha Island: 1 spec.

d. Ine village, Arno Atoll, Marshall Islands; about midway between the shore and the sea reef edge; from head of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-288: 1 spec.

e. Ine village, Arno Atoll, Marshall Islands; about half way out on sea reef flat; from sponge on base of dead coral head; June-September 1950; R. W. Hiatt; Loc. E 1-307: 4 spec.

f. Ine village, Arno Atoll, Marshall Islands; near outer edge of sea reef flat; from heads of Acropora sp.; June-September 1950; R. W. Hiatt; Loc. E 1-388, E 1-612, E 1-642: 28 spec.

g. Onotoa Atoll, Gilbert Islands; about 9200 ft. S. 72° W. from offshore end of Government Station jetty (on S. portion of northern main island) just S. of main passage out of lagoon (Rawa ni Karoro) where coral shoals known as Aon te ra Bata begin to deepen; from low coral patch about 14 ft. below the surface; bottom limesand, at about 16 feet depth; July 29, 1951; P. E. Cloud; Loc. GOC-27: 1 spec.

h. Onotoa Atoll, Gilbert Islands; about $3\frac{1}{4}$ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef; from thickly set coral masses rising from 15 feet (sounded at low tide) to within about 8-10 feet of the surface locally; August 23, 1951; P. E. Cloud; Loc. GOC-51: 1 ovig. female.

Conchodytes meleagrinae Peters

a. Ine village, Arno Atoll, Marshall Islands; edge of lagoon reef; commensal with pearl oyster, Pinctada margaritifera (L.); June-September 1950; R. W. Hiatt; Loc. E 2-25: 1 ovig. female.

b. Tehakapikipiki Island, Raroia Atoll, Tuamotu Islands; slope of Tomogoru patch reef, approximately 1 mile W. of the center of lagoon shore; depth 30 feet; from mantle cavity of pearl oyster (No. 2017); July 29, 1952; J. P. E. Morrison; Loc. 2018: 2 spec.
c. South end of Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; off inner reef; depth 15 feet; from pearl oyster (No. 2021); August 1, 1952; J. P. E. Morrison; Loc. 2022: 2 spec.

Conchodytes tridacnae Peters
a. Arno Atoll, Marshall Islands; commensal in the mantle cavity of giant clams, Tridacna elongata; June-September 1950; R. W. Hiatt; Loc. E 2-442: 2 spec.

Family Gnathophyllidae

Gnathophyllum americanum Guérin
a. Lagoon W. of Susupe, Saipan, Marianas Islands; April 24, 1949; P. E. Cloud, Jr.; Loc. G-1: 2 spec.
b. East side of Kakapuka Island, Raroia Atoll, Tuamotu Islands; from first channel; August 26, 1952; J. P. E. Morrison; Loc. 2187: 1 spec.

STENOPODIDEA

Family Stenopodidae

Stenopus hispidus (Olivier)
a. Lagoon W. of Susupe, Saipan, Marianas Islands; April 24, 1949; P. E. Cloud; Loc. G-1: 2 spec.
b. Onotoa Atoll, Gilbert Islands; July-September 1951; A. H. Banner: 1 spec.
c. Onotoa Atoll, Gilbert Islands; lagoon; July 24, 1951; A. H. Banner: 1 spec.
d. Mataira Island, Raroia Atoll, Tuamotu Islands; under rock in pool near shore, outer reef flats; July 16, 1952; J. P. E. Morrison; Loc. 1944: 2 spec.

Pseudosquilla ornata Miers
a. Lagoon west of Saipan, Marianas Islands; April 28, 1949; April 28, 1949; P. E. Cloud; Loc. 2, from ½ ton block of dead coral-algal rock taken on anchor of LT 535: 1 spec.

Pseudosquilla oxyrhyncha Borradaile
a. About ½ mile E. offshore from the central part of Bikati Island, Butaritari Atoll, Gilbert Islands; in pocket of broad area of Heliopora reef; September 3, 1951; P. E. Cloud; Loc. GBC-2: 1 spec.

Pseudosquilla sp.
a. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 1 juv.
b. Lagoon west of Saipan, Marianas Islands; May 13, 1949; P. E. Cloud; Loc. D-8: 1 juv.
c. Ujae Atoll, Marshall Islands; skimmed from surface of sea at stern of ship under lights; anchored 200 feet outside Ujae passage; 1951-1952; F. S. MacNeil; Loc. 922: 2 juvs.

All are juveniles, a and c are in the monodactyla stage, b is slightly larger.

Gonodactylus gyrosus Odhner
a. Ine village, Arno Atoll, Marshall Islands; from outer edge of sea reef; June-September 1950; R. W. Hiatt; Loc. E 1-406: 1 spec.

Gonodactylus falcatus (Forskål)
a. Matuis Beach, NW. Saipan, Marianas Islands; taken mostly from clumps of brown Acropora and partly from Pocillopora damicornis cespitosa Dana; December 1, 1948; P. E. Cloud: 2 spec.
b. Onotoa Atoll, Gilbert Islands; August 8, 1951; A. H. Banner; Loc. B-4: 2 spec.

Gonodactylus chiragra (Fabr.)
a. Saipan, Marianas Islands; 1949; P. E. Cloud; Loc. C-IX: 1 spec.
b. Lagoon west of Saipan, Marianas Islands; April 12, 1949; P. E. Cloud; Loc. A-5: 2 spec.
c. Lagoon west of Saipan, Marianas Islands; Loc. A-7; April 27, 1949; P. E. Cloud: 1 spec.
d. Lagoon west of Saipan, Marianas Islands; April 4, 1949; P. E. Cloud; Loc. A-11; from coral heads in 4-6 feet of water: 1 spec.
e. Lagoon west of Saipan, Marianas Islands; May 6, 1949; P. E. Cloud; Loc. D-5: 5 spec.
f. Lagoon west of Saipan, Marianas Islands; May 3, 1949; P. E. Cloud; Loc. E-4: 1 spec.
g. Lagoon west of Saipan, Marianas Islands; May 4, 1949; P. E. Cloud; Loc. E-7; from coral rock: 3 spec.

h. Lagoon west of Saipan, Marianas Islands; April 19, 1949; P. E. Cloud; Loc. F-X: 2 spec.
i. Lagoon west of Saipan, Marianas Islands; June 20, 1949; P. E. Cloud; Loc. 4; 500 yards NNE. of Mañagaha Island: 7 spec.
j. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-305: 1 spec.
k. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-178: 1 spec.
l. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-375: 1 spec.
m. Onotoa, Gilbert Islands; July 13, 1951; A. H. Banner; Loc. A-2: 1 spec.
n. Onotoa, Gilbert Islands; July 19, 1951; A. H. Banner; Loc. A-4: 1 spec.
o. Onotoa, Gilbert Islands; August 2, 1951; P. E. Cloud; Loc. GOC-30: 1 spec.
p. Onotoa, Gilbert Islands; August 1, 1951; P. E. Cloud; Loc. GOC-32: 1 spec.
q. Bikati Islet, Butaritari Atoll, Gilbert Islands; September 3, 1951; P. E. Cloud; Loc. GBC-2: 1 spec.

Gonodactylus chiragra platysoma Wood-Mason
a. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-294: 2 spec.
b. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 1-701: 1 spec.
c. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-22: 1 spec.
d. Arno Atoll, Marshall Islands; 1950; R. W. Hiatt; Loc. E 2-511: 2 spec.
e. Onotoa, Gilbert Islands; August 4, 1951; A. H. Banner; Loc. A 10-12: 1 spec.
f. West of Ailuk Island, Ailuk Atoll, Marshall Islands; seaward side of leeward reef; 1951-1952; F. S. MacNeil; Loc. 847: 2 spec.
g. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; under rocks on middle to inner section or zone of outer reef opposite village; July 6, 1952; J. P. E. Morrison; Loc. 1861: 1 spec.
h. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef flats; July 11, 1952; J. P. E. Morrison; Loc. 1920: 1 spec.
i. Ngarumaoa Island, Raroia Atoll, Tuamotu Islands; outer reef flats; August 25, 1952; J. P. E. Morrison; Loc. 2215: 1 spec.

Appendix

Collection data relating to specimens taken
by R. W. Hiatt at Arno Atoll

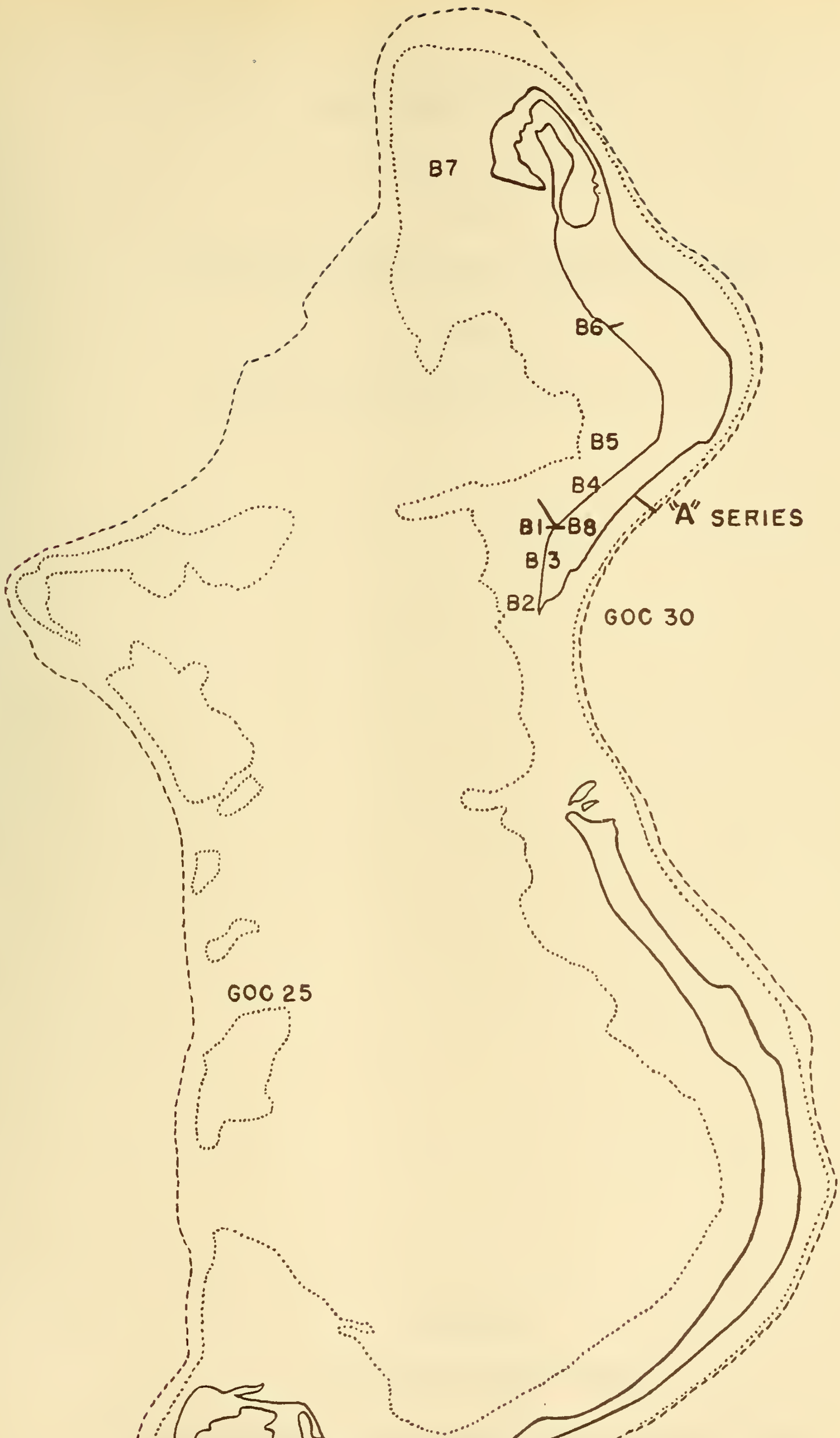
E 1-3. Churchyard, Ine Village, about 30 yards from edge of water.
E 1-7. Under rocks near shore on sea reef. Ine.
E 1-8. Common on rocks near shore, especially at night.
E 1-10. Undersides of rocks in shallow water on sea reef.
E 1-12. On rocks exposed at low tide, sea reef, Ine.
E 1-16. Sandy bottom near shore, sea reef, Ine.
E 1-28. Inshore area, sea reef, Ine.
E 1-41. Sandy bottom inshore on sea reef, Ine.
E 1-42. Common under rocks sitting in inshore tide pools, sea reef, Ine.
E 1-44. Sandy bottom inshore on sea reef, Ine.
E 1-46. Common under rocks and boulders inshore on sea reef, Ine.
E 1-47. Common in sand inshore on sea reef, Ine.
E 1-48. Common under rocks in sand inshore on sea reef, Ine.
E 1-51. Common in inshore area of sea reef, Ine.
E 1-52. Inshore area of sea reef, Ine.
E 1-66. Sea reef, Ine, about halfway between beach and outer edge.
E 1-108. Inshore area, sea reef, Ine.
E 1-109. Same area as E 1-108.
E 1-153. In bases of dead coral heads, halfway out on sea reef, Ine.
E 1-163. Uncommon in dead bases of heads of Montipora garinardi, sea reef, Ine.
E 1-171. Common, inshore on sea reef, Ine.
E 1-178. Sea reef, Ine, near outer edge.
E 1-294. Bases of dead coral about halfway out on sea reef, Ine.
E 1-302. Sea reef near outer edge.
E 1-304. Common about halfway out on sea reef, Ine.
E 1-305. Brackish water pond on Malel Island, Arno Atoll.
E 1-386. Sea reef near outer edge, Ine.
E 1-389. Near outer edge of sea reef, Ine.
E 1-390. Near outer edge of sea reef, Ine.
E 1-391. Near outer edge of sea reef, Ine.
E 1-399. Beach rock on sea reef side, Ine.
E 1-400. Beach rock and boulders on sea reef side, Ine.
E 1-406. Outer edge of sea reef, Ine.
E 1-411. Outer sea reef edge, Ine.
E 1-413. Taken from trunk of breadfruit tree, 15 feet from the ground. Several others seen higher up, all on green patches of moss or lichens.
E 1-416. Taken under rocks.
E 1-417. Taken from trunks of coconut palms bearing epiphytic ferns 3 to 4 feet above the ground.
E 1-418. Common under rocks 100-200 feet inland from sea beach.
E 1-419. Found under overhanging base of coconut palm.
E 1-419a. Very common over much of land area.
E 1-420. Common over much of land area.

E 1-423. Common on many islets and extends across from sea to lagoon side on narrow islets.
E 1-424. Under rocks on seaward portion of Ine island.
E 1-426. Common on land near seaward side of Ine island.
E 1-427. As in E 1-426.
E 1-428. As in E 1-426.
E 1-429. As in E 1-426.
E 1-435. In sandy bottom, inshore area of sea reef, Ine.
E 1-438. Center of Ine island.
E 1-440. Center of Ine island.
E 1-589. Ine island about 200 feet from the lagoon beach.
E 1-592. Inshore area of sea reef, Ine.
E 1-620. Uncommon near outer edge of sea reef, Ine.
E 1-622. Common near outer edge of sea reef, Ine.
E 1-631. From heads of Pocillopora sp. on outer seaward slope of reef flat, Ine.
E 1-644. From Acropora sp. heads, on outer sea reef slope, Ine.
E 1-645. From heads of Stylophora sp., on outer sea reef slope, Ine.
E 1-651. From heads of Pocillopora sp., on outer sea reef slope, Ine.
E 1-658. Land near lagoon side of Ine island.
E 1-659. From decaying vegetation and coconut bushes, near lagoon beach, Ine island.
E 1-660. Land at edge of lagoon reef beach, Ine.
E 1-661. As in E 1-660.
E 1-662. From boulders and rocks high on the sea reef boulder rampart, Ine.
E 1-665. As in E 1-662.
E 1-666. ?
E 1-666a. Under rocks at inner edge of sea reef, Ine.
E 1-667. Most common crab under boulders resting on sand in shallow tide pools of intertidal area of sea reef shore, Ine.
E 1-668. Uncommon, as in E 1-667.
E 1-673. Commensal with giant anemone, Discosoma, on outer sea reef slope, Ine.
E 1-678. Outer edge of sea reef, Ine.
E 1-680. Sand beach on sea side, Ine.
E 1-701. Ine.
E 1-702. "
E 1-703. "
E 1-704. "
E 1-705. "
E 2-3. Abundant in shallow water of lagoon reef in sandy areas near shore, Ine.
E 2-4. Lagoon beach, Ine.
E 2-5. Sandy bottom inshore on lagoon reef flat, Ine.
E 2-7. Tide pool near shore on lagoon reef flat, Ine.
E 2-8. Under rocks near shore on lagoon reef flat, Ine.
E 2-16. Taken from shell of Trochus niloticus off outer slope of lagoon reef, Ine.
E 2-17. Lagoon beach, Ine.
E 2-18. Taken from trunks of bread fruit trees on Tagelib islet, Arno Atoll.

E 2-19. From head of _Pocillopora_ near lagoon reef shore, Ine.
E 2-20. Under rocks on shore of lagoon, Ine.
E 2-21. Sand bottom inshore on lagoon reef flat, Ine.
E 2-22. From base of dead coral in shallow water inshore on lagoon reef, Tagelib Island, Arno Atoll.
E 2-23. From sandy bottom of lagoon reef, 20 feet deep, Tagelib Island, Arno Atoll.
E 2-123. Walked into house in interior of Ine Island.
E 2-124. Ine Village.
E 2-138. Lagoon reef flat near outer portion, Ine.
E 2-144. Inshore area of lagoon reef flat, Ine.
E 2-149. Upper edge of lagoon beach, Ine.
E 2-150. Lagoon beach, Ine.
E 2-151. From sandy bottom inshore on lagoon reef, Ine.
E 2-155. Sandy shore, lagoon beach, Ine.
E 2-164. Sandy bottom at inner edge of lagoon reef flat, Ine.
E 2-170. Inner edge of lagoon reef flat, Ine.
E 2-171. Uncommon under coral heads near outer edge of lagoon reef flat, Ine.
E 2-172. From bread fruit tree in interior of Ine Island.
E 2-175. Under coral head near outer edge of lagoon reef flat, Ine.
E 2-178. In base of dead coral head at inner edge of lagoon reef flat, Ine.
E 2-180. Inner portion of lagoon reef flat, Ine.
E 2-185. Very common under rocks and in crevices in intertidal area of lagoon reef flat, Ine.
E 2-187. Under rocks at high tide level and above on lagoon beach, Ine.
E 2-189. Common in tidepools in intertidal area of lagoon reef flat, Ine.
E 2-190. As in E 2-189.
E 2-192. Very common under rocks near the water's edge, lagoon reef flat, Ine.
E 2-275. Dredged from 20 fathoms in the lagoon.
E 2-304. Common in inshore area of lagoon reef flat.
E 2-306. In sandy bottom at inshore edge of lagoon reef flat, Ine.
E 2-307. As in E 2-306.
E 2-308. As in E 2-306.
E 2-325. Common in inshore area of lagoon reef flat, Ine.
E 2-339. Outer edge of lagoon reef flat, Ine.
E 2-340. Outer portion of lagoon reef flat, Ine.
E 2-351. From heads of _Ceriatopora hystrix_ near outer edge of lagoon reef flat, Ine.
E 2-366. From heads of _Stylophora mordax_ near outer edge of lagoon reef flat, Ine.
E 2-367. Outer edge of lagoon reef flat, Ine.
E 2-369. Inshore area of lagoon reef, Ine.
E 2-400. From rocks at upper edge of intertidal zone on lagoon shore, Ine.
E 2-401. As in E 2-400.
E 2-403. As in E 2-400.

E 2-405. Near outer edge of lagoon reef flat, Ine.
E 2-443. Near outer edge of lagoon reef flat, Ine.
E 2-454. Outer lagoon reef slope, Ine.
E 2-455. Under coral head, outer lagoon reef slope, Ine.
E 2-457. Near outer edge of lagoon reef flat, Ine.
E 2-488. ?
E 2-496. Outer lagoon reef slope, Ine.
E 2-497. As in E 2-496.
E 2-498. Near outer edge of lagoon reef flat, Ine.
E 2-502 to E 2-517. All from lagoon reef except E 2-513 and E 2-514 which are land forms from Ine Island.

MAP NO. I.



MAP NO. 2.

ATOLL RESEARCH BULLETIN

No. 25

Bryophytes from Arno Atoll, Marshall Islands

by

Harvey Alfred Miller and Maxwell S. Doty

Issued by

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November 15, 1953.

BRYOPHYTES FROM ARNO ATOLL, MARSHALL ISLANDS[1]

by Harvey Alfred Miller[2] and Maxwell S. Doty[3]

There appears to have been but a single previous record of a bryophyte from the Marshalls. This is Calymperes tenerum, a widely distributed species in Oceania, collected by W. R. Taylor (12) in the northern Marshall Islands in 1946. Glassman (7), and others (2,3,8,9,10,11), have reported on the bryophytes from the nearby Caroline Islands. Dixon (4) published a list of mosses from the Gilbert Islands, south of the Marshalls. There is little or no reference to the bryophyta in Catala's "Report on the Gilbert Islands" prepared for the South Pacific Commission, or in the vegetational and other reports on the Pacific Science Board's atoll studies.

During the summer of 1951, Leonard Horwitz collected several species of mosses and liverworts on Arno Atoll in the southern Marshall Islands in connection with the Coral Atoll Project of the Pacific Science Board. Horwitz's collections were turned over to the authors at the University of Hawaii for determination. It is these collections which form the basis for this report. The senior author made the determinations, produced the first draft of the report manuscript and drew up the specific conclusions in reference to the bryophyta. The junior author contributed the original illustrations, the key and the labor involved in finishing the work in this form.

The authors are greatly indebted to E. B. Bartram who made many of the original determinations of the mosses. The specimens cited herein are deposited in the U. S. National Museum, Washington, D. C., and in the herbarium of the B. P. Bishop Museum, Honolulu, with duplicates, wherever possible, in the Chicago Museum of Natural History and the herbaria of E. B. Bartram and the authors. The senior author wishes to thank Prof. Harold St. John, of the University of Hawaii, for provision of the assistantship and space in the Department of Botany which have enabled him to continue his studies of Central Pacific bryophytes. The authors are grateful for the material assistance given this project by Mr. Harold J. Coolidge, Mrs. Lenore Smith, and Miss Ernestine Akers, of the Pacific Science Board.

For the convenience of future atoll workers at Arno who are not bryologists, the following key is included. A set of figures made from camera lucida sketches of leaves has been included. This has been done because the

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leaves are so distinctive that they may be used to distinguish rather positively between the few known Arno mosses. With the description of each figure there appears the number of the collection from which the drawing was made and certain remarks of aid in distinguishing the species. Illustrations have not been included for the liverworts as they are much more rare and their taxonomy is as yet most incomplete in many respects.

The characteristics to which this key refers are those visible in fresh, water-soaked or wet, mature specimens. The leaves of all mosses should be compared with the figures as to size and other characteristics, for juvenile forms, in particular, may not "key out" in this key. It is our hope that these devices will facilitate greater familiarity with the mosses in the field and promote a study of their role in the atolls.

KEY TO THE BRYOPHYTA KNOWN FROM ARNO ATOLL

A. Axis with leaves borne in 3 planes and in such a manner that the moist fronds are not bilateral; leaves elliptical to linear lanceolate; branches usually all erect from the substratum (mosses):

B. Leaf bases, stems and occasionally some leaves red when stems not densely clothed with leaves; growing on the ground: Bryum nitens.

B. Leaf bases, stems and leaves never red (though often brown); growing on wood or rocks or occasionally on the ground:

C. Growing on tree trunks or vegetable debris; tufts often over 1 cm. thick, dark brown inside or pale whitish-green throughout:

D. Tufts pale whitish green throughout: Leucophanes glauculum.

D. Tufts yellow at surface, dark brown internally: Calymperes mollucense.

C. Growing on various other substrata or yellow green to green throughout, or if in dense tufts then yellow-green to green:

E. Leaves with an area of large cells conspicuous near leaf base (Figs. 3, 4, 5); midribs extending to apex in leaves, percurrent, often extending into macroscopically visible propagulae (terminal lumps which are asexual reproductory bodies); no capsules known for the Arno material:

F. Prostrate moss with green stems and often widely spaced green leaves; leaf tips denticulate: Calymperes hyophyllaceum.

F. Erect moss with closely placed brownish green leaves; leaf tips not denticulate:

Calymperes tenerum.

E. Leaves without an area of large cells near the base (Figs. 2, 6); midribs lacking or not extending completely to the apex; leaf tips not bearing propagulae; capsules often present in abundance:

G. Leaves tapering quickly to a long point, often sickle shaped; midrib absent or extremely short; capsules often abundant:

Ectropothecium monumentorum.

G. Leaves strap-shaped, broadly rounded at apex, almost symmetrical; midrib extending nearly to leaf apex; capsules not known in Arno material:

Splachobryum indicum.

A. Axis with leaves borne in two planes and in such a manner that flat or hemispherical branches result; leaves either overlapping and ovoid or like the flattened axis in structure; usually all branches (except in _Ptychocoleus_) prostrate on the substratum (liverworts).

H. Leaves and axis alike in appearance, flat; frond prostrate:

Riccardia multifida.

H. Leaves bladelike and axis terete; frond free or prostrate:

I. Leaves strongly overlapping so as to form a frond which is hemispherical in cross section when damp and more or less cylindrical when dry; fronds becoming free from the substratum, forming a moss-like coating on tree bases up to one centimeter thick:

Ptychocoleus sp.

I. Leaves not strongly overlapping, if at all; frond usually flattened against the substratum:

J. Fronds green, about or over 1.5 mm. broad:

Lejeunea sp.

J. Fronds pale if green at all, about or less than 0.5 mm. broad:

Microlejeunea sp.

MOSSES (MUSCI)

Leucophanes glauculum C. Müll. in Micholitz, M. Philippines 163.

(SEE: Figure 1.)

Eastern end of Ine Island, Horwitz 9669, 9670B, August 19, 1951.

Distribution: Malaysia, Caroline Islands.

This plant was collected on decaying wood and coconut, Cocos nucifera, husks. It formed dense tufts where found. E. B. Bartram (correspondence) reports that F. R. Fosberg has collected this species in abundance on strand coconuts in the Carolines.

Calymperes hyophyllaceum C. Müll. in Besch., Essai Calymp. Ann. Sci. Nat. 287. 1895.

(SEE: Figure 3.)

Malel Island, Horwitz 9425B.

Distribution: Sumatra, Java, Philippines (1).

Mixed with Riccardia multifida growing in the shade and on the under side of damp outer and inner coconut husks. This record is based on a few scattered plants, but the species is so distinct that there is little question of its identity.

At the apex the leaves of this genus may bear propagulae in varying stages of development. To the naked eye the asexual reproductory lumps of cells appear as little balls on the leaf tips. In figures 3, 4, and 5 the variation in shape of the apex may be due to the degree of maturity, largely in reference to the stage of propagulum development. This genus of mosses is the only one from the Marshalls that produces such structures. The presence of these propagulae is a good field character, the presence of which on a moss from Arno can be taken as indicating this genus, Calymperes.

Calymperes mollucense Schwaegr., Suppl. II, II, p. 99, t. 127. 1824.

(SEE: Figure 5.)

Malel Island, Horwitz 9422, 9426A, 9429B, August 4, 1951.

Distribution: Moluccas, Fiji, Philippines (1).

Horwitz collected a large tuft (#9422) of this species from the base of one coconut tree but gave no indication of its abundance or whether it occurs on more than one island in the atoll. A few isolated plants (#9429B) were scattered with the Ptychocoleus (#9429A) reported here, also from a coconut trunk.

Calymperes tenerum C. Müll., Linnaea 37: 174. 1871-73.

(SEE: Figure 4.)

Ine Village, Ine Island, Horwitz 9310A, August 3, 1951.

Distribution: India, Malaysia, Philippines, and Pacific Islands to Hawaii.

This is a widely distributed species and the only one reported by Taylor (12) from the northern Marshalls. It is interesting to note that Taylor found it abundant on Rongerik, Rongelap, Bikini and Eniwetok. The collection from Arno consisted of scattered plants among lichens scraped from the trunk of a breadfruit Artocarpus sp. tree.

The collector noted the propagulae to be particularly conspicuous on this moss when collected.

Splachnobryum indicum C. Müll., Linnaea 37: 174. 1871-73.

(SEE: Figure 2.)

Ine Village, Ine Island, Horwitz 9437B.

Distribution: India, Java (1).

Scattered plants among Ectropothecium monumentorum growing "on top, sides, and even some on bottom of shady moist stones near a cistern."

The Philippines have not been included in the distribution of this species because there is considerable doubt that the plant which Bartram cites (1: 126) is S. indicum. If the Philippine plant is a distinct species, then this record leaves a larger gap in distribution than any of the other species cited herein.

Bryum nitens Hook, in Wall., Cat. n. 7592 et Icon. pl. rar. t. 20, fig. 6. 1837.

(SEE: Figure 7.)

On vertical layer of soil lining main path across Jilang Island in open coconut grove. Horwitz 9105, July 17, 1951.

Main roadway of Ine Village, Ine Island. Horwitz 9312, August 3, 1951.

Distribution: Nepal, Ceylon, Java, Bali (8), Fiji.

The extension of range indicated by this collection may not be as great as shown here since there is considerable question whether this species and Bryum ambiguum Duby (known from the Philippines) are distinct from one another. E. B. Bartram (correspondence) suspects that Fleischer's (5) remark about B. nitens, "Diese Art zeigt so geringe Unterscheide von voriger, dass ich sie nur als Abart auffassen kann. Sie is sicher nur eine kleinere Varietät von Br. ambiguum, von dem sie sich mehr durch eine Summe kleiner Merkmale, als wie specifisch unterscheidet" was well justified.

Ectopothecium monumentorum (Duby) Jaeg., Adumbr. 2 (1877-1878) 523.

(SEE: Figure 6.)

On ground in a coconut grove, Jilang Island, Horwitz 9103, July 17, 1951. On damp stump and on outer husk of coconut, Malel Island, Horwitz 9426B, 9427, 9424, August 4, 1951.

On shady moist stones near a cistern, Ine Village, Ine Island, Horwitz 9437A, August 9, 1951.

On decaying wood at eastern end of Ine Island, Horwitz 9670A, August 19, 1951.

Distribution: Sumatra, Java, Timor, Philippines, Carolines (1), Gilberts (4).

This moss appears to be common in the southern Marshalls from the number of collections Horwitz made. It was fruiting abundantly and was found in a variety of habitats. This was the only species of moss in the whole collection with sporophytes (capsules).

LIVERWORTS (HEPATICAE)

Riccardia multifida (L.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 683, 1821.

Growing over damp coconut husks and occasionally also on inner husks. These were growing in the shade and on under surfaces. Malel Island, Horwitz 9425A, August 4, 1951.

Distribution: Worldwide (6).

Although cosmopolitan, this is the first record of the species from eastern Micronesia. See also next species.

Riccardia sp.

Found growing on a piece of outer coconut husk by Horwitz, 9426C, at Malel Island, August 4, 1951.

While the literature is not presently available for a definite determination, the material seems to be placeable close to the widely distributed Riccardia sinuata (Dicks.) Trev. The thalli of this material and this species (6) have no unicellular margin more than one cell broad. R. multifida has a 2- to 3-celled unistratose margin along with additional differences in the sporophyte. The more dependable sporophyte characters were not available in our sterile material.

Microlejeunea sp.

On an old inner coconut husk found lying in a damp situation, Malel Island, Horwitz 9426D, 9428, August 4, 1951.

This is a large and widespread tropical genus, the previous nearest report being from Ponape by Glassman (7).

Lejeunea sp.

Growing on the trunk of Cocos nucifera, Jilang Island, with various other bryophytes and lichens, Horwitz 9102B, July 17, 1951.

In abundance but only on dampest parts of the same breadfruit tree trunk which bore the Calymperes tenerum collection, 9310, Ine Village, Horwitz 9316, August 3, 1951.

The closest locality known for this genus is Yap, from which Stephani (10) reported two species.

Ptychocoleus sp.

Growing on upfacing side of a slanting coconut tree from the ground level up to about the 4 or 6 ft. level where it thinned out, Malel Island, Horwitz 9429A, August 4, 1951. On the same island and date on a coconut husk, Horwitz 9426E.

This may prove to be a species distinct from all sofar described; as a search of the available literature has revealed nothing close to it. However, here as with the previously cited lejeuneoid species, the limited library sources immediately available have necessitated a temporary reservation of judgment concerning the specific identity.

DISCUSSION

The only bryophytes known to be common to both the Gilbert and the Marshall Islands are Calymperes tenerum and Ectropothecium monumentorum. These two are species of wide Indomalaysian distribution.

It is particularly interesting to note that although a goodly number of investigators have reported on moss collections from the Carolines, most of the species found on Arno Atoll have not been reported from there. Perhaps the reason that these species have not been reported from the Carolines lies in the fact that the greatest interest in these islands has been centered on the rain forests of the higher islands and the moss strand vegetation, which is similar to that of an atoll, has been grossly neglected.

There are several good reasons for believing that the Carolines are the route of migration for the Marshallese species. Nearly all of the mosses cited here are found in the Philippines. The strong storm winds of the fall and winter months are widely experienced coming from the west and southwest and it seems reasonable to assume that these winds might at some time or other carry spores as far as the Marshalls. There is a possibility, too, that the early inhabitants of these islands unwittingly carried spores or propagulae with them during their migrations.

There is a possibility of comparatively recent introduction by traders and copra boats, but if this is so then one is led to wonder why these mosses are not found in the Gilberts which are isolated by the winds and currents from the Marshalls. It seems logical that some boats would visit both groups.

Until more is known of the distribution of bryophytes in the Pacific one can propose only such broad hypotheses, to be later substantiated, modified or rejected on the basis of more complete information.

A search was made for literature reporting ethnic uses of bryophytes in Micronesia. None was found. It is hoped that future workers at Arno will inquire into the ethnobotany of the different bryophytes and that such work will be facilitated by the treatment which has been presented here.

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EXPLANATION OF FIGURES

Figure 1) Leucophanes glauculum (9669).

The pale color, hardly green at all, and the leaf size distinguish this species from other Arno species.

Figure 2) Splachnobryum indicum (9437B).

Note that the midrib does not quite reach the leaf tip, there often being a group of specialized cells between the leaf apex and the tip of the midrib.

Figure 3) Calymperes hyophyllaceum (9425B).

The leaf tip shapes are variable and of relatively little taxonomic value. The leaf bases with their conspicuous areas of large cells, called cancellineae, and the nature of the leaf margins are much more dependable taxonomic characters. In this particular species, opposite the cancellineae and again near the apex, the margin of the leaf tends to have a little tooth opposite each marginal cell (denticulations).

Figure 4) Calymperes tenerum (9310A).

See notes under figure 3 and in text under the other species of Calymperes. The margins of the leaves in this species are nowhere denticulate. Note the difference in shape of the cancellineae.

Figure 5) Calymperes mollucensis (9422).

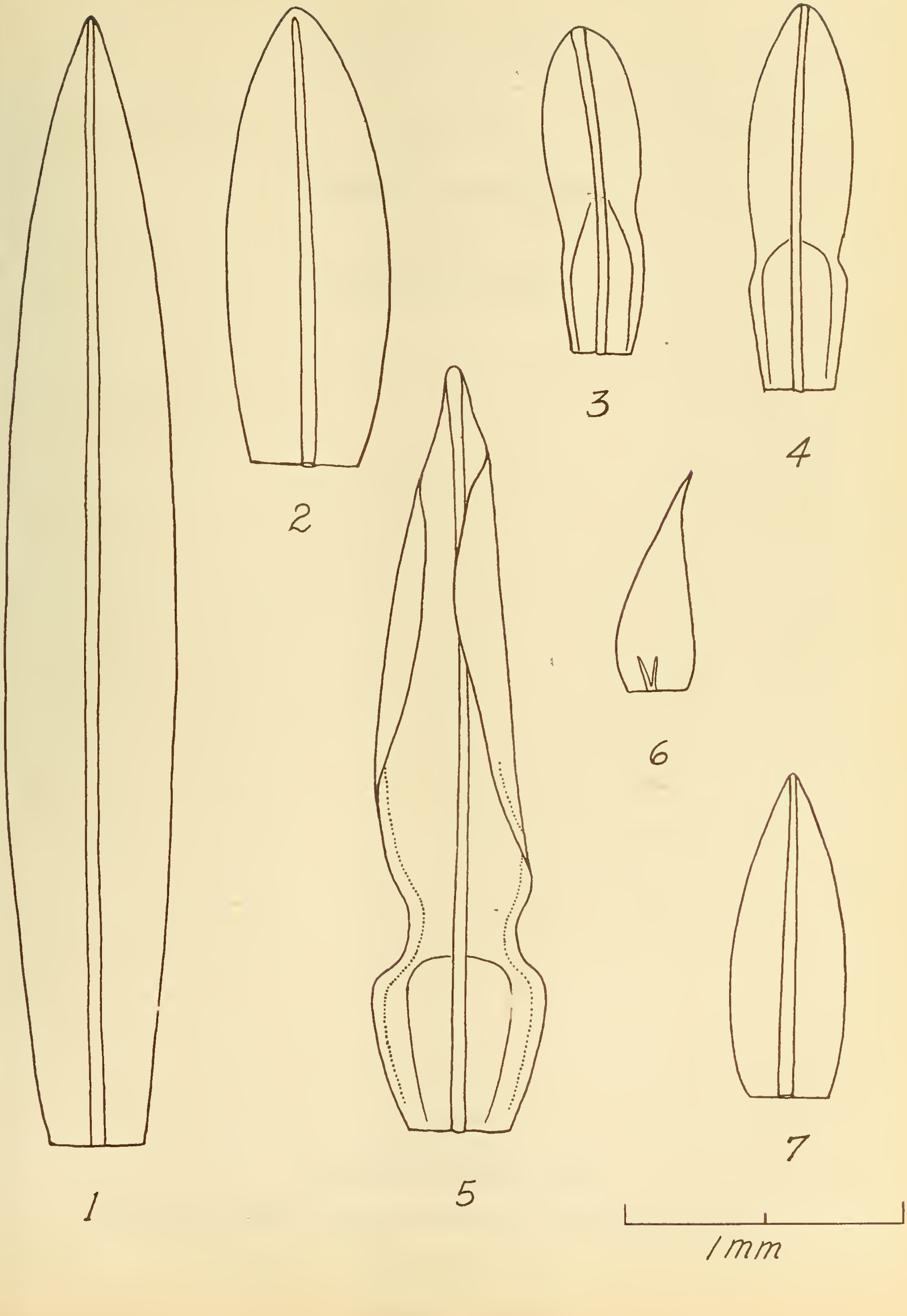
See notes under figure 3 and in text under the other species of Calymperes. The dotted lines just within the leaf margin indicate the extent of a thickened strip. This is absent in the other two Arno species.

Figure 6) Ectropothecium monumentorum (9103).

Most of the leaves of this species are sickle-shaped. There are only very small traces of midrib thickenings near the base of the leaves.

Figure 7) Bryum nitens (9312).

The midrib extends right to the apex of these usually strongly concave, boat-shaped, green leaves.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ATOLL RESEARCH BULLETIN

No. 26

Scorpions on Coral Atolls

by

Marie Hélène Sachet

Issued by

THE PACIFIC SCIENCE BOARD

National Academy of Sciences--National Research Council

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SCORPIONS ON CORAL ATOLLS

by
Marie-Hélène Sachet

With their very limited fauna, coral atolls are remarkably free of "dangerous animals". There are of course no large mammals, and no carnivorous or poisonous reptiles except for an occasional sea-snake. The only macroscopic animals which can be described as dangerous in themselves are sharks and poisonous fish, the Conus shells, and the black-widow spider (Latrodectus mactans) introduced on Kwajalein. With these and a few other exceptions, the animal pests have mostly a nuisance value, or cause painful, but not dangerous stings. Such are ants, wasps, scorpions, centipedes, flies, mosquitoes, and even birds when they form large colonies. Some of these pests, of course, are dangerous as carriers of disease-producing organisms, or parasites. A few can be rather harmless individually but dangerous if met with in great numbers: the Portuguese Man o'War for instance causes such painful stings that encountering a great many of them may render a swimmer panicky and quite helpless.

Two kinds of animals occur on most atolls which inspire often unwarranted fears in the various parts of the world where they are found: these are the centipedes and scorpions. A few species of the former cause very painful bites, and some scorpions are even deadly, but the dread they inspire is often out of proportion with the actual danger. The species of these which occur on atolls are not at all dangerous, and not too abundant, either. However, it seemed worthwhile to assemble the information on one of these groups, the scorpions, as a zoological summary with practical aspects.

In spite of their formidable appearance and their sting, scorpions are rather fascinating for various reasons. The group is rather homogeneous, and all scorpions look much more alike than different spiders, for instance. They are often found in pairs, the couple apparently going about together for a long time before fertilization takes place, at which time they go through a remarkable courtship and what is called a mating dance. These have been described in great detail by J. Henri Fabre, for the scorpions which live in the south of France, and observed in various other species. After these extraordinary performances, fecundation takes place, and the female eats up the male, at least in some species. When the young are born they look just like adult scorpions, and are simply enclosed inside a thin membrane. They break out of it at once and promptly climb onto the back of their mother. They are rather easy to observe thus, because they are white and almost translucent, while adult scorpions are yellow to black.

These are just a few of the peculiarities of these animals. Another, of a different order, but very interesting, too, is that scorpions are one of the oldest groups of living animals: in other words, fossil scorpions are found in very ancient (Silurian, about 400 million years old) deposits, and look astonishingly like modern scorpions. These must be extremely successful animals, therefore, which is only partly explained by the fact that they have few enemies.

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This brief account is no attempt to exhaust the interesting facts known or suspected about scorpions, but aims to render the idea of these animals less formidable and dreadful before discussing them in more detail.

Scorpions are arthropods, which means that they belong to the phylum of invertebrates whose legs are jointed and whose skeleton is an external armor of chitin. Other arthropods are crustaceans, for instance, and insects. The group to which scorpions belong, and which corresponds in the classification to crustaceans or insects is that of the Arachnida. Scorpions are one of the groups of arachnids, spiders are another; there are several others, which are not so commonly known, although one contains the mites and ticks.

The different groups of arthropods are classified mostly according to the number and arrangement of their legs and other appendages. Arachnids have only four pairs of legs, insects three, and crustaceans more. Besides their walking legs, scorpions have two pairs of pincers. The larger pair looks rather like the claws of a crab or lobster and are used to seize food, usually living prey, and bring it to the smaller pincers, which have the role of jaws and teeth, and tear up the food before it is swallowed.

Arachnids, once recognized by the number of their legs, are further classified according to the nature of their bodies. While insects have three main parts to their body, arachnids have only two, the cephalothorax, which contains the mouth, eyes and various other organs, and to which are attached all the legs, and the abdomen. The soft rounded abdomen of the spiders is quite different, for instance, from that of the scorpions, which is made up of segments, terminating in a narrow tail with a last segment modified into a sting.

More characteristic of scorpions than their pincers, therefore, is their tail with its stinging apparatus. The tail of the scorpion, which is really a narrow part of the abdomen, is made up of 5 narrow segments and followed by a sixth, which is the sting. It is very mobile, and is usually curved back above the rest of the body bringing the sting near the front of it, its extremity pointing forward; the scorpion stings by driving the tail and the sting forward and upward or upward and backward. This sting is pear-shaped, with a curved needle-like extremity. In the pear-shaped part are two venom glands, and they open by two small holes slightly below the extremity of the curved needle: this arrangement functions just as does a hypodermic, in which the sharp needle point breaks the skin and protects from obstruction the opening of the needle which is just behind it.

The venom produced by the glands and injected by the sting varies with different species; not all have been studied in detail. In regions of the world which happen to be well-equipped for research, and rich in deadly scorpions, much work has been carried on to analyze the venoms, understand their toxic effect, and find remedies. In North Africa, for instance where there are various dangerous species, including one which causes some deaths every year, the Pasteur Institute in Algiers has been studying these scorpions for many years, and is manufacturing anti-scorpion serum, in just the same way that sera are prepared to help victims of snake bites. In Arizona, the Poisonous Animals Research Laboratory of the State College, at Tempe, studies the local deadly scorpions, and advises on treatment of stung persons (Stahnke, 1949).

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The effect of a scorpion's sting is quite independent of the size of the species, some of the deadly scorpions being rather small; the giant scorpions of tropical Africa, Pandinus, which can be as much as 180 mm. long and the Palamnaeus or Heterometrus of the East Indies which come next in size, are relatively harmless. They must be rather formidable animals, and some Pandinus species have formidable names: P. imperator, and P. dictator. However, the scorpions that occur on atolls are rather small, and relatively harmless. Their sting is painfull, but the pain vanishes after some hours, leaving no after-effects.

Generally six families of living scorpions are recognized by zoologists, and atoll scorpions represent two of them. In the family Scorpionidae (the same to which the above-mentioned giants belong) is the species Hormurus australasiae (Fabr.); the family Buthidae is represented on atolls by Isometrus maculatus de Geer, two species of Lychas (Archisometrus of Kraepelin), and perhaps others. It must be borne in mind, of course, that on atolls, scorpions are not very abundant or conspicuous, and that, since collecting there has almost never been carried on intensively, there must be many atolls from which they have not been recorded, though present. There also may be more species present on some atolls, especially those near high islands or continents; for instance a species of Lychas is known from the Duizend Eilanden, which are very close to Java, just outside the Bay of Batavia, and not, so far as records are available, from other atolls.

Family SCORPIONIDAE.

1. Hormurus australasiae (Fabr.)
   (Scorpio australasiae Fabr. Syst. Ent. 399, 1775)

This scorpion has a wide range of occurrence, and is found all over the islands of the Pacific, Malaysia and some parts of the Indian Ocean.

It is found in the woods and coconut plantations; most authors who record it do not indicate the exact habitat, but we have some information on the specimens collected in the Marshall Islands by F. R. Fosberg in 1951-52. One, on Lae Atoll, was found in the crotch of a split, partially decaying breadfruit tree. Otherwise, the specimens were observed under sticks and stones, in coconut trash, and especially under the bark of dead logs, in coconut plantations and in the various types of forest and scrub found in the Marshalls. Also in the Marshalls, on Arno, Usinger (1953, p. 27) cites scorpions as predators in the fallen log stratum of the canopy woodland community. This most probably refers to Hormurus. It certainly would be interesting to have more information on this scorpion, and its habits: Does it burrow at all, or just hide under loose material? Does it give chase to prey, or, as reported for Mediterranean scorpions, mostly wait with extended pincers, ready to grasp an unwary spider or other animal? Does it exhibit the same courtship behavior?

Chamisso (1821, p. 159) recorded this under the name Scorpio australasiae from the Marshalls "of which the natives did not appear to be afraid; and the sting of which, according to Kadu [his informant], produces a local swelling which is of short duration". Since then, all reports agree

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that the sting of this scorpion is not to be feared.

Marshall Islands:

Ailuk Atoll; Lae Atoll, Lae Islet, Lwejap Islet, Enemanman Islet; Wotho Atoll, Wotho Islet; Ujae Atoll, Bock Islet; all collected by F. R. Fosberg in 1951-52.

Ailinglaplap Atoll, Bigatyelang Islet, collected by H. K. Townes in 1946; other specimens, collector unknown, collected in 1948.

Arno Atoll, collected by J. W. Wells in 1950.

Bikini Atoll, Romuk Islet, collected by L. P. Schultz in 1946; Namu Islet, and Bikini Islet, collected by J. P. E. Morrison in 1946.

Caroline Islands:

Ulithi Atoll, Mogmog Islet; Kapingamarangi Atoll, Hare Islet; Nukuoro Atoll, Nukuoro Islet; all collected by H. K. Townes in 1946.

Tuamotu Islands:

Raroia Atoll, Ngarumaoa Islet, Oteteu Islet, Opakea Islet; all collected by J. P. E. Morrison in 1952.

The above records are hitherto unpublished, and were kindly furnished by Dr. E. A. Chapin, of the U. S. National Museum, who identified the specimens and transmitted the information in time to include these many recent records in this paper. His help and advice are here gratefully acknowledged. The species had been previously recorded from the Marshall Islands: by Karsch 1881, p. 15 (as Liocheles australasiae), collected by O. Finsch, and by Chamisso (see above).

Ellice Islands:

Funafuti, Pocock 1898 p. 323 (see discussion of Buthus brevicaudatus Rainbow, below); many specimens were collected by Sollas and Gardiner during the Funafuti survey and boring work; Kopstein, 1921 p. 136 (specimens apparently available in Dutch museums, but no record of collection).

Ellice Islands, Buxton, 1927 p. 13; collected by O'Connor, determined by Hirst.

Duizend Eilanden:

Edam Island, Kopstein 1921 p. 119, 135.

Noordwachter Island, Kopstein 1923 p. 185, 186.

Kopstein in his 1921 paper, p. 135, also records this species from "Kokos Inseln". Unfortunately, this is not quite clear, and although it may be supposed that this refers to Cocos Keeling Atoll, extending the range of

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the species to this Indian Ocean atoll, it may well also be one of the many other Cocos Islands, especially those in the Andaman Islands.

Family BUTHIDAE

2. Isometrus maculatus (de Geer)

(Scorpio maculatus de Geer, Mem. Hist. Ins. 7:346, 1778)

Unlike the above species, this scorpion is found in and around human habitations, and is transported by human agency. It is not native to the islands. It has managed to travel all around the world, and is found practically everywhere in the tropics, as shown by the following atoll records:

Marshall Islands:

Karsch, 1881 p. 15, collected by O. Finsch; Schnee, 1904 p. 406, determined by Dahl.

Jemo Island, collected by F. R. Fosberg in 1951, on the floor of the only house on this tiny island, which is uninhabited, except when visited occasionally to prepare copra. Only one individual was seen.

Phoenix Islands:

Canton Island, Van Zwaluwenburg, 1943 p. 303 "found occasionally in buildings".

Pratas Island (China Sea):

Cambridge 1871 p. 617 (as Lychas maculatus); collected by Collingwood, who says (1868 p. 27) that small scorpions were abundant in an abandoned Chinese temple on Pratas.

Cocos-Keeling:

Hirst, in Wood-Jones 1910 p. 366. Wood-Jones, p. 306 says that wounds are painful and dreaded, but not fatal. Gibson-Hill, 1950, p. 101: "Plentiful on all the larger islands. Local name, Kala Jengking. It does not appear to be seasonal. In the plantation it is found at the base of the fronds of the coconut palms, and under the piles of fallen nuts. On Pulo Selma and Pulo Tikus it occurs fairly freely in the buildings. It moves about mostly at night."

Seychelles:

Bird Island, Hirst, 1913 p. 32.

Dennis Island, Hirst, l. c.

Astove Island:

Hirst, l. c.

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Maldives:

North Mahlosmadulu Atoll, Fainu Islet, Male Atoll, Huhule Islet, Suvadiva Atoll, Havaru Tinadu Islet, Pocock, 1904, p. 798, as I. europaeus (L.), collected by J. S. Gardiner.

Minicoi, Pocock, l. c.

3. Lychas scutatus Koch Arach. 12: pp. 3, 163, 1845. [indicated as L. scutilus on p. 3, apparently typographical error].

Cocos-Keeling Atoll:

Kopstein, 1921 p. 122.

4. Lychas mucronatus (Fabr.)
(Scorpio mucronatus Fabr. Ent. Syst. suppl. 294, 1798)

Duizend Eilanden:

Edam Island, Kopstein 1921 p. 123.

5. Buthus brevicaudatus Rainbow, Austral. Mus. Mem. 3: 107, 1897.

Ellice Islands:

Funafuti Atoll; Rainbow, created this new name for Funafuti scorpions, but Pocock, 1898 p. 323, severely criticized this determination, and placed the specimens in the species Hormurus australasiae, see above. Rainbow's plate, however, does not much resemble Hormurus australasiae, so this reduction may quite possibly be incorrect.

These are available records of identified scorpion species from atolls. In addition to these, there are a number of records of "scorpions", from various other islands; some of these for instance are found in lists of native names for various atolls.

Gilbert Islands:

Abemama Atoll: Woodford, 1895 p. 347 records a small species.

Onotoa Atoll: E. T. Moul (ined.) collected some scorpions among packing cases (probably Isometrus, possibly just introduced).

Caroline Islands:

Kapingamarangi, Miller, 1950 p. 6 records a small scorpion.

Nukuoro, Eilers, 1934 p. 193 cites native name.

Ifaluk, Burrows, 1949 p. 19 says that nothing was heard or seen of scorpions.

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Marshall Islands:

Kraemer and Nevermann 1938 p. 297 give native names.

Luangia and Nukumanu Atolls:

Sarfert and Damm, 1929, p. 31, give native names.

There are undoubtedly other such records of scorpions scattered throughout the non-systematic literature on atolls, and it is hoped that more of them will become known, and that more collections and determinations will help clarify them. New records are always interesting even though of the same species as they enable us to follow the spread of the species, especially that of Isometrus maculatus, to new islands. Only a great many observations on atolls can lead to such results. As mentioned above, in addition to distribution records and specimens, data on the biology and ecology of scorpions on atolls are meager and such observations would be a valuable addition to our knowledge of atoll biota. To make such information of maximum value, it should always be accompanied by specimens.

As this summary was nearing completion, Dr. Waldo L. Schmitt kindly called attention to a very recent paper on scorpions (Vachon, 1953). It consists of brief general notes on their biology, and has no mention of atolls, but has a short list of useful references, and is illustrated with some beautiful color plates, including one of the giant African scorpion (see p. 5 of this paper), and several of one of the deadly North African species, showing various postures. A lengthy, and much-praised work by the same author, "Etudes sur les scorpions", published by the Pasteur Institute of Algiers in 1952, unfortunately could not be consulted.

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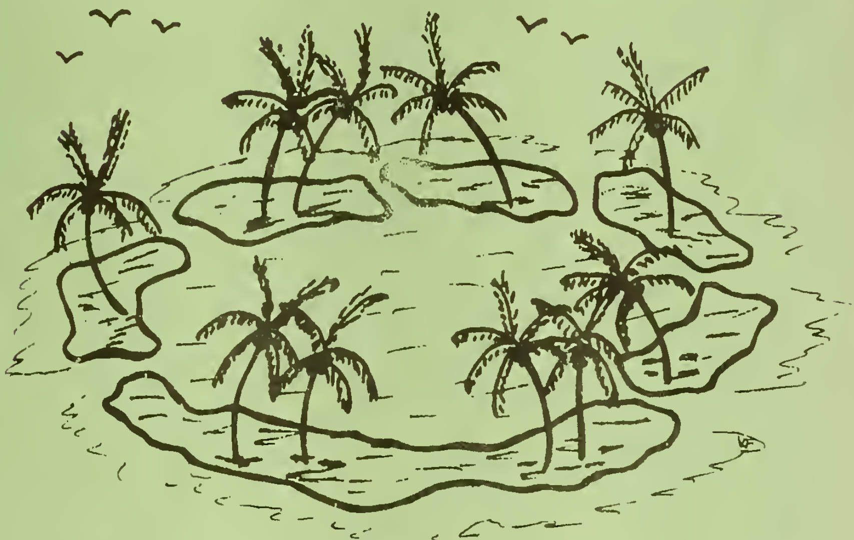
ATOLL RESEARCH BULLETIN

27. Nutrition Study in Micronesia

by MARY MURAI



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27. Nutrition Study in Micronesia

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It is a pleasure to commend the far-sighted policy of the Office of Naval Research, with its emphasis on basic research, as a result of which a grant has made possible the continuation of the Coral Atoll Program of the Pacific Science Board.

It is of interest to note, historically, that much of the fundamental information on atolls of the Pacific was gathered by the U. S. Navy's South Pacific Exploring Expedition, over one hundred years ago, under the command of Captain Charles Wilkes. The continuing nature of such scientific interest by the Navy is shown by the support for the Pacific Science Board's research programs, CIMA, SIM, and ICCP, during the past six years. The Coral Atoll Program is a part of SIM.

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NUTRITION STUDY IN MICRONESIA

SCIENTIFIC INVESTIGATIONS IN MICRONESIA
Pacific Science Board
National Research Council

Mary Murai
Honolulu, Hawaii
August 1953.

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGMENTS

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To the many others who helped to make my stay on Majuro and Truk so pleasant, I wish to express my gratitude and appreciation.

NUTRITION STUDY IN MICRONESIA

INTRODUCTION

OBJECTIVE:

To make a study of dietary habits and nutritional status of inhabitants and the nutrient composition of basic plant and animal foods in at least two islands with somewhat contrasting conditions for the purpose of developing effective methods of gathering nutrition information necessary for promoting educational and developmental programs conducive to improved conditions.

PROCEDURE:

Two islands were selected for which some medical, anthropological or other pertinent observations had been reported under the CIMA or SIM programs.

Majuro in the Marshall Islands was selected as representative of a "low" island and Udot in the Truk district, Eastern Caroline Islands, as a "high" island.

The field activities in the Marshall Islands covered the period from January 18 through May 29, 1951. The field activities in the Caroline Islands covered the period from June 27 through October 8, 1951.

Samples of native foods for nutrient analysis were also collected at this time. The samples were sent to the Foods and Nutrition Department, University of Hawaii Agricultural Experiment Station, where Professor Carey D. Miller directed the chemical analysis of the samples.

PART I

NUTRITION STUDY ON MAJURO ISLAND, MARSHALL ISLANDS

Majuro Atoll lies 7 degrees 05' North, 171 degrees 23' East, about ten miles West of Arno Atoll; it is 21 miles in an east and west direction. There are more than 50 low coral islands, of which Majuro island, the largest, stretches along the southern side for a distance of about 14 miles.

I. Planning and organizing the survey.

Before beginning the actual collection of data for the nutrition survey, time was spent in acquiring some knowledge of village life, gaining cooperation of inhabitants, becoming familiar with local foodstuffs, and local methods of preparing and cooking meals. At the same time, an attempt was made to learn enough of the native language to be able to understand simple terms which would be helpful when gathering data for the survey.

This preliminary work was done on Uliga, where it was possible to contact Marshallese officials and persons of authority and influence on the locality from whom help could be obtained, as the success of the survey, to a large degree, depended on obtaining such cooperation.

The teacher trainee group at the school, who had come from many islands of the Marshalls, helped by volunteering information on Marshallese terminology for foods, preparation of foods and description of foods used in native villages.

A list is given of Marshallese foods with a brief description of the foods which are produced locally.

A LIST OF MARSHALLESE FOODS WITH A BRIEF DESCRIPTION IN ENGLISH OF EACH FOOD

MARSHALLESE	ENGLISH
Bop	Pandanus fruit.
Eroum	Boiled or baked pandanus.
Mōkan	Cooked and preserved pandanus fruit.
Beru	Pandanus and arrowroot flour cooked together as a dessert.
Joanrong	Pandanus juice.
Mokanrul	Meat of baked or boiled pandanus fruit mixed with grated coconut and baked.
Jakaka	Shredded fresh pandanus dried for almost one week and used as a confection.
Kōbeo	Raw pandanus fruit.
Mā	Breadfruit.
Konjin	Baked breadfruit--roasted and skin scraped off before eating.
Boljej	Green breadfruit is taken and stored until it ripens. Both core and skin are removed. Hole is filled with coconut milk from grated coconuts. Hole is covered with part of core, then breadfruit is wrapped with green breadfruit, leaves tied with pandanus roots and baked about half an hour.
Kōbjar	Baked breadfruit in um or pit.
Jokkob	Breadfruit porridge--both core and skin are removed. Breadfruit is cut into pieces, boiled, mashed, mixed with coconut milk. Salt to taste.

MARSHALLESE	ENGLISH
Ainbat ben	Breadfruit is cored and skinned. Cut into pieces and boiled. After it is boiled once, it is again boiled with coconut milk.
Bwiro	Preserved breadfruit. 1. Skin is removed, core taken out and breadfruit cut into half. 2. Then breadfruit is put in a basket and left overnight anchored in the waters of the lagoon. 3. Breadfruit is taken from the lagoon and left overnight on the ground to soften. 4. Breadfruit is then put in a pit, covered with dried breadfruit leaves and left for about six months. 5. Eat when needed.
Jankwin	Made from Mijiwan (seeded) breadfruits. Take while green from tree and let ripen. Take out seeds, core, and skin. Put breadfruit in large coconut leaves which are woven into coconut leaf baskets. Put baskets in earth oven and leave overnight. Take out, unwrap, flatten out and leave out in sun to dry. After breadfruit is dried, roll and wrap in pandanus leaves and tie with sennit twine into rolls.
Manakajen	Made from preserved fermented breadfruit of the seedless variety of <u>Artocarpus incisus</u>. Preserved breadfruit is taken from the pit and compressed into slabs in "coconut cloth" (fibrous, mesh-like stipule of the coconut tree) and left out in the sun. It is usually left for one week until it becomes very hard, never exposing it to fire. How to eat manakajen: The slabs are broken up into small pieces and soaked overnight in cold water. The breadfruit is then washed and cleaned several times in water. The mixture is put in a cloth bag and the water strained out. The preserved breadfruit is put on a board and gently kneaded until it becomes sticky.
Ieok	At this stage, breadfruit can be mixed with coconut milk and jekamai (coconut syrup), wrapped in fresh breadfruit leaves and put in the earth oven to bake for two hours.

MARSHALLESE	ENGLISH
Cbubwe	After kneading until breadfruit becomes sticky, mix with coconut milk, wrap in coconut leaves and roast in open fire.
Bitrō	After kneading, breadfruit with added water can be boiled. Water with sugar is boiled, then the breadfruit mixture is dropped in the boiling water and boiled for two hours. The finished product resembles dumplings.
Ni	Coconut.
Jekaro	Coconut sap.
Mere	Meat of the immature coconut.
Iu	Embryo of the sprouting coconut.
Waini	Meat of the ripe coconut.
Jakamai	Jekaro boiled for four hours or more until it becomes a syrup (coconut syrup).
Jekajeje	Jekaro boiled for half an hour.
Amedama	Coconut candy made from a mixture of jakamai and grated coconuts.
Lukor	Iu and jekaro made into a pudding.
Iutir	Baked iu.
Jiab	Heart of the palm tree.
Ren in ni	Water of the drinking coconut.
Jimañin	Fermented coconut.
Boloñar	Immature embryo of the sprouting coconut.
Āl	Coconut milk.
Kābrañ	Banana.
Ainbat kābrañ	Boiled banana.
Fry kābrañ	Fried banana.
Jenkunin kābrañ	Dried banana halves.
Jukjuk in kābrañ	Boiled bananas in skin. Mashed and mixed with grated coconut meat. Sugar or jekaro added for flavoring.

MARSHALLESE	ENGLISH
Kābrañ emmer	Ripe banana.
Umum kābrañ	Baked banana in um.
Iik	Fish.
Iukor	Raw fish eaten with grated coconut meat, limes, and salt.
Iik umum	Baked fish in umum.
Fry iik	Fried fish with salt for flavoring.
Iik sol	Preserved fish. Head and bones are removed from fresh fish. Salted overnight. Dried for about one week.
Iik monaknok	Dried fish baked in umum and dried for one week.
Iik kālāl	Boiled fish with coconut milk.
Soup in iik	Boiled fish soup with breadfruit, arrowroot flour, rice and iu.
Iik jin	Fish cooked on heated rocks.
Iik jinbatat	Smoked fish—coconut husks and dried pandanus husks are used for smoking.
Shiokara	Salted entrails of tuna or bonito fish.
Bao	Chicken.
Bao umum	Baked chicken.
Bao ainbat	Boiled chicken.
Soup in bao	Chicken soup with breadfruit, rice and iu.
Taktake	Boiled chicken with green papayas cooked with soy sauce and sugar.
Fry bao	Fried chicken.
Koniekin pik	Pork.
Ainbat pik	Boiled pork.
Umum pik	Baked pork.
Fry pik	Pork fixed with shoyu and fried.

MARSHALLESE	ENGLISH
Pik sol	Preserved pork (salted).
Wōr	Lobster.
Ainbat wōr	Boiled lobster.
Jinkar wōr	Lobster cooked on heated rocks.
Mōj	Eel
Ainbat in mōj	Boiled eel.
Umum in mōj	Baked eel.
Mōj kālāl	Boiled eel with coconut milk.
Iaraj	_Cyrtosperma chamissonis_.
Ainbat iaraj	Boiled _Cyrtosperma chamissonis_.
Umum iaraj	Baked _Cyrtosperma chamissonis_.
Iaraj killel	_Cyrtosperma chamissonis_ boiled in coconut milk.
Jukjuk in iaraj	Mashed _Cyrtosperma chamissonis_ with grated coconut meat.
Mokmok	Arrowroot flour.
Likōbla	Arrowroot flour and jekaro mixed together.
Benben in mokmok	Arrowroot flour, jekaro and grated coconut meat.
Jup in mokmok	Arrowroot flour, iu, fish and coconut milk.
Kebjeltak	Arrowroot flour, crackers, and jekaro.
Jamkok	Arrowroot flour with grated coconut meat from semi-ripe coconuts and baked.
Banke	Pumpkin.
Ainbat in banke	Boiled pumpkin.
Bere banke	Pumpkin is boiled and mashed. Grated coconuts and sugar are added and the mixture is baked.
Jokkob in banke	Boiled pumpkin and rice.
Rimuj	Mollusk baked and boiled.
Barulep	Coconut crab boiled or baked on hot rocks.

MARSHALLESE	ENGLISH
Raj-sol	Whale preserved with salt.
Ke-umum	Baked porpoise.
Won-umum	Turtle, baked and preserved.
Kwet-ainbat and umum	Octopus, boiled and baked.
Ninet (Ratak) or Net (Rālik)	Squids, boiled and baked.
Lupenwon - ainbat and umum	Turtle eggs, baked and boiled.
Pako	Shark, baked and boiled.
Jojo	Flying fish.
Mamo	Sardine.
Tou	Mackarel.
Mon	Red snapper.
Bwebwe	Tuna fish.
Lajabil	Bonito.
Jirul	Shellfish.
Bejiwak	Black tern.
Mejo	White tern.
Ak	Frigate bird.
Nana	Booby gannet.
Kalo	Sea gull.
Mule	Pigeon.
Kear Mot	Grey tern.
Memej	Black tern.
Jekar	Black tern.
Koak	Rail.
Kot kot	Turnstone.
Ran (Ratak) or Ronbat (Rālik)	Wild duck.

FOODS AVAILABLE IN THE MARSHALL ISLANDS FOR THE MARSHALLESE

Stores were visited and prices collected during the time spent on Uliga, Marshall Islands to gather information about food purchasing and food availability. Imported food for native consumption was available at the Island Trading Company of Micronesia, Marshallese wholesalers, and retailers. A few organizations bought in small quantities from firms in the United States, but the Island Trading Company supplied the main bulk of food going to these stores.

The Island Trading Company of Micronesia had as its purpose the promotion of economic advancement and self-sufficiency of the inhabitants of the Trust Territory. The company fostered the development of private industry and commerce, adjusted the policies to encourage such developments and withdrew from any particular district or activity as soon as private enterprise demonstrated it could adequately meet the needs of the people.

Only a standard list of items were stocked. The items were bought from the Naval Supply Center, Naval Procurement Office, San Francisco, or other Island Trading Company channels. Purchases were made anywhere in the world, when it was to the best advantage to the company.

In general, sales prices were intended to cover all costs private enterprise would have to bear. Food supplies were sold to wholesalers, retailers, and directly to consumers; each group had a different set of food prices.

TABLE 1

FOODS AVAILABLE AT THE ISLAND TRADING COMPANY

AND PRICES AS OF MARCH, 1951

FOOD	WHOLESALE per lb.	RETAIL per lb.	CONSUMER per lb.
Rice	12 cents	12 cents	13 cents
Sugar	13 cents	14 cents	15 cents
Flour	9 cents	10 cents	11 cents
Coffee	62 cents	66 cents	72 cents
Biscuits	33 cents	35 cents	38 cents
Corned beef (12 oz. can)	57 cents/can	61 cents/can	66 cents/can
Tea	$1.13	$1.19	$1.30

TABLE 2

INDIGENOUS WAGE SCALES FOR THE MARSHALL ISLANDS

Group (I)	Apprentices	(minimum rate)	0.11 cents/hr.
Group (II)	Unskilled	(minimum rate)	0.17 cents/hr.
Group (III)	Semiskilled	(minimum rate)	0.21 cents/hr.
Group (IV)	Skilled	(minimum rate)	0.25 cents/hr.
Group (V)	Supervisors	(minimum rate)	0.29 cents/hr.
Group (VI)	Professionals	(minimum rate)	$40 per month

An average unskilled laborer receives about $28 per month. $90 per month is considered the highest salary paid to a Marshallese in Uliga.

Salary scales were low and food prices were comparable to the prices found in the United States where the wage scale is higher.

A number of Marshallese worked for the Civil Administration Unit for five and a half days of the week. Sunday was observed as the Sabbath and the Marshallese did not work. They spent most of the day in church. Food for Sunday was cooked on Saturday except in Darrit and Kwajalein where they cooked on Sunday.

The author asked about the possibility of fishing to help augment the food supply but the Marshallese felt that they did not have the time to fish and, therefore, must depend on imported canned foods. They found that getting sufficient food was an economic hardship, especially the protein foods, such as canned meats, canned fish and evaporated milk.

Marshallese stores

There were six retail stores and sixteen bakeries owned by Marshallese. The most important one was the Majuro Trading Association, a Marshallese cooperative composed of about 200 members. Some of the prices as of March, 1951 quoted by the Association were as follows:

Rice	11 cents/lb.
Soy sauce	$1.27/gal.
Sugar	13 cents/lb.
Saloon pilot cracker	33 cents/lb.
Flour	9 cents/lb.

Canned beef stew with vegetables	59 cents/#2 can
Canned evaporated milk (when available)	23 cents/#2 can

The storekeepers felt that the demand always exceeded the food supply.

Other food establishments

There were sixteen bakeries, two restaurants and a delicatessen. The bakeries sold eight-ounce loaves of bread for ten cents and an eight-ounce doughnut for five cents. They usually baked four times a week, and sold about fifty loaves a day. Bread is baked in large kerosene drums set in the coral lengthwise and the top cut away. The section which is cut out is covered with a piece of tin. A fire is made by using coconut husks and wood for fuel. Loaves of bread are put on sheets of tin and placed over the fire.

One restaurant was visited. The menu for lunch consisted of canned beef stew, boiled rice, coffee, and bread. Fish, pork or any other available food is substituted for the main dish. The daily menu does not vary except for the main dish. A plate lunch cost twenty five-cents or fifteen dollars on a monthly basis. Three meals were served every day of the week. Raw food supplies were bought from the Island Trading Company store once a month. Breakfast was served from 5:00 a. m. to 7:00 a. m.; lunch from 10:30 a. m. to 12:00 noon; and supper from 3:30 p. m. to 7:30 p. m.

Studying foods eaten, how they were eaten, and native food preparation at the school kitchen and at the labor camp, where they had communal cook-houses, gave more knowledge of diet patterns of the Marshallese. It was learned that large round doughnuts were used frequently and large amounts of sugar were always taken with tea. Such information was valuable later when interviewing subjects. For example, when tea was mentioned in the dietary intake records, the amount of sugar taken could be asked and such information could be included which might otherwise have been omitted. Finding doughnuts in the diets of the Marshallese was a surprise at first but later on inquiry found that they were a common and popular food in most of Micronesia. To have doughnuts mentioned in their dietaries became a common occurrence.

A field trip to the outlying districts furnished information about food consumption away from a naval base, foods available, types of utensils used, and other methods of food preparation.

Although a number of reports by others had been read, they did not furnish sufficient information to enable one to begin without making a preliminary survey. This preliminary residence in the community at Uliga was invaluable in that the knowledge gained about the manner of life, religion, and politics provided the necessary background information on habits and beliefs of the Marshallese.

The investigator had gained enough knowledge to be able to identify foods at sight, and had enough experience to estimate amounts of foods taken, as most utensils used in the village were brought from a central store and they were alike. Thus, without changing the routine procedures of the villagers with experimentation, deviations from the normal were kept at a minimum so that data collected would be indicative of their daily normal consumption of food. The survey went along smoothly and was completed in a shorter time due to preliminary planning, thus keeping the natives interested in food intake records which were kept willingly. This would have been difficult to do if the survey had been an unduly long, dull, and tedious procedure.

Other factors considered in planning and organizing the survey

1. Unit of survey

In Micronesia, a family unit is different from one in our society. A household was selected as a unit for the survey. A group who lived and ate together, usually consisting of blood relatives and relatives by adoption, was considered a household group and comparable to our family unit.

2. Sampling

The selection of subjects was influenced by availability of families, distances to be covered, attitude of people towards the survey, and presence of leading members of the community who were in close touch with people and could explain to them the purposes of the survey and introduce them to the investigator.

No statistician was available to give technical aid in choosing the sample. An attempt was made to get a representative sample of families from the Jolab district of Majuro village who were within walking distance according to the random sampling plan, giving each group the same chance of being included. Roads were good and well marked so that one could travel distances by foot. Various income groups were included, such as copra workers, storekeepers, the King and others. Many age groups, males, females, lactating women, pregnant women, and children were included. Most age groups were included but there were very few of the intermediate school age group and young adults who were either at school in Uliga, or worked in government positions at Uliga.

3. Time period

A seven day period was chosen so that any variation in food patterns would be included and thus give a more accurate account of food intakes. Diet in Majuro village goes through seasonal changes as the harvesting of vegetable crops determined the food patterns. The diet was monotonous and showed very little day to day variation.

4. Interpreter

It was necessary to employ an interpreter. He was a local person who knew local foods and sources from which they were obtained. He was familiar with the cooking and eating customs of the community. This was necessary to detect any deviation from normal which may be introduced to impress the investigator. He was aware of local habits and beliefs concerning the preparation and cooking of food so was less likely than a stranger to introduce resentment. As he was a local person, he was trusted more than an outsider and received a greater degree of co-operation from the group under survey. The techniques of interviewing and other relevant business was discussed before the survey was begun.

5. Record forms

Formal record forms were unnecessary. Informal records of the diary type were kept in bound notebooks in a uniform manner.

6. Publicity

Many means of obtaining co-operation were used such as the news items in the base newspaper about the survey which was translated into Marshallese and released to people in Majuro village. Personal visits to the King and village chiefs with gifts to explain the survey and having them pass the information on to their subjects.

III. NUTRITION SURVEY IN MAJURO VILLAGE, MAJURO ISLAND, MARSHALL ISLANDS

1. Preparation for survey in Majuro village

After the orientation period on Uliga was over, the necessary equipment, canned foods and other items, were taken to Majuro Island by Coast Guard boat.

Miss Eleanor Wilson, Protestant missionary, accompanied me to Majuro village and introduced me to the community leaders. It was very helpful to have Miss Wilson, who was respected and well-liked by the villagers, to take the investigator into a predominantly Protestant community.

There were two political groups on Majuro Island and since both groups were to be included in the study, formal calls with gifts were made to both leaders.

All this was done Saturday morning. Saturday afternoon was devoted to thoroughly cleaning the native house. An office, housekeeping and working units were set up in the house. Scales, gram and pound, and other tools for research were ready for use. The interpreter was interviewed and hired.

Church services were attended on Sunday where everyone in the community met. During the service, I was introduced to the villagers and had an opportunity to talk to them about the study and to become acquainted with them. Monday morning visits to families were begun with the interpreter.

Type and extent of waste was investigated in detail from pilot samples. In order that the accuracy of household measurements could be checked, and to obtain further information about the degree of waste and edible portions of common foods, a series of weighings were taken of common native foods. For example, data was necessary about edible portion that could be obtained from one pandanus key, the amount of drinking fluid from one immature nut, how much spoon meat could be obtained from one coconut and other similar facts. Foods were measured and weighed on a gram scale. By determining these figures, the villagers could write down the number of various foods such as two pandanus keys or three drinking coconuts. For a few foods, which appeared most frequently on dietaries, the food eaten by a number of subjects was measured and weighed in order to arrive at a more accurate estimation of the serving size. Foods such as boiled rice, taro, and breadfruit were weighed to determine in grams the amounts recorded in household measurements of foods, such as a serving of rice in an enamel dish, coconut shell, or messkit; a roasted breadfruit, half of a breadfruit, heaping tablespoon of sugar and other food items. As stated before, since most household utensils were alike as source of supply was the same, an average weight could be used for the various foods.

Several types of fish were weighed after cooking to determine edible portions by removing wastage and refuse such as bones, head and entrails.

Households were visited at random once during their weekly period at meal time. One meal was weighed to determine in grams the amount of food consumed and also to check accuracy of food amounts as noted by subjects. Food was always served cold and it was divided as evenly as possible among the members of the household. Adults took certain portions and children (6 to 10 years of age) got about half of the adult portion.

Recipes were made up for mixed cooked dishes. Many cooked food samples were brought back to the University of Hawaii Agricultural Experiment Station for chemical food analysis which were used in interpreting and calculating the diets.

2. Routine procedure of the interview

The number interviewed in a given time depended on the distances involved, as well as on the average time taken per interview. The average number per day was about eight households. Household visits began about seven in the morning and the last visit ended about six at night. Lunch was eaten at home or with villagers when invited at meal time.

Daily visits were made to the households. On the initial visit, the investigator and household members became acquainted with each other. Several things were discussed, such as the procedure to be followed for the survey and the data to be recorded. At this time, the villager displayed dishes, spoons, cups, glasses, coconut shells and other utensils and equipment used in eating so that the investigator knew what they were reporting in terms of household measurements. Individual consumption was determined by recording individual food intake in terms of servings and household measures. Portions were given as edible portions except for certain foods which were given in numbers as mentioned before in this report. Information about the household was also recorded at this time. A day's record was to be kept in Marshallese and they were to be collected the following day. When records were collected each item was discussed in detail and anything of ambiguous nature was clarified and recorded in the notebook on the premises. Some reports were given verbally and these were recorded in the notebook, also. Each person in the household was interviewed separately. Mothers were questioned about food intakes of smaller children. All food consumed during the day including between meal feedings were recorded. Data was not recorded as meal to meal as the number of meals daily differed according to individuals. There were no set meal hours nor any definite number of meals consumed daily.

3. Data collected

a. Basic data
   1. Kinds of foods eaten
   2. Distribution of foods among meals and between meal feedings
   3. Amounts eaten in numbers of foods, servings, or household measurements
   4. Time period for seven days

b. Information about household
   1. Composition of the family
      a. Number
      b. Sex
      c. Age to nearest year
      d. Other members of the household
      e. Names - all names used in the past
      f. Other relevant information
         1. Pregnancy
         2. Lactation
      g. Occupation

c. Example of a household for one week
   1. Information about the household
      Members of the household
      (a) Male, 40 years old, husband, copra maker
      (b) Female, 38 years old, wife, lactating woman
      (c) Female, 5 years old
      (d) Female, 3 months, 12 days old
      (e) Female, 70 years old, grandmother

   2. Food data

      40 years old man

Monday	
Rice, boiled, white	700 grams
Coconut, drinking (fluid only)	1
Breadfruit, Bukdrol, roasted	400 grams
Fish, Mouij, baked (edible portion)	100 grams
Tuesday	
Bread, white, fresh	8 ounces
Tea, black	1 cup
Sugar, white, granulated	$2\frac{1}{2}$ teaspoons
Rice, boiled, white	300 grams
Jawit, baked (edible portion)	300 grams
Taro, Kaliklik, boiled	500 grams
Water	1 cup
Milk, evaporated	2 teaspoons
Sugar, white, granulated	2 teaspoons
Wednesday	
Baru (little crab)	10
Rice, boiled, white	700 grams

Bread, white, fresh	4 slices
Coconut, drinking (fluid only)	1
Pandanus, raw	13 keys
Tea, black	2 cups
Sugar, white, granulated	4 teaspoons
Thursday	
Rice, boiled, white	500 grams
Fish, Kuban, baked	400 grams
Tea, black	2 cups
Sugar, white, granulated	4 tablespoons
Coconut, drinking (fluid only)	2
Pandanus, raw	13 keys
Coconut, mature, meat	200 grams
Friday	
Fish, Net, baked	200 grams
Bread, white, fresh	4 ounces
Tea, black	1 cup
Sugar, white, granulated	2 tablespoons
Coconut, drinking, (fluid only)	1
Pig, roasted	100 grams
Breadfruit, Batakdak, roasted	400 grams
Saturday	
Rice, boiled, white	400 grams
Breadfruit, roasted, Bukdrol	200 grams
Fish, Mouij, baked	200 grams
Coffee	2 cups
Sugar, white, granulated	4 tablespoons
Sunday	
Breadfruit, Bukdrol, roasted	200 grams
Pig, roasted	100 grams
Doughnut	1
Rice, boiled, white	400 grams
Tea, black	1 cup
Sugar, white, granulated	2 tablespoons

38 years old woman

Monday	
Rice, boiled, white	700 grams
Coconut, drinking (fluid only)	1
Breadfruit, Bukdrol, roasted	400 grams
Fish, Mouij, baked	100 grams
Tuesday	
Taro, Kaliklik, boiled	500 grams
Coconut, mature, meat	200 grams
Tea, black	2 cups
Pandanus, raw	3 keys
Wednesday	
Rice, boiled, white	300 grams
Taro, Wan, boiled	200 grams

Coconut, drinking (fluid only)	1
Coconut, spoon meat	1
Pandanus, raw	11 keys
Tea, black	2 cups
Sugar, white, granulated	2 teaspoons
Thursday	
Rice, boiled, white	500 grams
Fish, Kuban, baked	400 grams
Tea, black	2 cups
Sugar, white, granulated	4 tablespoons
Coconut, drinking (fluid only)	2
Pandanus, raw	13 keys
Coconut, mature, meat	200 grams
Friday	
Fish, Net, baked	200 grams
Bread, white, fresh	4 ounces
Tea, black	1 cup
Sugar, white, granulated	2 tablespoons
Saturday	
Rice, boiled, white	400 grams
Breadfruit, Bukdrol, roasted	200 grams
Fish, Mouij, baked	200 grams
Coffee	2 cups
Sugar, white, granulated	4 tablespoons
Sunday	
Breadfruit, Bukdrol, roasted	200 grams
Pig, roasted	100 grams
Doughnut	1
Rice, boiled, white	400 grams
Tea, black	1 cup
Sugar, white, granulated	2 tablespoons

5 years old female

Monday	
Rice, boiled, white	300 grams
Breadfruit, Bukdrol, roasted	200 grams
Salted fish, Mouij, boiled	50 grams
Tuesday	
Fish, Jawit, baked	50 grams
Rice, boiled, white	100 grams
Sausage, pork	50 grams
Tea, black	1 cup
Sugar, white, granulated	½ teaspoon
Wednesday	
Rice, boiled, white	200 grams
Pandanus, raw	5 keys
Coconut, drinking (fluid only)	1
Coconut, spoon meat	1
Tea, black	½ cup
Sugar, white, granulated	½ tablespoon

Thursday	
Rice, boiled, white	200 grams
Fish, Kuban, baked	150 grams
Pandanus, raw	4 keys
Coconut, mature, meat	50 grams
Tea, black	1 cup
Sugar, white, granulated	1 tablespoon
Friday	
Fish, Net, baked	100 grams
Bread, white, fresh	2 ounces
Coconut, drinking (fluid only)	1
Pig, roasted	100 grams
Breadfruit, Batakdak, roasted	100 grams
Saturday	
Doughnut	1
Rice, boiled, white	200 grams
Fish, Mouij, baked	100 grams
Breadfruit, Bukdrol, roasted	200 grams
Coffee	1 cup
Sugar, white, granulated	1 teaspoon
Sunday	
Breadfruit, Bukdrol, roasted	100 grams
Pig, roasted	100 grams
Doughnut	1
Rice, boiled, white	200 grams
Tea	1 cup
Sugar, white, granulated	1 tablespoon

Baby 3 months, 12 days old

Monday	
Coconut, drinking (fluid only).	4 ounces
Milk, breast	
Tuesday	
Milk, evaporated	4 ounces
Water, boiled	3 teaspoons
Milk, breast	
Wednesday	
Milk, evaporated	2 ounces
Milk, breast	
Thursday	
Milk, evaporated	2 ounces
Water, boiled	2 ounces
Milk, breast	
Water, boiled	4 ounces
Friday	
Coconut, drinking (fluid only)	8 ounces
Milk, breast	

Saturday	
Milk, evaporated	4 ounces
Water, boiled	4 ounces
Milk, breast	
Sunday	
Coconut, drinking (fluid only)	4 ounces
Milk, breast	

70 years old woman

Monday	
Rice, boiled, white	700 grams
Coconut, drinking (fluid only)	1
Breadfruit, Bukdrol, roasted	400 grams
Fish, Mouij, baked	100 grams
Tuesday	
Taro, Kaliklik, boiled	500 grams
Coconut, mature, meat	200 grams
Tea, black	1 cup
Sugar, white, granulated	2 teaspoons
Pandanus, raw	3 keys
Wednesday	
Rice, boiled, white	300 grams
Taro, Wan, boiled	200 grams
Coconut, drinking (fluid only)	1
Coconut, spoon meat	1
Pandanus, raw	11 keys
Tea, black	1 cup
Sugar, white, granulated	2 teaspoons
Thursday	
Rice, boiled, white	500 grams
Fish, Kuban, baked	400 grams
Tea, black	2 cups
Sugar, white, granulated	4 tablespoons
Coconut, drinking (fluid only)	2
Pandanus, raw	13 keys
Coconut, mature, meat	200 grams
Friday	
Fish, Net, baked	200 grams
Bread, white, fresh	4 ounces
Tea, black	1 cup
Sugar, white, granulated	2 tablespoons
Saturday	
Rice, boiled, white	400 grams
Breadfruit, Bukdrol, roasted	200 grams
Fish, Mouij, baked	200 grams
Coffee	2 cups
Sugar, white, granulated	4 tablespoons
Sunday	
Breadfruit, Bukdrol, roasted	200 grams
Pig, roasted	100 grams
Doughnut	1
Rice, boiled, white	400 grams
Tea, black	1 cup
Sugar, white, granulated	2 tablespoons

Treatment of the dietary survey data

From the detailed dietary record of each subject, the consumption of each food was recorded, tabulated and calculated.

The calorie value and the nutrients supplied by these foods were then determined by the use of food composition tables.

The tables used were as follows:

1. Food Values of Portions Commonly Used, Bowes and Church. (1)

2. Composition of Foods. U.S.D.A. Agriculture Handbook No. 8. (2)

3. Composition of Foods Used in Far Eastern Countries. Agriculture Handbook No. 34. (3)

4. Food Values of Portions Commonly Used, Hawaii Supplement to Bowes and Church, Carey D. Miller, Marian Weaver and Stella Okita. (4)

5. Protein, Fat, Mineral and Vitamin Content of South Pacific Island Foods. Unpublished data on native foods, brought back from field by author, from the laboratories of Professor Carey D. Miller, Foods and Nutrition Department, University of Hawaii Agricultural Experiment Station, Honolulu, Hawaii. (5)

The composite cooked dishes were converted back to raw weight equivalents of ingredients used.

The calorie and nutrient values of the diet were expressed on a per person per day basis.

Assessment of adequacy of diets

To assess the adequacy of diets, appropriate standards must be used as the basis of comparison. The Recommended Daily Dietary Allowances, Revised 1948, Food and Nutrition Board, National Research Council (6), were used as standards. Since definite figures were not given for phosphorus, Sherman's standards were used (7). For fat allowances, 25% of the calories intake for each age group was taken as suggested in the report of Food Consumption Levels in the United States, Canada and the United Kingdom (8).

The average per capita intake for calories and nutrients, as determined in the survey, was compared with the average per capita recommended allowances.

Comparison of the actual intake of individuals with these allowances indicates how closely intake approaches the recommended level for calories and various nutrients for optimum health. Conclusions can then be drawn as to which persons have a dietary status less favorable than others.

RESULTS

Infants under one year of age

Intake records for infants under one year of age were collected for eight subjects. Calories and nutrient values were calculated whenever possible, however, intakes of breast feeding were not recorded. Therefore, all calculations exclude breast milk intakes.

There were three female infants on a diet of breast milk and boiled water. One subject was two weeks old; another, one month old; and the third, six months old.

One female infant of three months had the following foods in her diet: breast milk, boiled water, evaporated milk, and drinking fluid of immature coconuts. The daily intake was estimated at 81 grams of coconut fluid, 2 ozs. of evaporated milk diluted with 2 ozs. of boiled water, and 2 ozs. of boiled water. Calculated daily caloric and nutrient values were as follows: calories, 87; protein, 4 gms.; fat, 4.4 gms.; carbohydrate, 7.94 gms.; calcium, 151.11 mgs.; phosphorus, 112.64 mgs.; iron, 0.19 mgs.; vitamin A, 219.4 I. U.; thiamine, 27.4 mcgs.; riboflavin, 205.58 mcgs.; niacin, 0.11 mgs.; and ascorbic acid, 32 mgs.

One female infant of six months of age had for a day's intake, breadfruit either baked or roasted, 16 mgs.; evaporated milk, 4 ozs. diluted with 4 ozs. of boiled water; coconut sap, 56 gms.; boiled water, 4 ozs.; and breast milk. Calculated daily caloric and nutrient values were as follows: calories, 144.88; protein, 5.34 gms.; fat, 5.91 gms.; carbohydrate, 15.19 gms.; calcium, 180.94 mgs.; phosphorus, 155.10 mgs.; iron, 0.47 mgs.; vitamin A, 292.6 I. U.; thiamine, 53.34 mcgs.; riboflavin, 280.93 mcgs.; niacin, 0.54 mgs.; and ascorbic acid, 12.96 mgs.

One female infant of eight months had a diet of breast milk, evaporated milk, boiled water, boiled white rice, bread, tea with sugar, and soda crackers. Taking a day's intake, consumption was estimated at 4 ozs. of evaporated milk diluted with 4 ozs. of water; 4 ozs. of boiled water; 15 gms. of boiled rice; 15 gms. of white bread; 1 cup of tea with 1/2 teaspoon of sugar; and breast milk. Calculated daily caloric and nutrient values were as follows: calories, 84.72; protein, 1.76 gms.; fat, 1.05 gms.; carbohydrate, 16.63 gms.; calcium, 3.52 mgs.; phosphorus, 18.56 mgs.; iron 0.28 mgs.; vitamin A, 1.47 I. U.; thiamine, 30.41 mcgs.; riboflavin, 13.65 mcgs.; niacin, 0.23 mgs.; and a trace of ascorbic acid.

The daily estimated consumption of one male infant of eight months: breast milk; evaporated milk, 5 ozs. diluted with 5 ozs. of boiled water; boiled water, 8 ozs; and roasted breadfruit, 30 gms. Calculated daily caloric and nutrient values were as follows: calories, 278.4; protein, 12.89 gms.; fat, 14.14 gms.; carbohydrate, 25.23 gms.; calcium, 441.06 mgs.; phosphorus, 363.68 mgs.; iron, 0.66 mgs.; vitamin A 713.1 I. U.; thiamine, 117.73 mcgs.; riboflavin, 660.58 mcgs.; niacin, 0.76 mgs.; and 2.16 mgs. ascorbic acid.

One male infant of eleven months had the following foods in his dietary: breadfruit, roasted; boiled pandanus keys; coconut embryos;

drinking fluid of immature coconuts; boiled white rice; ripe bananas; white bread; doughnuts; soda crackers; limes; white granulated sugar; and baked or boiled fish. The daily estimated intake was as follows: breadfruit roasted, 350 gms.; boiled pandanus keys, 50 gms.; coconut embryos,150 gms., fluid of immature coconuts, 100 gms.; boiled white rice, 150 gms.; and ripe bananas, 60 gms. Calculated daily nutrient intakes were as follows: calories, 944.43; protein, 23.06 gms.; fat, 6.92 gms.; carbohydrate, 196.99 gms.; calcium, 180.81 mgs.; phosphorus, 433-36 mgs.; iron, 10.96 mgs.; vitamin A, 1239.98 I. U.; thiamine, 676.10 mcgs.; riboflavin, 524.22 mcgs.; niacin, 8.56 mgs.; and ascorbic acid, 17.26 mgs.

Table 3 shows the daily quantities of various nutrients per person and comparison with NRC allowances of one hundred sixty-one subjects from the ages of 1 through 70 years of age.

There were forty-eight children, ages one through twelve years of age; forty-six males, ages thirteen through 70 years of age; and sixty-seven females, ages one through 70 years of age; included among the adult females are pregnant and lactating women. They are divided into different age groups, giving the number of subjects in each group, sex, range of each nutrient, number of subjects in each group, average NRC allowances and number below allowances and percent of subjects below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin and ascorbic acid.

1. Calories

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 406 to 1304 calories, and the average per person was 823 calories. The average figure was 68% of the NRC allowances of 1200 calories. Twenty-two subjects or 92% were below allowances and two subjects or 8% were above allowances.

Table 3.

Dietary Studies of the Marshallese of Majuro Village, Majuro Atoll, Marshall Islands by Mary Murai

Daily Quantities of Various Nutrients per Person
and Comparison with National Research Council Allowances

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Calories									
1-3	24	M+F	406-1304	< 500 500-1499	3 21	823	1200	22	92
4-6	12	M+F	471-1635	< 500 500-1499 1500-2499	1 10 1	1096	1600	11	92
7-9	6	M+F	1095-1827	1000-1999	6	1269	2000	6	100
10-12	6	M+F	1193-1913	1000-1999	6	1577	2500	6	100
13-15	3	M	597-1910	500-1499 1500-2499	1 2	1385	3200	3	100
13-15	3	F	1469-1521	1000-1999	3	1487	2600	3	100
16-20	2	M	1186-3294	1000-1999 3000-3999	1 1	2240	3800	2	100
16-20	4	F	972-1703	500-1499 1700-2699	3 1	1323	2400	4	100
21-60	33	M	407-2187	< 500 500-1499 1500-2499	1 17 15	1469	3000	33	100
21-60	36	F	499-2483	< 500 500-1499 1500-2499	1 22 13	1365	2400	35	97

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver- age	NRC allow- ances	Number below allowances	Percent below allowances
61-70	8	M	640-1684	500-1499	4	1302	2400	8	100
				1500-2499	4				
61-70	9	F	368-1829	<500	1	1197	2000	9	100
				500-1499	5				
				1500-2499	3				
Pregnant women	4	F	714-1375	500-1499	4	1013	2400	4	100
Lactating women	11	F	1081-2078	1000-1999	9	1695	3000	11	100
				2000-2999	2				
Protein (gm.)									
1-3	24	M/F	5-49	<20	11	26	40	21	88
				20-39	10				
				40-59	3				
4-6	12	M/F	14-91	<20	2	42	50	8	67
				20-39	5				
				40-59	3				
				90-109	2				
7-9	6	M/F	39-64	20-39	1	52	60	3	50
				40-59	2				
				60-79	3				
10-12	6	M/F	35-88	30-49	1	62	70	5	83
				50-69	4				
				80-109	1				
13-15	3	M	23-80	20-39	1	49	85	3	100
				40-59	1				
				80-109	1				
13-15	3	F	52-69	50-69	3	59	80	3	100

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	2	M	42-142	40-59	1	92	100	1	50
				140-159	1				
16-20	4	F	28-81	20-39	2	52	75	3	75
				60-79	1				
				80-109	1				
21-60	33	M	8-134	<20	3	54	70	27	82
				20-39	9				
				40-59	10				
				60-79	8				
				120-139	3				
21-60	36	F	8-85	<20	5	47	60	26	72
				20-39	7				
				40-59	14				
				60-79	8				
				80-99	2				
61-70	8	M	23-50	20-39	3	42	70	8	100
				40-59	5				
61-70	9	F	13-76	<20	3	38	60	7	78
				20-39	2				
				40-59	2				
				60-79	2				
Pregnant women	4	F	20-63	20-39	3	32	85	4	100
				60-79	1				
Lactating women	11	F	34-88	30-49	2	62	100	11	100
				50-69	6				
				70-89	3				
<u>Fat</u> (gm.)									
1-3	24	M/F	1-37	<20	22	13	33	23	96
				20-49	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver- age	NRC allow- ances	Number below allowances	Percent below allowances
4-6	12	M/F	8-50	< 20 20-49 50-79	7 4 1	21	44	11	92
7-9	6	M/F	10-36	< 20 20-49	3 3	21	56	6	100
10-12	6	M/F	21-52	20-49 50-79	5 1	30	69	6	100
13-15	3	M	17-48	< 20 40-79	2 1	28	89	3	100
13-15	3	F	17-30	< 20 20-49	1 2	25	72	3	100
16-20	2	M	5-60	< 20 60-89	1 1	32	105	2	100
16-20	4	F	3-28	< 20 20-49	3 1	15	67	4	100
21-60	33	M	2-95	< 20 20-49 90-119	16 16 1	24	83	32	97
21-60	36	F	2-50	< 20 20-49	10 26	23	67	35	97
61-70	8	M	3-32	< 20 20-49	5 3	16	67	8	100
61-70	9	F	2-34	< 20 20-49	5 4	19	56	9	100
Pregnant women	4	F	2-19	< 20	4	8	67	4	100
Lactating women	11	F	10-44	< 20 20-49	3 8	27	83	11	100

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
<u>Calcium</u> (mg.)									
1-3	24	M/F	48-647	< 200	14	229	1000	24	100
				200-399	7				
				500-699	3				
4-6	12	M/F	112-627	< 200	4	303	1000	12	100
				200-399	4				
				400-599	3				
				600-799	1				
7-9	6	M/F	129-1028	< 200	1	534	1000	4	67
				200-399	2				
				400-599	1				
				1000-1299	2				
10-12	6	M/F	112-1028	<200	1	486	1200	6	100
				200-399	1				
				400-599	3				
				1000-1299	1				
13-15	3	M	188-509	< 200	1	313	1400	3	100
				200-399	1				
				400-599	1				
13-15	3	F	150-714	< 200	1	442	1300	3	100
				400-599	1				
				700-999	1				
16-20	2	M	289-690	200-399	1	489	1400	2	100
				600-799	1				
16-20	4	F	191-375	< 200	1	277	1000	4	100
				200-399	3				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver- age	NRC allow- ances	Number below allowances	Percent below allowances
21-60	33	M	92-1029	< 200	6	390	1000	32	97
				200-399	10				
				400-599	13				
				600-799	2				
				800-999	1				
				1000-1199	1				
21-60	36	F	112-799	< 200	4	363	1000	36	100
				200-399	19				
				400-599	9				
				600-799	4				
61-70	8	M	145-768	< 200	2	308	1000	8	100
				200-399	4				
				400-599	1				
				600-799	1				
61-70	9	F	177-662	< 200	3	375	1000	9	100
				200-399	4				
				400-599	1				
				600-799	1				
Pregnant women	4	F	107-319	< 200	2	205	1500	4	100
				200-399	2				
Lactating women	11	F	213-667	200-399	4	466	2000	11	100
				400-599	4				
				600-799	3				
Phosphorus (mg.)									
1-3	24	M/F	157-868	< 200	3	404	1000	24	100
				200-399	12				
				400-599	5				
				600-799	2				
				800-999	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
4-6	12	M/F	218-928	200-399	3	572	1000	12	100
				400-599	4				
				600-799	2				
				800-999	3				
7-9	6	M/F	466-1125	400-599	3	732	1200	6	100
				800-999	2				
				1000-1999	1				
10-12	6	M/F	481-1745	400-599	1	925	1200	5	83
				600-799	1				
				800-999	3				
				1500-1699	1				
13-15	3	M	302-752	302-500	1	552	1320	3	100
				602-752	2				
13-15	3	F	572-782	500-699	2	655	1200	3	100
				700-899	1				
16-20	2	M	673-2422	600-799	1	1547	1320	1	50
				> 2000	1				
16-20	4	F	360-1911	300-499	1	867	1200	2	50
				700-899	1				
				> 1200	2				
21-60	33	M	299-1784	200-399	5	744	1320	30	91
				400-599	9				
				600-799	9				
				800-999	6				
				1200-1399	2				
				> 1400	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver-age	NRC allow-ances	Number below allowances	Percent below allowances
21-60	36	F	32-1704	< 200	1	661	1320	35	97
				200-399	2				
				400-599	10				
				600-799	16				
				800-999	5				
				1200-1399	1				
				>1400	1				
61-70	8	M	360-986	200-399	2	601	1320	8	100
				400-599	3				
				600-799	2				
				800-999	1				
61-70	9	F	313-1319	200-399	3	582	1320	9	100
				400-599	3				
				600-799	2				
				1200-1399	1				
Pregnant women	4	F	287-810	200-399	3	451	1800	4	100
				800-999	1				
Lactating women	11	F	597-1097	400-599	1	840	1800	11	100
				600-799	4				
				800-999	3				
				1000-1199	3				
<u>Iron</u> (mg.)									
1-3	24	M/F	1-12	< 5	7	6	7	15	62
				5-9	13				
				10-14	4				
4-6	12	M/F	3-11	< 5	2	8	8	4	33
				5-9	9				
				10-14	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
7-9	6	M/F	5-17	5-9 10-14 >15	3 2 1	10	10	3	50
10-12	6	M/F	8-15	5-9 10-14 >15	1 4 1	11	12	4	67
13-15	3	M	5-11	5-9 10-14	2 1	8	15	3	100
13-15	3	F	6-12	5-9 10-14	2 1	9	15	3	100
16-20	2	M	8-27	5-9 >15	1 1	17	15	1	50
16-20	4	F	5-17	5-9 10-14 >15	1 1 2	6	15	2	50
21-60	33	M	4-19	< 5 5-9 10-14 > 15	3 11 10 9	10	12	21	64
21-60	36	F	4-18	< 5 5-9 10-14 > 15	4 13 16 3	10	12	24	67
61-70	8	M	5-15	5-9 10-14 >15	5 2 1	8	12	6	75
61-70	9	F	5-28	< 5 5-9 10-14 >15	1 4 2 2	11	12	7	78

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Pregnant women	4	F	4-10	< 5	1	7	15	4	100
				5-9	2				
				10-14	1				
Lactating women	11	F	7-17	5-9	2	12	15	8	73
				10-14	6				
				>15	3				
Vitamin A (I.U.)									
1-3	24	M/F	29-6569	< 499	9	1404	2000	20	83
				500-999	6				
				1000-1999	5				
				>2000	4				
4-6	12	M/F	52-9346	< 499	5	2019	2500	10	83
				500-999	3				
				1000-1999	1				
				>2000	3				
7-9	6	M/F	77-10231	< 499	4	3508	3500	4	67
				>2000	2				
10-12	6	M/F	118-10230	<499	4	2550	4500	5	83
				>2000	2				
13-15	3	M	88-1781	< 499	1	901	5000	3	100
				500-999	1				
				1000-1999	1				
13-15	3	F	79-824	< 499	2	332	5000	3	100
				500-999	1				
16-20	2	M	140-3458	< 499	1	1799	6000	1	50
				>2000	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	4	F	138-2853	<499	1	1119	5000	4	100
				500-999	2				
				>2000	1				
21-60	33	M	83-12067	< 499	20	1307	5000	30	91
				500-999	7				
				1000-1999	1				
				>2000	5				
21-60	36	F	72-10231	< 499	19	1524	5000	32	89
				500-999	6				
				1000-1999	3				
				>2000	8				
61-70	8	M	74-1865	< 499	6	436	5000	8	100
				500-999	1				
				1000-1999	1				
61-70	9	F	82-7231	< 499	5	1375	5000	8	89
				1000-1999	3				
				>2000	1				
Pregnant women	4	F	209-1730	< 499	1	1040	6000	2	50
				500-999	1				
				1000-1999	2				
Lactating women	11	F	148-8693	< 499	3	2499	8000	10	91
				500-999	3				
				1000-1999	1				
				>2000	4				
<u>Thiamine</u> (mcg.)									
1-3	24	M/F	124-1192	< 200	1	503	600	18	75
				200-499	12				
				500-799	9				
				800-1099	1				
				1100-1399	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
4-6	12	M/F	380-1064	200-499	5	642	800	9	75
				500-799	4				
				800-1099	3				
7-9	6	M/F	284-1259	200-499	3	631	1000	5	83
				500-799	1				
				800-1199	1				
				1100-1399	1				
10-12	6	M/F	417-1221	200-499	1	801	1200	5	83
				500-799	2				
				800-1099	2				
				1100-1399	1				
13-15	3	M	377-1435	200-499	1	939	1500	3	100
				800-1099	1				
				1400-1699	1				
13-15	3	F	708-772	500-999	3	745	1300	3	100
16-20	2	M	721-2109	721	1	1415	1700	1	50
				2109	1				
16-20	4	F	452-1021	200-499	1	801	1200	4	100
				500-799	1				
				800-1099	2				
21-60	33	M	431-2045	200-499	3	944	1500	28	85
				500-799	13				
				800-1099	8				
				1100-1399	3				
				1400-1699	4				
				>1500	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
21-60	36	F	296-2090	200-499	7	809	1200	31	86
				500-799	14				
				800-1099	10				
				1100-1399	3				
				>1500	2				
61-70	8	M	447-1875	200-499	2	839	1200	7	88
				500-799	3				
				800-1099	2				
				>1500	1				
61-70	9	F	345-1494	200-499	2	683	1000	8	89
				500-799	6				
				1400-1699	1				
Pregnant women	4	F	546-933	500-799	3	718	1500	4	100
				800-1099	1				
Lactating women	11	F	121-1910	< 200	1	876	1500	10	91
				500-799	5				
				800-1099	1				
				1100-1399	3				
				>1500	1				
<u>Riboflavin</u> (mcg.)									
1-3	24	M/F	99-964	< 500	18	409	900	23	96
				500-799	5				
				800-1099	1				
4-6	12	M/F	221-700	< 500	9	439	1200	12	100
				500-799	3				
7-9	6	M/F	365-863	< 500	3	563	1500	6	100
				500-799	2				
				800-1099	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
10-12	6	M/F	471-831	< 500	3	621	1800	6	100
				500-799	2				
				800-1099	1				
13-15	3	M	320-877	< 500	1	622	2000	3	100
				500-799	1				
				800-1099	1				
13-15	3	F	459-653	< 500	1	568	2000	3	100
				500-799	2				
16-20	2	M	684-1583	500-799	1	1133	2500	2	100
				>1500	1				
16-20	4	F	458-832	< 500	2	637	1800	4	100
				500-799	1				
				800-1099	1				
21-60	33	M	367-1477	< 500	9	726	1800	33	100
				500-799	15				
				800-1099	3				
				1100-1399	5				
				1400-1699	1				
21-60	36	F	375-1318	< 500	12	648	1500	36	100
				500-799	18				
				800-1099	4				
				1100-1399	2				
61-70	8	M	351-1150	< 500	3	619	1800	8	100
				500-799	4				
				1100-1399	1				
61-70	9	F	383-958	< 500	5	550	1500	9	100
				500-799	3				
				800-1099	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Pregnant women	4	F	262-770	< 500	2	485	2500	4	100
				500-799	2				
Lactating women	11	F	384-1293	< 500	1	786	3000	11	100
				500-799	6				
				800-1099	3				
				1100-1399	1				
<u>Niacin</u> (mg.)									
1-3	24	M/F	3-14	< 10	23	11	6	8	33
				10-19	1				
4-6	12	M/F	6-16	< 10	10	9	8	5	42
				10-19	2				
7-9	6	M/F	10-15	10-19	6	12	10	0	0
10-12	6	M/F	9-17	< 10	2	12	10	2	33
				10-19	4				
13-15	3	M	9-18	< 10	1	13	15	2	67
				10-19	2				
13-15	3	F	11-14	10-19	3	12	13	2	67
16-20	2	M	9-25	< 10	1	17	17	1	50
				20-29	1				
16-20	4	F	8-12	< 10	1	10	12	3	75
				10-19	3				
21-60	33	M	7-40	< 10	7	13	15	23	70
				10-19	21				
				20-29	4				
				40-49	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver-age	NRC allow-ances	Number below allowances	Percent below allowances
21-60	36	F	7-20	< 10	11	12	12	17	47
				10-19	24				
				20-29	1				
61-70	8	M	8-15	< 10	3	12	12	3	38
				10-19	5				
61-70	9	F	7-15	< 10	5	10	10	4	44
				10-19					
Pregnant women	4	F	6-11	< 10	3	8	15	4	100
				10-19	1				
Lactating women	11	F	10-21	10-19	9	16	15	5	45
				20-29	2				
Ascorbic Acid (mg.)									
1-3	24	M/F	3-114	< 10	13	20	35	20	83
				10-29	6				
				30-49	3				
				> 50	2				
4-6	12	M/F	1-78	< 10	5	30	50	8	67
				10-29	2				
				30-49	1				
				> 50	4				
7-9	6	M/F	5-47	< 10	3	19	60	6	100
				10-29	1				
				30-49	2				
10-12	6	M/F	6-57	< 10	2	26	75	6	100
				10-29	2				
				30-49	1				
				> 50	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
13-15	3	M	6-88	< 10	2	33	90	3	100
				> 50	1				
13-15	3	F	3-9	< 10	3	6	80	3	100
16-20	2	M	8-32	< 10	1	20	100	2	100
				30-49	1				
16-20	4	F	7-47	< 10	2	10	80	4	100
				10-29	1				
				30-49	1				
21-60	33	M	3-88	< 10	22	14	75	32	97
				10-29	6				
				30-49	3				
				> 50	2				
21-60	36	4	4-88	< 10	21	13	70	35	97
				10-29	12				
				30-49	1				
				> 50	2				
61-70	8	M	7-34	< 10	6	11	75	8	100
				10-29	1				
				30-49	1				
61-70	9	F	4-32	< 10	4	13	70	9	100
				10-29	4				
				30-49	1				
Pregnant women	4	F	6-18	< 10	3	9	100	4	100
				10-29	1				
Lactating women	11	F	5-71	< 10	6	17	150	11	100
				10-29	3				
				> 50	2				

For twelve male and female subjects, 4 to 6 years of age, the range was from 471 to 1635 calories, and the average per person was 1096 calories. The average figure was 68% of the NRC allowances of 1600 calories. Eleven subjects or 92% were below allowances and one subject or 8% was above the allowance.

For six male and female subjects, 7 to 9 years of age, the range was from 1095 to 1827 calories, and the average per person was 1269 calories. The average figure was 63% of the NRC allowances of 2000 calories. Six subjects or 100% were below allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 1193 to 1913 calories, and the average per person 1577 calories. The average figure was 63% of the NRC allowances of 2500 calories. Six subjects or 100% were below allowances.

For three male subjects, 13 to 15 years of age, the range was from 597 to 1910 calories, and the average per person was 1385 calories. The average figure was 43% of the NRC allowances of 3200 calories. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 1469 to 1521 calories, and the average per person was 1487 calories. The average figure was 57% of the NRC allowances of 2600 calories. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 1186 to 3294 calories, and the average per person was 2240 calories. The average figure was 59% of the NRC allowances of 3800 calories. Two subjects or 100% were below allowances.

For four female subjects, 16 to 20 years of age, the range was from 972 to 1703 calories, and the average per person was 1323 calories. The average figure was 55% of the NRC allowances of 2400 calories. Four subjects or 100% were below allowances.

For thirty-three male subjects, 21 to 60 years of age, the range was from 407 to 2187 calories, and the average per person was 1469 calories. The average figure was 49% of the NRC allowances of 3000 calories. Thirty-three subjects or 100% were below allowances.

For thirty-six female subjects, 21 to 60 years of age, the range was from 499 to 2483 calories, and the average per person was 1365 calories. The average figure was 57% of the NRC allowances of 2400 calories. Thirty-five subjects or 97% were below allowances and one subject or 3% was above the allowance.

For eight male subjects, 61 to 70 years of age, the range was from 640 to 1684 calories, and the average per person was 1302 calories. The average figure was 54% of the NRC allowances of 2400 calories. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 368 to 1829 calories, and the average per person was 1197 calories. The average figure was 60% of the NRC allowances of 2000 calories. Nine subjects or 100% were below allowances.

For four female subjects, pregnant women, the range was from 714 to 1375 calories, and the average per person was 1013 calories. The average figure was 42% of the NRC allowances of 2400 calories. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 1081 to 2078 calories, and the average per person was 1695 calories. The average figure was 56% of the NRC allowances of 3000 calories. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred fifty-seven subjects or 97% were below allowances and four subjects or 3% were above allowances.

2. Protein

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 5 to 49 grams, and the average per person was 26 gms. The average figure was 65% of the NRC allowances of 40 gms. Twenty-one or 88% were below allowances and three subjects or 12% were above allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 14 to 91 gms., and the average per person was 42 gms. The average figure was 84% of the NRC allowances of 50 gms. Eight subjects or 67% were below allowances and four subjects or 33% were above allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 39 to 64 gms., and the average per person was 52 gms. The average figure was 87% of the NRC allowances of 60 gms. Three subjects or 50% were below allowances and three subjects or 50% were above allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 35 to 88 gms., and the average per person was 62 gms. The average figure was 88% of the NRC allowances of 70 gms. Five subjects or 83% were below allowances and one subject or 17% was above the allowance.

For three male subjects, 13 to 15 years of age, the range was from 23 to 80 gms., and the average per person was 49 gms. The average figure was 58% of the NRC allowances of 85 gms. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was 52 to 69 gms., and the average per person was 59 gms. The average figure was 74% of the NRC allowances of 80 gms. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 42 to 142 gms., and the average per person was 92 gms. The average figure was 92% of the NRC allowances of 100 gms. One subject or 50% was below the allowance and one subject or 50% was above the allowance.

For four female subjects, 16 to 20 years of age, the range was from 28 to 81 gms., and the average per person was 52 gms. The average figure was 69% of the NRC allowances of 75 gms. Three subjects or 75% were below allowances and one subject or 25% was above the allowance.

For thirty-three male subjects, 21 to 60 years of age, the range was from 8 to 134 gms., and the average per person was 54 gms. The average figure was 77% of the NRC allowances of 70 gms. Twenty-seven subjects or 82% were below allowances and six subjects or 18% were above allowances.

For thirty-six female subjects, 21 to 60 years of age, the range was from 8 to 85 gms., and the average per person was 47 gms. The average figure was 78% of the NRC allowances of 60 gms. Twenty-six subjects or 72% were below allowances and ten or 28% were above allowances.

For eight male subjects, 61 to 70 years of age, the range was from 23 to 50 gms., and the average per person was 42 gms. The average figure was 60% of the NRC allowances of 70 gms. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 13 to 76 gms., and the average per person was 38 gms. The average figure was 63% of the NRC allowances of 60 gms. Seven subjects or 78% were below allowances and two or 22% were above allowances.

For four female subjects, pregnant women, the range was from 20 to 63 gms., and the average per person was 32 gms. The average figure was 38% of the NRC allowances of 85 gms. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 34 to 88 gms., and the average per person was 62 gms. The average figure was 62% of the NRC allowances of 100 gms. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred thirty or 81% were below allowances and thirty-one or 19% were above allowances.

3. Fat

For twenty-four male and female subjects, 1 to 3 years of age, the range was from one to 37 gms., and the average per person was 13 gms. The average figure was 39% of the NRC allowances of 33 gms. Twenty-three subjects or 96% were below allowances and one subject or 4% was above the allowance.

For twelve male and female subjects, 4 to 6 years of age, the range was from 8 to 50 gms., and the average per person was 21 gms. The average figure was 48% of the NRC allowances of 44 gms. Eleven subjects or 92% were below allowances and one subject or 8% was above the allowance.

For six male and female subjects, 7 to 9 years of age, the range was from 10 to 36 gms., and the average per person was 21 gms. The average figure was 37% of the NRC allowances of 56 gms. Six subjects or 100% were below allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 21 to 52 gms., and the average per person was 30 gms. The average figure was 43% of the NRC allowances of 69 gms. Six subjects or 100% were

below allowances.

For three male subjects, 13 to 15 years of age, the range was from 17 to 48 gms., and the average per person was 28 gms. The average figure was 31% of the NRC allowances of 89 gms. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was 17 to 30 gms., and the average per person was 25 gms. The average figure was 35% of the NRC allowances of 72 gms. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 5 to 60 gms., and the average per person was 32 gms. The average figure was 30% of the NRC allowances of 105 gms. Two subjects or 100% were below allowances.

For four female subjects, 16 to 20 years of age, the range was from 3 to 28 gms., and the average per person was 15 gms. The average figure was 22% of the NRC allowances of 67 gms. Four subjects or 100% were below allowances.

For thirty-three male subjects, 21 to 60 years of age, the range was from 2 to 95 gms., and the average per person was 24 gms. The average figure was 29% of the NRC allowances of 83 gms. Thirty-two subjects or 97% were below allowances and one subject or 3% was above the allowance.

For thirty-six female subjects, 21 to 60 years of age, the range was from 2 to 50 gms., and the average per person was 23 gms. The average figure was 34% of the NRC allowances of 67 gms. Thirty-five subjects or 97% were below allowances and one subject or 3% was above the allowance.

For eight male subjects, 61 to 70 years of age, the range was from 3 to 32 gms., and the average per person was 16 gms. The average figure was 24% of the NRC allowances of 67 gms. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 2 to 34 gms., and the average per person was 19 gms. The average figure was 34% of the NRC allowances of 56 gms. Nine subjects or 100% were below allowances.

For four female subjects, pregnant women, the range was from 2 to 19 gms., and the average per person was 8 gms. The average figure was 12% of the NRC allowances of 67 gms. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 10 to 44 gms., and the average per person was 27 gms. The average figure was 32% of the NRC allowances of 83 gms. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred fifty-seven subjects or 97% were below allowances and four subjects or 3% were above allowances.

4. Calcium

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 48 to 647 mgs., and the average per person was 229 mgs. The average figure was 23% of the NRC allowances of 1000 mgs. Twenty-four subjects or 100% were below allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 112 to 627 mgs., and the average per person was 303 mgs. The average figure was 30% of the NRC allowances of 1000 mgs. Twelve subjects or 100% were below allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 129 to 1028 mgs., and the average per person was 534 mgs. The average figure was 53% of the NRC allowances of 1000 mgs. Four subjects or 67% were below allowances and two subjects or 33% were above allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 112 to 1028 mgs., and the average per person was 486 mgs. The average figure was 40% of the NRC allowances of 1200 mgs. Six subjects or 100% were below allowances.

For three male subjects, 13 to 15 years of age, the range was from 188 to 509 mgs., and the average per person was 1400 mgs. The average figure was 22% of the NRC allowances of 1400 mgs. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 150 to 714 mgs., and the average per person was 442 mgs. The average figure was 34% of the NRC allowances of 1300 mgs. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 289 to 690 mgs., and the average per person was 489 mgs. The average figure was 35% of the NRC allowances of 1400 mgs. Two subjects or 100% were below allowances.

For four female subjects, 16 to 20 years of age, the range was from 191 to 375 mgs., and the average per person was 277 mgs. The average figure was 28% of the NRC allowances of 1000 mgs. Four subjects or 100% were below allowances.

For thirty-three male subjects, 21 to 60 years of age, the range was from 92 to 1029 mgs., and the average per person was 390 mgs. The average figure was 39% of the NRC allowances of 1000 mgs. Thirty-two subjects or 97% were below allowances and one subject or 3% was above the allowance.

For thirty-six female subjects, 21 to 60 years of age, the range was from 112 to 799 mgs., and the average per person was 363 mgs. The average figure was 36% of the NRC allowances of 1000 mgs. Thirty-six subjects or 100% were below allowances.

For eight male subjects, 61 to 70 years of age, the range was from 145 to 768 mgs., and the average per person was 308 mgs. The average figure was 31% of the NRC allowances of 1000 mgs. Eight subjects or 100% were

below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 177 to 662 mgs., and the average figure was 375 mgs. The average figure was 37% of the NRC allowances of 1000 mgs. Nine subjects or 100% were below allowances.

For four female subjects, pregnant women, the range was from 107 to 319 mgs., and the average per person was 205 mgs. The average figure was 20% of the NRC allowances of 1500 mgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 213 to 667 mgs., and the average per person was 466 mgs. The average figure was 23% of the NRC allowances of 2000 mgs. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred fifty-eight subjects or 98% were below allowances and three subjects or 2% were above allowances.

5. Phosphorus

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 157 to 868 mgs., and the average per person was 404 mgs. The average figure was 40% of the NRC allowances of 1000 mgs. Twenty-four subjects or 100% were below allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 218 to 928 mgs., and the average per person was 572 mgs. The average figure was 57% of the NRC allowances of 1000 mgs. Twelve subjects or 100% were below allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 466 to 1125 mgs. The average figure was 61% of the NRC allowances of 1200 mgs. Six subjects or 100% were below allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 481 to 1745 mgs., and the average per person was 925 mgs. The average figure was 77% of the NRC allowances of 1200 mgs. Five subjects or 83% were below allowances and one subject or 17% was above the allowance.

For three male subjects, 13 to 15 years of age, the range was from 302 to 752 mgs., and the average per person was 552 mgs. The average figure was 42% of the NRC allowances of 1320 mgs. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 572 to 782 mgs., and the average per person was 655 mgs. The average figure was 54% of the NRC allowances of 1200 mgs. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 673 to 2422 mgs., and the average per person was 117% of the NRC allowances of 1320 mgs. One subject or 50% was below the allowance and one subject or 50% was above the allowance.

For four female subjects, 16 to 20 years of age, the range was from 360 to 1911 mgs., and the average per person was 867 mgs. The average figure was 72% of the NRC allowances of 1200 mgs. Two subjects or 50% were below allowances and two subjects or 50% were above the allowance.

For thirty-three male subjects, 21 to 60 years of age, the range was from 299 to 1784 mgs., and the average per person was 744 mgs. The average figure was 56% of the NRC allowances of 1320 mgs. Thirty subjects or 91% were below allowances and three subjects or 9% were above allowances.

For thirty-six female subjects, 21 to 60 years of age, the range was from 32 to 1704 mgs., and the average per person was 661 mgs. The average figure was 50% of the NRC allowances of 1320 mgs. Thirty-five or 97% were below allowances and one subject or 3% was above the allowance.

For eight male subjects, 61 to 70 years of age, the range was from 360 to 986 mgs., and the average per person was 601 mgs. The average figure was 45% of the NRC allowances of 1320 mgs. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 313 to 1319 mgs., and the average per person was 582 mgs. The average figure was 44% of the NRC allowances of 1320 mgs. Nine subjects or 100% were below allowances.

For four female subjects, pregnant women, the range was from 287 to 810 mgs., and the average per person was 451 mgs. The average figure was 25% of the NRC allowances of 1800 mgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 597 to 1097 mgs., and the average per person was 840 mgs. The average figure was 47% of the NRC allowances of 1800 mgs. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred fifty-three subjects or 95% were below allowances and eight subjects or 5% were above allowances.

6. Iron

For twenty-four male and female subjects, 1 to 2 years of age, the range was from 1 to 12 mgs., and the average per person was 6 mgs. The average figure was 86% of the NRC allowances of 7 mgs. Fifteen subjects or 62% were below allowances, and nine subjects or 38% were above allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 3 to 11 mgs., and the average per person was 8 mgs. The average figure was 100% of the NRC allowances of 8 mgs. Four subjects or 33% were below allowances and eight subjects or 67% were above allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 5 to 17 mgs., and the average per person was 10 mgs. The average figure was 100% of the NRC allowances of 10 mgs. Three subjects or 50% were below allowances, and three subjects or 50% were above allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 8 to 15 mgs., and the average per person was 11 mgs. The average figure was 92% of the NRC allowances of 12 mgs. Four subjects or 67% were below allowances and two subjects or 33% were above allowances.

For three male subjects, 13 to 15 years of age, the range was from 5 to 11 mgs., and the average per person was 8 mgs. The average figure was 53% of the NRC allowances of 15 mgs. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 6 to 12 mgs., and the average per person was 9 mgs. The average figure was 60% of the NRC allowances of 15 mgs. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 8 to 27 mgs., and the average per person was 17 mgs. The average figure was 113% of the NRC allowances of 15 mgs. One subject or 50% was below the allowance and one subject or 50% was above the allowance.

For four female subjects, 16 to 20 years of age, the range was from 5 to 17 mgs., and the average per person was 6 mgs. The average figure was 40% of the NRC allowances of 15 mgs. Two subjects or 50% were below allowances and two subjects or 50% were above allowances.

For thirty-three male subjects, 21 to 60 years of age, the range was from 4 to 19 mgs., and the average per person was 10 mgs. The average figure was 83% of the NRC allowances of 12 mgs. Twenty one subjects or 64% were below allowances and twelve subjects or 36% were above allowances.

For thirty six female subjects, 21 to 60 years of age, the range was from 4 to 18 mgs., and the average was 10 mgs. The average figure was 83% of the NRC allowances of 12 mgs. Twenty four subjects or 67% were below allowances and twelve subjects or 33% were above allowances.

For eight male subjects, 61 to 70 years of age, the range was from 5 to 15 mgs., and the average per person was 8 mgs. The average figure was 67% of the NRC allowances of 12 mgs. Six subjects or 75% were below allowances and two subjects or 25% were above allowances.

For nine female subjects, 61 to 70 years of age, the range was from 5 to 28 mgs., and the average per person was 11 mgs. The average figure was 92% of the NRC allowances of 12 mgs. Seven subjects or 78% were below allowances and two subjects or 22% were above allowances.

For four female subjects, pregnant women, the range was from 4 to 10 mgs., and the average per person was 7 mgs. The average figure was 47% of the NRC allowances of 15 mgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 7 to 17 mgs., and the average per person was 12 mgs. The average figure was 80% of the NRC allowances of 15 mgs. Eight subjects or 73% were below allowances and three subjects or 27% were above allowances.

For the total group of one hundred sixty-one subjects, one hundred five subjects or 65% were below allowances and fifty-six subjects or 35% were above allowances.

7. Vitamin A

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 29 to 6569 I. U., and the average per person was 1404 I. U. The average figure was 70% of the NRC allowances of 2000 I. U. Twenty subjects or 83% were below allowances and four subjects or 17% were above allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 52 to 9346 I. U., and the average per person was 2019 I. U. The average figure was 81% of the NRC allowances of 2500 I. U. Ten subjects or 83% were below allowances and two subjects or 17% were above allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 77 to 10,231 I. U., and the average per person was 3508 I. U. The average figure was 100% of the NRC allowances of 3500 I. U. Four subjects or 67% were below allowances and two subjects or 33% were above allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 118 to 10,230 I. U., and the average per person was 2550 I. U. The average figure was 57% of the NRC allowances of 4500 I. U. Five subjects or 83% were below allowances and one subject or 17% was above allowance.

For three male subjects, 13 to 15 years of age, the range was from 88 to 1781 I. U., and the average per person was 901 I. U. The average figure was 18% of the NRC allowances of 5000 I. U. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 79 to 824 I. U., and the average per person was 332 I. U. The average figure was 7% of the NRC allowances of 5000 I. U. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 140 to 3458 I. U., and the average per person was 1799 I. U. The average figure was 30% of the NRC allowances of 6000 I. U. One subject or 50% was below the allowance, and one subject or 50% was above the allowance.

For four female subjects, 16 to 20 years of age, the range was from 138 to 2853 I. U., and the average per person was 1119 I. U. The average figure was 22% of the NRC allowances of 5000 I. U. Four subjects or 100% were below allowances.

For thirty three male subjects, 21 to 60 years of age, the range was from 83 to 12,067 I. U., and the average per person was 1307 I. U. The average figure was 26% of the NRC allowances of 5000 I. U. Thirty subjects or 91% were below allowances and three subjects or 9% were above allowances.

For thirty six female subjects, 21 to 60 years of age, the range was from 72 to 10,231 I. U., and the average per person was 1524 I. U.

The average figure was 30% of the NRC allowances of 5000 I. U. Thirty-two subjects or 89% were below allowances and four subjects or 11% were above allowances.

For eight male subjects, 61 to 70 years of age, the range was from 74 to 1865 I. U., and the average per person was 436 I. U. The average figure was 9% of the NRC allowances of 5000 I. U. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 82 to 7231 I. U., and the average per person was 1375 I. U. The average figure was 27% of the NRC allowances of 5000 I. U. Eight subjects or 89% were below allowances and one subject or 11% was above the allowance.

For four female subjects, pregnant women, the range was from 209 to 1730 I. U., and the average per person was 1040 I. U. The average figure was 17% of the NRC allowances of 6000 I. U. Two subjects or 50% were below allowances and two subjects or 50% were above allowances.

For eleven female subjects, lactating women, the range was from 148 to 8693 I. U., and the average per person was 2499 I. U. The average figure was 31% of the NRC allowances of 8000 I. U. Ten subjects or 91% were below allowances and one subject or 9% was above the allowance.

For the total group of one hundred sixty-one subjects, one hundred forty subjects or 87% were below allowances and twenty-one subjects or 13% were above allowances.

8. Thiamine

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 124 to 1192 mcgs., and the average per person was 503 mcgs. The average figure was 84% of the NRC allowances of 600 mcgs. Eighteen subjects or 75% were below allowances and six or 25% were above allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 380 to 1064 mcgs., and the average per person was 642 mcgs. The average figure was 80% of the NRC allowances of 800 mcgs. Nine subjects or 75% were below allowances and three or 25% were above allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 284 to 1259 mcgs., and the average person was 631 mcgs. The average figure was 63% of the NRC allowances of 1000 mcgs. Five subjects or 83% were below allowances and one subject or 17% was above the allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 417 to 1221 mcgs., and the average per person was 801 mcgs. The average figure was 67% of the NRC allowances of 1200 mcgs. Five subjects or 83% were below allowances and one subject or 17% was above the allowance.

For three male subjects, 13 to 15 years of age, the range was from 377 to 1435 mcgs., and the average per person was 939 mcgs. The average figure was 63% of the NRC allowances of 1500 mcgs. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 708 to 772 mcgs., and the average per person was 745 mcgs. The average figure was 57% of the NRC allowances of 1300 mcgs. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 721 to 2109 mcgs., and the average per person was 1415 mcgs. The average figure was 83% of the NRC allowances of 1700 mcgs. One subject or 50% was below the allowance and one subject or 50% was above the allowance.

For four female subjects, 16 to 20 years of age, the range was from 452 to 1021 mcgs., and the average per person was 801 mcgs. The average figure was 67% of the NRC allowances of 1200 mcgs. Four subjects or 100% were below allowances.

For thirty three male subjects, 21 to 60 years of age, the range was from 431 to 2045 mcgs., and the average per person was 944 mcgs. The average figure was 63% of the NRC allowances of 1500 mcgs. Twenty eight subjects or 85% were below allowances and five subjects or 15% were above allowances.

For thirty six female subjects, 21 to 60 years of age, the range was from 296 to 2090 mcgs., and the average per person was 909 mcgs. The average figure was 67% of the NRC allowances of 1200 mcgs. Thirty one or 86% were below allowances, and five subjects or 14% were above allowances.

For eight male subjects, 61 to 70 years of age, the range was from 447 to 1875 mcgs., and the average per person was 839 mcgs. The average figure was 70% of the NRC allowances of 1200 mcgs. Seven subjects or 88% were below allowances and one subject or 12% was above the allowance.

For nine female subjects, 61 to 70 years of age, the range was from 345 to 1494 mcgs., and the average per person was 683 mcgs. The average figure was 68% of the NRC allowances of 1000 mcgs. Eight subjects or 89% were below allowances and one subject or 11% was above the allowance.

For four female subjects, pregnant women, the range was from 546 to 933 mcgs., and the average per person was 718 mcgs. The average figure was 48% of the NRC allowances of 1500 mcgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 121 to 1910 mcgs., and the average per person was 876 mcgs. The average figure was 58% of the NRC allowances of 1500 mcgs. Ten subjects or 91% were below allowances and one subject or 9% was above the allowance.

For the total group of one hundred sixty-one subjects, one hundred thirty six subjects or 85% were below allowances and twenty-five subjects or 15% were above allowances.

9. Riboflavin

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 99 to 964 mcgs., and the average per person was 409 mcgs. The average figure was 45% of the NRC allowances of 900 mcgs. Twenty-three subjects or 96% were below allowances and one subject or 4% was above the allowance.

For twelve male and female subjects, 4 to 6 years of age, the range was from 221 to 700 mcgs., and the average per person was 439 mcgs. The average figure was 36% of the NRC allowances of 1200 mcgs. Twelve subjects or 100% were below allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 365 to 863 mcgs., and the average per person was 563 mcgs. The average figure was 37% of the NRC allowances of 1500 mcgs. Six subjects or 100% were below allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 471 to 831 mcgs., and the average per person was 621 mcgs. The average figure was 34% of the NRC allowances of 1800 mcgs. Six subjects or 100% were below allowances.

For three male subjects, 13 to 15 years of age, the range was from 320 to 877 mcgs., and the average per person was 622 mcgs. The average figure was 31% of the NRC allowances of 2000 mcgs. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was 459 to 653 mcgs., and the average per person was 568 mcgs. The average figure was 28% of the NRC allowances of 2000 mcgs. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 684 to 1583 mcgs., and the average per person was 1133 mcgs. The average figure was 45% of the NRC allowances of 2500 mcgs. Two subjects or 100% were below allowances.

For four female subjects, 16 to 20 years of age, the range was from 458 to 832 mcgs., and the average per person was 637 mcgs. The average figure was 35% of the NRC allowances of 1800 mcgs. Four subjects or 100% were below allowances.

For thirty-three male subjects, 21 to 60 years of age, the range was from 367 to 1477 mcgs., and the average per person was 726 mcgs. The average figure was 40% of the NRC allowances of 1800 mcgs. Thirty-three subjects or 100% were below allowances.

For thirty-six female subjects, 21 to 60 years of age, the range was from 375 to 1318 mcgs., and the average per person was 648 mcgs. The average figure was 43% of the NRC allowances of 1500 mcgs. Thirty-six subjects or 100% were below allowances.

For eight male subjects, 61 to 70 years of age, the range was from 351 to 1150 mcgs., and the average per person was 619 mcgs. The average figure was 34% of the NRC allowances of 1800 mcgs. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 383 to 958 mcgs., and the average per person was 550 mcgs. The average figure was 37% of the NRC allowances of 1500 mcgs. Nine subjects or 100% were below allowances.

For four female subjects, pregnant women, the range was from 262 to 770 mcgs., and the average per person was 485 mcgs. The average figure was 19% of the NRC allowances of 2500 mcgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 384 to 1293 mcgs., and the average per person was 786 mcgs. The average figure was 26% of the NRC allowances of 3000 mcgs. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred sixty or 99% were below allowances and one subject or 1% was above the allowance.

10. Niacin

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 3 to 14 mgs., and the average per person was 11 mgs. The average figure was 180% of the NRC allowances of 6 mgs. Eight subjects or 33% were below allowances and sixteen subjects or 67% were above allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 6 to 16 mgs., and the average per person was 9 mgs. The average figure was 112% of the NRC allowances of 8 mgs. Five subjects or 42% were below allowances and seven subjects or 58% were above allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 10 to 15 mgs., and the average per person was 12 mgs. The average figure was 120% of the NRC allowances of 10 mgs. Six subjects or 100% were above allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 9 to 17 mgs., and the average per person was 12 mgs. The average figure was 120% of the NRC allowances of 10 mgs. Two subjects or 33% were below allowances and four subjects or 67% were above allowances.

For three male subjects, 13 to 15 years of age, the range was from 9 to 18 mgs., and the average per person was 13 mgs. The average figure was 87% of the NRC allowances of 15 mgs. Two subjects or 67% were below allowances and one subject or 33% was above the allowance.

For three female subjects, 13 to 15 years of age, the range was from 11 to 14 mgs., and the average per person was 12 mgs. The average figure was 92% of the NRC allowances of 13 mgs. Two subjects or 67% were below allowances and one subject or 33% was above the allowance.

For two male subjects, 16 to 20 years of age, the range was from 9 to 25 mgs., and the average per person was 17 mgs. The average figure was 100% of the NRC allowances of 17 mgs. One subject or 50% was below the allowance and one subject or 50% was above the allowance.

For four female subjects, 16 to 20 years of age, the range was from 8 to 12 mgs., and the average per person was 10 mgs. The average figure was 83% of the NRC allowances of 12 mgs. Three subjects or 75% were below allowances and one subject or 25% was above the allowance.

For thirty-three male subjects, 21 to 60 years of age, the range was from 7 to 40 mgs., and the average per person was 13 mgs. The average figure was 87% of the NRC allowances of 15 mgs. Twenty-three subjects or 70% were below allowances and ten subjects or 30% were above allowances.

For thirty-six female subjects, 21 to 60 years of age, the range was from 7 to 20 mgs., and the average per person was 12 mgs. The average figure was 100% of the NRC allowances of 12 mgs. Seventeen subjects or 47% were below allowances and nineteen or 53% were above allowances.

For eight male subjects, 61 to 70 years of age, the range was from 8 to 15 mgs., and the average per person was 12 mgs. The average figure was 100% of the NRC allowances of 12 mgs. Three subjects or 38% were below allowances and five subjects or 62% were above allowances.

For nine female subjects, 61 to 70 years of age, the range was from 7 to 15 mgs., and the average per person was 10 mgs. The average figure was 100% of the NRC allowances of 10 mgs. Four subjects or 44% were below allowances and five subjects or 56% were above allowances.

For four female subjects, pregnant women, the range was from 6 to 11 mgs., and the average per person was 8 mgs. The average figure was 53% of the NRC allowances of 15 mgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 10 to 21 mgs., and the average per person was 16 mgs. The average figure was 107% of the NRC allowances of 15 mgs. Five subjects or 45% were below allowances and six subjects or 55% were above allowances.

For the total group of one hundred one subjects, seventy-nine subjects or 49% were below allowances and eighty-two subjects or 51% were above allowances.

11. Ascorbic Acid

For twenty-four male and female subjects, 1 to 3 years of age, the range was from 3 to 114 mgs., and the average per person was 20 mgs. The average figure was 57% of the NRC allowances of 35 mgs. Twenty subjects or 83% were below allowances and four subjects or 17% were above allowances.

For twelve male and female subjects, 4 to 6 years of age, the range was from 1 to 78 mgs., and the average person was 30 mgs. The average figure was 60% of the NRC allowances of 50 mgs. Eight subjects or 67% were below allowances and four subjects or 33% were above allowances.

For six male and female subjects, 7 to 9 years of age, the range was from 5 to 47 mgs., and the average per person was 19 mgs. The average figure was 32% of the NRC allowances of 60 mgs. Six subjects or 100% were below allowances.

For six male and female subjects, 10 to 12 years of age, the range was from 6 to 57 mgs., and the average per person was 26 mgs. The average figure was 35% of the NRC allowances of 75 mgs. Six subjects or 100% were below allowances.

For three male subjects, 13 to 15 years of age, the range was from 6 to 88 mgs., and the average per person was 33 mgs. The average figure was 37% of the NRC allowances of 90 mgs. Three subjects or 100% were below allowances.

For three female subjects, 13 to 15 years of age, the range was from 3 to 9 mgs., and the average per person was 6 mgs. The average figure was 7% of the NRC allowances of 80 mgs. Three subjects or 100% were below allowances.

For two male subjects, 16 to 20 years of age, the range was from 8 to 32 mgs., and the average per person was 20 mgs. The average figure was 20% of the NRC allowances of 100 mgs. Two subjects or 100% were below allowances.

For four female subjects, 16 to 20 years of age, the range from 7 to 47 mgs., and the average per person was 10 mgs. The average figure was 12% of the NRC allowances of 80 mgs. Four subjects or 100% were below allowances.

For thirty-three male subjects, 21 to 60 years of age, the range was from 3 to 88 mgs., and the average per person was 14 mgs. The average figure was 19% of the NRC allowances of 75 mgs. Thirty-two subjects or 97% were below allowances and one subject or 3% was above the allowance.

For thirty-six female subjects, 21 to 60 years of age, the range was from 4 to 88 mgs., and the average per person was 13 mgs. The average figure was 18% of the NRC allowances of 70 mgs. Thirty-five subjects or 97% were below allowances and one subject or 3% was above the allowance.

For eight male subjects, 61 to 70 years of age, the range was from 7 to 34 mgs., and the average per person was 11 mgs. The average figure was 15% of the NRC allowances of 75 mgs. Eight subjects or 100% were below allowances.

For nine female subjects, 61 to 70 years of age, the range was from 4 to 32 mgs., and the average per person was 13 mgs. The average figure was 18% of the NRC allowances of 70 mgs. Nine subjects or 100% were below allowances.

For four female subjects, pregnant women, the range was from 6 to 18 mgs., and the average per person was 9 mgs. The average figure was 9% of the NRC allowances of 100 mgs. Four subjects or 100% were below allowances.

For eleven female subjects, lactating women, the range was from 5 to 71 mgs., and the average per person was 17 mgs. The average figure was 11% of the NRC allowances of 150 mgs. Eleven subjects or 100% were below allowances.

For the total group of one hundred sixty-one subjects, one hundred fifty-one subjects or 94% were below allowances and ten subjects or 6% were above allowances.

Table 4 summarizes the daily quantities of various nutrients per person and comparison with National Research Council Allowances of children and adult male subjects of Majuro Village, Majuro Island, Marshall Islands. There were forty-eight children, males and females, and forty-six males. There were twenty-four male and female children between the ages of 1 through 3 years of age; twelve male and female children between the ages of 4 through 6 years of age; six male and female children between the ages of 7 to 9 years of age; and six male and female subjects between the ages of 10 through 12 years of age.

There were forty-six male subjects. There were three subjects, 13 through 15 years of age; two subjects, 16 through 20 years of age; thirty-three subjects, 21 to 60 years; eight subjects 61 through 70 years.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given.

I. CHILDREN

a. <u>1 to 3 years of age</u>

For twenty four males and females, 1 to 3 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 823 calories, which was 68% of the NRC allowances of 1200 calories. Ninety-two percent of the subjects were below allowances.

2. Protein: average intake was 26 gms., which was 65% of the NRC allowances of 40 gms. Eighty-eight percent of the subjects were below allowances.

3. Fat: average intake was 13 gms., which was 39% of the NRC allowances of 33 gms. Ninety-six percent of the subjects were below allowances.

4. Calcium: average intake was 229 mgs., which was 23% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 404 mgs., which was 40% of the NRC allowances of 1000 mgs. Forty percent of the subjects were below allowances.

6. Iron: average intake was 6 mgs., which was 86% of the NRC allowances of 7 mgs. Sixty-two percent of the subjects were below allowances.

7. Vitamin A: average intake was 1404 I. U., which was 70% of the NRC allowances of 2000 I. U. Eighty-three percent of the subjects were below allowances.

Table 4.

Dietary Study - Majuro Village, Marshall Islands

Summary of Daily Quantities of Various Nutrients
per Person and Comparison with National Research Council Allowances. By Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Males and Females (children)											
1 to 3 years (24)*											
Average intake	823	26	13	229	404	6	1404	503	409	11	20
NRC allowances	1200	40	33	1000	1000	7	2000	600	900	6	35
% of allowances	68	65	39	23	40	86	70	84	45	180	57
% of subjects below allowances	92	88	96	100	100	62	83	75	96	33	83
4 to 6 years (12)											
Average intake	1096	42	21	303	572	8	2019	642	439	9	30
NRC allowances	1600	50	44	1000	1000	8	2500	800	1200	8	50
% of allowances	68	84	48	30	57	100	81	80	36	112	60
% of subjects below allowances	92	67	92	100	100	33	83	75	100	42	67
7 to 9 years (6)											
Average intake	1269	52	21	534	732	10	3508	631	563	12	19
NRC allowances	2000	60	56	1000	1200	10	3500	1000	1500	10	60
% of allowances	63	87	37	53	61	100	100	63	37	120	32
% of subjects below allowances	100	50	100	67	100	50	67	83	100	0	100
10 to 12 years (6)											
Average intake	1577	62	30	486	925	11	2550	801	621	12	26
NRC allowances	2500	70	69	1200	1200	12	4500	1200	1800	10	75
% of allowances	63	88	43	40	77	92	57	67	34	120	35
% of subjects below allowances	100	83	100	100	83	67	83	83	100	33	100

* Figure in ( ) indicate number of subjects studied.

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Males											
13 to 15 years (3)*											
Average intake	1385	49	28	313	552	8	901	939	622	13	33
NRC allowances	3200	85	89	1400	1320	15	5000	1500	2000	15	90
% of allowances	43	58	31	22	42	53	18	63	31	87	37
% of subjects below allowances	100	100	100	100	100	100	100	100	100	67	100
16 to 20 years (2)											
Average intake	2240	92	32	489	1547	17	1799	1415	1133	17	20
NRC allowances	3800	100	105	1400	1320	15	6000	1700	2500	17	100
% of allowances	59	92	30	35	117	113	30	83	45	100	20
% of subjects below allowances	100	50	100	100	50	50	50	50	100	50	100
21 to 60 years (33)											
Average intake	1469	54	24	390	744	10	1307	944	726	13	14
NRC allowances	3000	70	83	1000	1320	12	5000	1500	1800	15	75
% of allowances	49	77	29	39	56	83	26	63	40	87	19
% of subjects below allowances	100	82	97	97	91	64	91	85	100	70	97
61 to 70 years (8)											
Average intake	1302	42	16	308	601	8	436	839	619	12	11
NRC allowances	2400	70	67	1000	1320	12	5000	1200	1800	12	75
% of allowances	54	60	24	31	45	67	9	70	34	100	15
% of subjects below allowances	100	100	100	100	100	75	100	88	100	38	100

* Figure in ( ) indicate number of subjects studied.

8. Thiamine: average intake was 503 mcgs., which was 84% of the NRC allowances of 600 mcgs. Seventy-five percent of the subjects were below allowances.

9. Riboflavin: average intake was 409 mcgs., which was 45% of the NRC allowances of 900 mcgs. Ninety-six percent of the subjects were below allowances.

10. Niacin: average intake was 11 mgs., which was 180% of the NRC allowances of 6 mgs. Thirty-three percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 20 mgs., which was 57% of the NRC allowances of 35 mgs. Eighty-three percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calcium and phosphorus with all twenty-four subjects below allowances. Ninety-six percent of the subjects were below allowances for fat and riboflavin; 92% of the subjects were below allowances for calories; 88% of the subjects were below allowances for protein; 83% of the subjects were below allowances for both vitamin A and ascorbic acid; 75% of the subjects were below allowances for thiamine; and 62% of the subjects were below allowances for iron.

Only 33% of the subjects were below allowances for niacin, 67% were above allowances.

b. 4 to 6 years of age

For twelve males and females, 4 to 6 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 1096 calories, which was 68% of the NRC allowances of 1600 calories. Ninety-two percent of the subjects were below allowances.

2. Protein: average intake was 42 gms., which was 84% of the NRC allowances of 50 gms. Sixty-seven percent of the subjects were below allowances.

3. Fat: average intake was 21 gms., which was 48% of the NRC allowances of 44 gms. Ninety-two percent of the subjects were below allowances.

4. Calcium: average intake was 303 gms., which was 30% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 572 mgs., which was 57% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 8 mgs., which was 100% of the NRC allowances of 8 mgs. Thirty-three percent of the subjects were below allowances.

7. Vitamin A: average intake was 2019 I. U., which was 81% of the NRC allowances of 2500 I. U. Eighty-three percent of the subjects were below allowances.

8. Thiamine: average intake was 642 mcgs., which was 80% of the NRC allowances of 800 mcgs. Seventy-five percent of the subjects were below allowances.

9. Riboflavin: average intake was 439 mcgs., which was 36% of the NRC allowances of 1200 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 9 mgs., which was 112% of the NRC allowances of 8 mgs. Forty-two percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 30 mgs., which was 60% of the NRC allowances of 50 mgs. Sixty-seven percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calcium, phosphorus, and riboflavin with twelve subjects below allowances. Fat and calories followed with 92% of the subjects below allowances; Vitamin A with 83% of the subjects below allowances; thiamine with 75% of the subjects below allowances; and protein and ascorbic acid both with 67% of the subjects below allowances. Thirty-three percent of the subjects were below allowances for iron and 42% of the subjects were below allowances for niacin; 67% of the subjects were above allowances for iron and 58% of the subjects were above allowances for niacin.

c. <u>7 to 9 years of age</u>

For six males and females, 7 to 9 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 1269 calories, which was 63% of the NRC allowances of 2000 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 52 gms., which was 87% of the NRC allowances of 60 gms. Fifty percent of the subjects were below allowances.

3. Fat: average intake was 21 gms., which was 37% of the NRC allowances of 56 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 534 mgs., which was 53% of the NRC allowances of 1000 mgs. Sixty-seven percent of the subjects were below allowances.

5. Phosphorus: average intake was 732 mgs., which was 61% of the NRC allowances of 1200 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 10 mgs., which was 100% of the NRC allowances of 10 mgs. Fifty percent of the subjects were below allowances.

7. Vitamin A: average intake was 3508 I. U., which was 100% of the NRC allowances of 3508 I. U. Sixty-seven percent of the subjects were below allowances.

8. Thiamine: average intake was 631 mcgs., which was 63% of the NRC allowances of 1000 mcgs. Eighty-three percent of the subjects were below allowances.

9. Riboflavin: average intake was 563 mcgs., which was 37% of the NRC allowances of 1500 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 12 mgs., which was 120% of the NRC allowances of 10 mgs. None of the subjects were below allowances.

11. Ascorbic acid: average intake was 19 mgs., which was 32% of the NRC allowances of 60 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, fat, phosphorus, riboflavin and ascorbic acid with six subjects below allowances. Thiamine followed with 83% of the subjects below allowances; calcium and Vitamin A both with 67% of the subjects below allowances.

For protein and iron, the percentage of subjects were equally divided with 50% below and 50% above allowances. All the subjects or 100% were above allowances for niacin.

d. <u>10 to 12 years of age</u>

For six males and females, 10 to 12 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 1577 calories, which was 63% of the NRC allowances of 2500 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 62 gms., which was 88% of the NRC allowances of 70 gms. Eighty-three percent of the subjects were below allowances.

3. Fat: average intake was 30 gms., which was 43% of the NRC allowances of 69 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 486 mgs., which was 40% of the NRC allowances of 1200 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 925 mgs., which was 77% of the NRC allowances of 1200 mgs. Eighty-three percent of the subjects were below allowances.

6. Iron: average intake was 11 mgs., which was 92% of the NRC allowances of 12 mgs. Sixty-seven percent of the subjects were below allowances.

7. Vitamin A: average intake was 2550 I. U., which was 57% of the NRC allowances of 4500 I. U. Eighty-three percent of the subjects were below allowances.

8. Thiamine: average intake was 801 mcgs, which was 67% of the NRC allowances of 1200 mcgs. 83% of the subjects were below allowances.

9. Riboflavin: average intake was 621 mcgs., which was 34% of the NRC allowances of 1800 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 12 mgs., which was 120% of the NRC allowances of 10 mgs. Thirty-three percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 26 mgs., which was 35% of the NRC allowances of 75 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, fat, calcium, riboflavin, and ascorbic acid with six subjects below allowances. Eighty-three percent of the subjects were below allowances for protein, phosphorus, vitamin A and thiamine. Sixty-seven percent of the subjects were below allowances for iron.

Thirty-three percent of the subjects were below allowances for niacin and sixty-seven percent were above allowances.

II. MALES

a. <u>13 to 15 years of age</u>

For three males, 13 to 15 years of age, the daily quantities of various nutrients per person and comparisons with NRC allowances are summarized here:

1. Calories: average intake was 1385 calories, which was 43% of the NRC allowances of 3200 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 49 gms., which was 58% of the NRC allowances of 85 gms. One hundred percent of the subjects were below allowances.

3. Fat: average intake was 28 gms., which was 31% of the NRC allowances of 89 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 313 mgs., which was 22% of the NRC allowances of 1400 mgs. One hundred percent of the subjects were below allowances of 1400 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 552 mgs., which was 42% of the NRC allowances of 1320 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 8 mgs., which was 53% of the NRC allowances of 15 mgs. One hundred percent of the subjects were below allowances.

7. Vitamin A: average intake was 901 I. U., which was 18% of the NRC allowances of 5000 I. U. One hundred percent of the subjects were below allowances.

8. Thiamine: average intake was 939 mcgs., which was 63% of the NRC allowances of 1500 mcgs. One hundred percent of the subjects were below allowances.

9. Riboflavin: average intake was 622 mcgs., which was 31% of the NRC allowances of 2000 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 13 mgs., which was 87% of the NRC allowances of 15 mgs. Sixty-seven percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 33 mgs., which was 37% of the NRC allowances of 90 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin and ascorbic acid. Sixty-seven percent of the subjects were below allowances for niacin.

b. <u>16 to 20 years of age</u>

For two males, 16 to 20 years of age, the daily quantities of various nutrients per person and comparisons with the NRC allowances are summarized:

1. Calories: average intake was 2240 calories, which was 59% of the NRC allowances of 3800 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 92 gms., which was 92% of the NRC allowances or 100 gms. Fifty percent of the subjects were below allowances.

3. Fat: average intake was 32 gms., which was 30% of the NRC allowances or 105 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 489 mgs., which was 35% of the NRC allowances of 1400 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 117% of the NRC allowances of 1320 mgs. Fifty percent of the subjects were below allowances.

6. Iron: average intake was 17 mgs., which was 113% of the NRC allowances of 15 mgs. Fifty percent of the subjects were below allowances.

7. Vitamin A: average intake was 1799 I. U., which was 30% of the NRC allowances of 6000 I. U. Fifty percent of the subjects were below allowances.

8. Thiamine: average intake was 1415 mcgs., which was 83% of the NRC allowances of 1700 mcgs. Fifty percent of the subjects were below allowances.

9. Riboflavin: average intake was 1133 mcgs., which was 45% of the NRC allowances of 2500 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 17 mgs., which was 100% of the NRC allowances of 17 mgs. Fifty percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 20 mgs., which was 20% of the NRC allowances of 100 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, fat, calcium, riboflavin, and ascorbic acid; 50% of the subjects were below allowances for protein, phosphorus, iron, vitamin A, thiamine and niacin.

c. <u>21 to 60 years of age</u>

For thirty-three males, 21 to 60 years of age, the daily quantities of various nutrients per person and comparisons with the NRC allowances are summarized here:

1. Calories: average intake was 1469 calories, which was 49% of the NRC allowances of 3000 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 54 gms., which was 77% of the NRC allowances of 70 gms. Eighty-two percent of the subjects were below allowances.

3. Fat: average intake was 24 mgs., which was 29% of the NRC allowances of 83 gms. Ninety-seven percent of the subjects were below allowances.

4. Calcium: average intake was 390 mgs., which was 39% of the NRC allowances of 1000 mgs. Ninety-seven percent of the subjects were below allowances.

5. Phosphorus: average intake was 744 mgs., which was 56% of the NRC allowances of 1320 mgs. Ninety-one percent of the subjects were below allowances.

6. Iron: average intake was 10 mgs., which was 83% of the NRC allowances of 12 mgs. Sixty-four percent of the subjects were below allowances.

7. Vitamin A: average intake was 1307 I. U., which was 26% of the NRC allowances of 5000 I. U. Ninety-one percent of the subjects were below allowances.

8. Thiamine: average intake was 944 mcgs., which was 63% of the NRC allowances of 1500 mcgs. Eighty-five percent of the subjects were below allowances.

9. Riboflavin: average intake was 726 mcgs., which was 40% of the NRC allowances of 1800 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 13 mgs., which was 87% of the NRC allowances of 15 mgs. Seventy percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 14 mgs., which was 19% of the NRC allowances of 75 mgs. Ninety-seven percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories and riboflavin; 97% of the subjects were below allowances for fat, calcium, and ascorbic acid; 91% of the subjects were below allowances for phosphorus and vitamin A; 85% of the subjects were below allowances for thiamine and 82% of the subjects were below allowances for protein. Seventy percent of the subjects were below allowances for niacin and 64% of the subjects were below allowances for iron.

d. <u>61 to 70 years of age</u>

For eight males, 61 to 70 years of age, the daily quantities of various nutrients per person and comparisons with the NRC allowances are summarized here:

1. Calories: average intake was 1302 calories, which was 54% of the NRC allowances of 2400 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 42 gms., which was 60% of the NRC allowances of 70 gms. One hundred percent of the subjects were below allowances.

3. Fat: average intake was 16 gms., which was 24% of the NRC allowances of 67 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 308 mgs., which was 31% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 601 mgs. which was 45% of the NRC allowances of 1320 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 8 mgs., which was 67% of the NRC allowances of 12 mgs. Seventy-five percent of the subjects were below allowances.

7. Vitamin A: average intake was 436 I. U., which was 9% of the NRC allowances of 5000 I. U. One hundred percent of the subjects were below allowances.

8. Thiamine: average intake was 839 mcgs., which was 70% of the NRC allowances of 1200 mcgs. Eighty-eight percent of the subjects were below allowances.

9. Riboflavin: average intake was 619 mcgs., which was 34% of the NRC allowances of 1800 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 12 mgs., which was 100% of the NRC allowances of 12 mgs. One hundred percent of the subjects were below allowances

11. Ascorbic acid: average intake was 11 mgs., which was 15% of the NRC allowances of 75 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, vitamin A, riboflavin, and ascorbic acid; 88% of the subjects were below allowances for thiamine; and 75% of the subjects were below allowances for iron.

Thirty-eight percent of the subjects were below allowances for niacin and 62% of the subjects were above allowances.

Table 5 summarizes the daily quantities of various nutrients per person and comparison with National Research Council Allowances for female subjects of Majuro village, Majuro Island, Marshall Islands.

There were sixty-seven females: three subjects, 13 through 15 years of age; four subjects, 16 through 20 years; thirty-six subjects, 21 to 60 years; nine subjects, 61 through 70 years; four pregnant women, and eleven lactating women. The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given.

Table 5.

Dietary Study - Majuro Village, Marshall Islands

Summary of Daily Quantities of Various Nutrients per Person and Comparison with National Research Council Allowances. By Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Females		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
13 to 15 years (3)*											
Average intake	1487	59	25	442	655	9	332	745	568	12	6
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	57	74	35	34	54	60	7	57	28	92	7
% of subjects below allowances	100	100	100	100	100	100	100	100	100	67	100
16 to 20 years (4)											
Average intake	1323	52	15	277	867	6	1119	801	637	10	10
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	55	69	22	28	72	40	22	67	35	83	12
% of subjects below allowances	100	75	100	100	50	50	100	100	100	75	100
21 to 60 years (36)											
Average intake	1365	47	23	363	661	10	1524	809	648	12	13
NRC Allowances	2400	60	67	1000	1320	12	5000	1200	1500	12	70
% of allowances	57	78	34	36	50	83	30	67	43	100	18
% of subjects below allowances	97	72	97	100	97	67	89	86	100	47	97
61 to 70 years (9)											
Average intake	1197	38	19	375	582	11	1375	683	550	10	13
NRC allowances	2000	60	56	1000	1320	12	5000	1000	1500	10	70
% of allowances	60	63	34	37	44	92	27	68	37	100	18
% of subjects below allowances	100	78	100	100	100	78	89	89	100	44	100

* Figure in ( ) indicate number of subjects studied.

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Pregnant women (4)*		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Average intake	1013	32	8	205	451	7	1040	718	485	8	9
NRC allowances	2400	85	67	1500	1800	15	6000	1500	2500	15	100
% of allowances	42	38	12	20	25	47	17	48	19	53	9
% of subjects below allowances	100	100	100	100	100	100	50	100	100	100	100
Lactating women (11)											
Average intake	1695	62	27	466	840	12	2499	876	786	16	17
NRC allowances	3000	100	83	2000	1800	15	8000	1500	3000	15	150
% of allowances	56	62	32	23	47	80	31	58	26	107	11
% of subjects below allowances	100	100	100	100	100	73	91	91	100	45	100

* Figure in ( ) indicate number of subjects studied.

III. FEMALES

a. 13 to 15 years of age

For three females, 13 to 15 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized:

1. Calories: average intake was 1487 calories, which was 57% of the NRC allowances of 2600 calories. One hundred percent of the subjects were below allowances.

2. Proteins: average intake was 59 gms., which was 74% of the NRC allowances of 80 gms. One hundred percent of the subjects were below allowances.

3. Fat: average intake was 25 gms., which was 35% of the NRC allowances of 72 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 442 gms., which was 34% of the NRC allowances of 1300 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 655 mgs., which was 54% of the NRC allowances of 1200 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 9 mgs., which was 60% of the NRC allowances of 15 mgs. One hundred percent of the subjects were below allowances.

7. Vitamin A: average intake was 332 I. U., which was 7% of the NRC allowances of 5000 I. U. One hundred percent of the subjects were below allowances.

8. Thiamine: average intake was 745 mcgs., which was 57% of the NRC allowances of 1300 mcgs. One hundred percent of the subjects were below allowances.

9. Riboflavin: average intake was 568 mcgs., which was 28% of the NRC allowances of 2000 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 12 mgs., which was 92% of the NRC allowances of 13 mgs. Sixty-seven percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 6 mgs. which was 7% of the NRC allowances of 80 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin and ascorbic acid.

Sixty-seven percent of the subjects were below allowances for niacin.

b. <u>16 to 20 years of age</u>

For four females, 16 to 20 years of age, the daily quantities of various nutrients per person and comparisons with the NRC allowances are summarized:

1. Calories: average intake was 1323 calories, which was 55% of the NRC allowances of 2400 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 52 gms., which was 69% of the NRC allowances of 75 gms. Seventy-five percent of the subjects were below allowances.

3. Fat: average intake was 15 gms., which was 22% of the NRC allowances of 67 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 277 mgs., which was 28% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 867 mgs., which was 72% of the NRC allowances of 1200 mgs. Fifty percent of the subjects were below allowances.

6. Iron: average intake was 6 mgs., which was 40% of the NRC allowances of 15 mgs. Fifty percent of the subjects were below allowances.

7. Vitamin A: average intake was 1119 I. U., which was 22% of the NRC allowances of 5000 I. U. One hundred percent of the subjects were below allowances.

8. Thiamine: average intake was 801 mcgs., which was 67% of the NRC allowances of 1200 mcgs. One hundred percent of the subjects were below allowances.

9. Riboflavin: average intake was 637 mcgs., which was 35% of the NRC allowances of 1800 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 10 mgs., which was 83% of the NRC allowances of 12 mgs. Seventy-five percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 10 mgs., which was 12% of the NRC allowances of 80 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, fat, calcium, vitamin A, thiamine, riboflavin, and ascorbic acid.

Seventy-five percent of the subjects were below allowances for protein and niacin; 50% of the subjects were below allowances for both phosphorus and iron.

c. 21 to 60 years of age

For thirty-six females, 21 to 60 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized:

1. Calories: average intake was 1365 calories, which was 57% of the NRC allowances of 2400 calories. Ninety-seven percent of the subjects were below allowances.

2. Protein: average intake was 47 gms., which was 78% of the NRC allowances of 60 gms. Seventy-two percent of the subjects were below allowances.

3. Fat: average intake was 23 gms., which was 34% of the NRC allowances of 67 gms. Ninety-seven percent of the subjects were below allowances.

4. Calcium: average intake was 363 mgs., which was 36% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 661 mgs., which was 50% of the NRC allowances of 1320 mgs. Ninety-seven percent of the subjects were below allowances.

6. Iron: average intake was 10 mgs., which was 83% of the NRC allowances of 12 mgs. Eighty-three percent of the subjects were below allowances.

7. Vitamin A: average intake was 1524 I. U., which was 30% of the NRC allowances of 5000 I. U. Eighty-nine percent of the subjects were below allowances.

8. Thiamine: average intake was 809 mcgs., which was 67% of the NRC allowances of 1200 mcgs. Eighty-six percent of the subjects were below allowances.

9. Riboflavin: average intake was 648 mcgs., which was 43% of the NRC allowances of 1500 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 12 mgs., which was 100% of the NRC allowances of 12 mgs. Forty-seven percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 13 mgs., which was 18% of the NRC allowances for 70 mgs. Ninety-seven percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calcium and riboflavin; ninety-seven percent of the subjects were below allowances for calories, fat, phosphorus, and ascorbic acid; 89% of the subjects were below allowances for vitamin A; 86% of the subjects were below allowances for thiamine; 72% of the subjects were below allowances for protein; and 67% of the subjects were below allowances for iron. Forty-seven percent of the subjects were below allowances and 53% were above allowances for niacin.

d. 61 to 70 years of age

For nine females, 61 to 70 years of age, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized:

1. Calories: average intake was 1197 calories, which was 60% of the NRC allowances of 2000 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 38 gms., which was 63% of the NRC allowances of 60 gms. Seventy-eight percent of the subjects were below allowances.

3. Fat: average intake was 19 gms., which was 34% of the NRC allowances of 56 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 375 mgs., which was 37% of the NRC allowances of 1000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 582 mgs., which was 44% of the NRC allowances of 1320 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 11 mgs., which was 92% of the NRC allowances of 12 mgs. Seventy-eight percent of the subjects were below allowances.

7. Vitamin A: average intake was 1375 I. U., which was 27% of the NRC allowances of 5000 I. U. Eighty-nine percent of the subjects were below allowances.

8. Thiamine: average intake was 683 mcgs., which was 68% of the NRC allowances of 1000 mcgs. Eighty-nine percent of the subjects were below allowances.

9. Riboflavin: average intake was 550 mcgs., which was 37% of the NRC allowances of 1500 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 10 mgs., which was 100% of the NRC allowances of 10 mgs. Forty-four percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 13 mgs., which was 18% of the NRC allowances of 70 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, fat, calcium, phosphorus, riboflavin and ascorbic acid; 89% of the subjects were below allowances for vitamin A and thiamine; 78% of the subjects were below allowances for protein and iron.

Forty-four percent of the subjects were below allowances for niacin and 56% were above allowances.

e. Pregnant women

For four pregnant women, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized:

1. Calories: average intake was 1013 calories, which was 42% of the NRC allowances of 2400 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 32 gms., which was 38% of the NRC allowances of 85 gms. One hundred percent of the subjects were below allowances.

3. Fat: average intake was 8 gms., which was 12% of the NRC allowances of 67 gms. One hundred percent of the subjects were below allowances.

4. Calcium average intake was 205 mgs., which was 20% of the NRC allowances of 1500 gms. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 451 mgs., which was 25% of the NRC allowances of 1800 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 7 mgs., which was 47% of the NRC allowances of 15 mgs. One hundred percent of the subjects were below allowances.

7. Vitamin A: average intake was 1040 I. U., which was 17% of the NRC allowances of 6000 I. U. Fifty percent of the subjects were below allowances.

8. Thiamine: average intake was 718 mcgs., which was 48% of the NRC allowances of 1500 mcgs. One hundred percent of the subjects were below allowances.

9. Riboflavin: average intake was 485 mcgs., which was 19% of the NRC allowances of 2500 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 8 mgs., which was 53% of the NRC allowances of 15 mgs. One hundred percent of the subjects were below allowances.

11. Ascorbic acid: average intake was 9 mgs., which was 9% of the NRC allowances of 100 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin, niacin and ascorbic acid. Fifty percent of the subjects were below allowances for vitamin A.

f. Lactating women

For eleven lactating women, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized:

1. Calories: average intake was 1695 calories, which was 56% of the NRC allowances of 3000 calories. One hundred percent of the subjects were below allowances.

2. Protein: average intake was 62 gms., which was 62% of the NRC allowances of 100 gms. One hundred percent of the subjects were below allowances.

3. Fat: average intake was 27 gms., which was 32% of the NRC allowances of 83 gms. One hundred percent of the subjects were below allowances.

4. Calcium: average intake was 466 mgs., which was 23% of the NRC allowances of 2000 mgs. One hundred percent of the subjects were below allowances.

5. Phosphorus: average intake was 840 mgs., which was 47% of the NRC allowances of 1800 mgs. One hundred percent of the subjects were below allowances.

6. Iron: average intake was 12 mgs., which was 80% of the NRC allowances of 15 mgs. Seventy-three percent of the subjects were below allowances.

7. Vitamin A: average intake was 2499 I. U., which was 31% of the NRC allowances of 8000 I. U. Ninety-one percent of the subjects were below allowances.

8. Thiamine: average intake was 876 mcgs., which was 58% of the NRC allowances of 1500 mcgs. Ninety-one percent of the subjects were below allowances.

9. Riboflavin: average intake was 786 mcgs., which was 26% of the NRC allowances of 3000 mcgs. One hundred percent of the subjects were below allowances.

10. Niacin: average intake was 16 mgs., which was 107% of the NRC allowances of 15 mgs. Forty-five percent were below allowances.

11. Ascorbic acid: average intake was 17 mgs., which was 11% of the NRC allowances of 150 mgs. One hundred percent of the subjects were below allowances.

One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, riboflavin and ascorbic acid; 91% of the subjects were below allowances for vitamin A and thiamine; and 73% of the subjects were below allowances for iron. Forty-five percent of the subjects were below allowances for niacin and 55% were above allowances.

The averages of nutrient intake of one hundred sixty-one Marshallese of Majuro village are classified in relation to NRC Recommended Dietary Allowances. The average intakes are given as percentages of NRC Recommended Dietary Allowances. The results are given in Table 6.

Table 6.

Classification of Averages of Nutrient Intake of one hundred sixty-one Marshallese of Majuro village in Relation to NRC Recommended Dietary Allowances

Nutrient	Classification of Average Intake as Percentage of NRC Recommended Dietary Allowances		
	90 to 100% and over	70 to 89%	Under 70%
		Number of individuals	
Calories	7	29	125
Protein	47	44	70
Fat	4	3	154
Calcium	3	4	154
Phosphorus	13	15	133
Iron	67	33	61
Vitamin A	21	5	135
Thiamine	33	29	99
Riboflavin	2	6	153
Niacin	94	33	34
Ascorbic acid	11	5	145

The intakes of calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, and ascorbic acid were much below recommended allowances. One hundred fifty-four subjects were in this "under 70% of NRC recommended allowances group" for fat and calcium. Others in the same group were as follows: 153 subjects for riboflavin, 145 subjects for ascorbic acid, 135 subjects for vitamin A, 133 subjects for phosphorus and 125 subjects for calories.

For the nutrients with average intakes of 90 to 100% or more of NRC recommended allowances, niacin intakes were met by the greatest number of individuals. Iron had the next highest number of individuals.

DISCUSSION

No attempt has been made in this study to determine whether the diet the Marshallese are consuming is adequate for their physiological needs. The diets were assessed by comparing the intake records with the National Research Council allowances.

The value and limitations of dietary allowances and their use have been a subject of many discussions. Criticisms may be made in the use of these dietary standards for comparison, as these standards were drawn up primarily from studies of individuals and populations of the western world. Little is known about the physiological requirements of nutrients of the Marshallese. These requirements are influenced in varying degrees by body size, climate, activity, and other factors.

In order to have some information of body sizes of Marshallese, 255 male and female Marshallese, from the ages of 9 months through 70 years, participants in this dietary survey, were weighed and measured by the author.

Table 7 shows the weights and heights of 255 male and female Marshallese subjects from 9 months through 70 years of age. The weights are given in pounds showing the range and average; heights are given in inches showing the range and average.

TABLE 7.

WEIGHTS AND HEIGHTS OF MARSHALLESE SUBJECTS

by Mary Murai

Age (yrs.)	Sex	Number of subjects	Weight (pounds) Range	Weight (pounds) Average	Height (inches) Range	Height (inches) Average
9 months	M&F	2	20-25	22	16-20	18
1-3	M	21	20-30	25	20-30	25
	F	3	20-33	28	22-30	27
4-6	M	6	30-35	32	36-40	38
	F	6	25-30	27	34-40	37
7-9	M	3	42-60	50	40-50	44
	F	3	40-60	48	41-54	45
10-12	M	2	58-60	59	48-54	51
	F	7	64-88	77	51-59	55
13-15	M	8	70-120	99	55-66	61
	F	23	77-130	103	52-64	59
16-20	M	56	95-164	123	55-69	64
	F	42	80-146	109	55-64	60
21-60	M	34	102-190	138	58-67	64
	F	22	80-170	123	57-67	61
61-70	M	8	130-158	139	59-67	63
	F	9	110-120	115	59-60	59

The average weights of Marshallese were compared with average weights of Americans of the same age group to obtain the difference between the Marshallese and Americans.

Table 8 shows the differences between average body weights of the Marshallese and American subjects of the same age group.

Table 8.

Comparison of Average Weights of Marshallese with Weights of Americans Given for Each Age Group in the Table of Recommended Daily Allowances, National Research Council.

Age groups	Weights of Americans Weight in lbs.	Weights of Marshallese Weight in lbs.	Difference in lbs.
1 to 3	27	27	0
4 to 6	42	30	-12
7 to 9	58	49	- 9
10 to 12	78	68	-10
13 to 15 (girls)	108	103	- 5
16 to 20 (girls)	122	109	-13
13 to 15 (boys)	108	99	- 9
16 to 20 (boys)	141	123	-18
21 and over (females)	123	123	0
21 and over (males)	154	138	-16

Marshallese subjects had smaller body sizes when compared with American subjects of the same age group. The exceptions were the 1 to 3 years old group, and the females 21 and over age group. The average weights were the same for the Marshallese and American subjects in these two groups.

In spite of these differences in body size, some yardstick had to be used for comparison and since recommended allowances represent certain levels of intake considered desirable, they were used as standards for this study. As stated in "Recommended Dietary Allowances, Revised 1948" (N.R.C. Reprint and Circular Series No. 129, Oct. (1948):

"The quantitative data in the accompanying table are intended to represent exactly what is implied in a literal interpretation of the words recommended dietary allowances. Hence in contrast to some previously promulgated standards, the data in the following table are rather to be understood as representing levels of nutrient intakes which the Food and

Nutrition Board recommends as normally desirable goals or objectives.

"The recommendations are not called 'requirements' because they are intended to represent not merely the literal (minimal) requirements of average individuals, but levels enough higher to cover substantially all individual variations in the requirements of normal people.

"The figures here recommended are, therefore, generally higher than average requirements but generally lower than the doses used to meet needs created by pathological states of certain environmental conditions or in compensating for an earlier period of depletion...."

Other dietary standards have been used by international groups, the two most frequently used for references are the standards proposed by the Committee on Nutrition of the British Medical Association (9) and the Canadian standards approved by the Canadian Council on Nutrition (10).

Goldsmith (11) compared the American, British and Canadian dietary standards in her paper. "The most striking difference is the much lower recommendation for ascorbic acid in the Canadian and British standards than in the Recommended Dietary Allowances of this country. The recommended intakes for the B vitamins and for calcium are also lower, especially in the Canadian. The recommended intake of vitamin A is lower in the Canadian than in the other standards, since the recommendation is made in terms of carotene, rather than in terms of a mixed diet furnishing vitamin A as 2/3 carotine and 1/3 preformed vitamin A. recommended intake of iron is also lower in the Canadian standard. These differences are in line with expectations since the Canadian standard is a nutritional floor and approaches minimal requirements. The British standard is an allowance for maintenance of good nutrition in the average person, and the United States allowances are designed for maintenance of good nutrition of substantially all normal persons and include a margin of safety."

Calories

The Committee on Calorie Requirements of the Food and Agriculture Organization (FAO) of the United Nations (12) has formulated a standard for calories. "The recommendations made.....represent a considered attempt to provide practical guidance on the requirement of population and population groups. The method followed was to assign numerical value to the calorie requirements of a fully defined "reference', and to indicate (also in numerical form) the adjustments to these values which may be made in order to calculate the requirements of individuals differing from the reference in age, body size, temperature of environment, and activity."

"The reference man and woman are 25 years old and live in the temperate zone at a mean annual external temperature of 10 degrees Centigrade. They consume a well-balanced diet and are fully healthy. The degree of activity of the man is that involved in occupation in light industry; that of the woman is the activity appropriate to general household duties or light industrial work. The mean calorie requirements of the reference man and woman on a year-round basis are judged to be 3,200 and 2,300 calories per day respectively."

"It is estimated that requirements in the third trimester of pregnancy are increased by approximately 450 calories daily. In lactation, requirements are increased by 1,000 calories daily, this figure being based on the assumption that the period of lactation is 6 months and the average quantity of milk given by the mother at 3 months after delivery is 850 milliliters."

"The reference children belong to the same type of population as the reference adults and live in the same climatic environment. These values are the 'recommended allowances' of the National Research Council, U. S. A."

"The reference adolescents are 18 years old and weigh 60 kilograms (boys) and 50 kilograms (girls). In health and activity they are similar to the reference children. The requirements of such adolescents at 16 and 19 years of age inclusive are judged to be 3,800 and 2,400 calories for boys and girls respectively."

"Calorie requirements are influenced by body size. It is recommended that the formulae $E = 152.0\ (W)^{0.73}$ (Men) and $E = 123.4\ (W)^{0.73}$ (Men) and E = total calorie requirements and W = body weight (kg.), be used to calculate the requirements of adults according to body size when their activity is that of the reference."

"No adjustments for body size should be applied to children under 16. During the years from 16 to 20, body size is approaching final mature dimensions. In populations in which the average weight of adolescents is less than that of the reference adolescents, adjustments should be made on the basis of the mature size attained at age 25 rather than the actual weight of adolescents. In such circumstances, requirements for males from 16 to 19, inclusive should be reckoned as 120 percent of the requirements of well-nourished active males of 25 years in the same population, the corresponding percentage for females being 105."

A scale to allow for the effect of increasing age on calorie requirements is suggested. According to this scale, requirements at 25 years of age are decreased by 7.5 percent for every 10 years beyond the age of 25."

"The existence of an approximately linear relationship between calorie expenditure and mean annual external temperature was assumed. It is recommended tentatively that for every 10 degrees departure in mean annual temperature from the reference temperature of 10 degrees Centigrade, requirements should be adjusted by 5 percent of requirements at the reference level, the 5 percent being subtracted for higher temperatures and added for lower temperatures."

"The degree of activity directly influence calorie requirements. It is considered that in most populations the mean activity will approximate the degree of activity assigned to the reference adults. No adjustments should be made for activity under 16 years of age. In the scale recommended for children, the activity of boys and girls is assumed to be the same under the age of 13, though in some populations the activity of boys exceeds that of girls at an earlier age than this."

The above recommendations were followed and the calorie requirements of Marshallese were calculated by taking into consideration body size, age, and environmental temperature. Using the equation: $E = (1.1875 - 0.0075A)(1.050 - 0.005T) a W^{0.73}$, where E = total requirements, A = age in years, T = temperature in degrees Centigrade, W = body weight in kilograms. The mean external temperature of the Marshall Islands was taken as 27 degrees Centigrade.

The calorie requirements of Marshallese of various ages living in the Marshall Islands calculated by using the FAO formula for calorie requirements are summarized in Table 9.

Table 9

Calculated Calorie Requirements for Marshallese of Various Ages Living in the Marshall Islands and NRC Recommended Calorie Requirements

	Age	Weight kg.	Calculated Calorie Requirements calories	NRC Requirements
Adolescents				
Men	16-20		3434	3800
Women	16-20		2263	2400
Pregnant women	16-20		2713	2400
Lactating women	16-20		3263	3000
Adults				
Women	21	56	2195	2400
Pregnant women	21	56	2645	2400
Lactating women	21	56	3195	3000
Women	35	56	1971	2400
Pregnant women	35	56	2421	2400
Lactating women	35	56	2971	3000
Women	45	56	1810	2000
Women	65	52	1414	2000
Men	21	63	2949	3000
Men	35	63	2679	3000
Men	45	63	2433	3000
Men	65	63	2003	2400

In most cases, the calculated calorie requirements were lower than the "recommended allowances" of the National Research Council.

Protein

The protein standard for the recommended allowances for adults are based on 1 gm. protein daily for each kilogram of body weight, which is a generous allowance. Leitch and Duckworth (13) concluded in their study that an average maintenance requirement of about 50 gms. per day per normal adult was sufficient. Hegsted, Tsongas, Abbott, and Stare (14) did experiments on protein requirements of adults on 26 adults ranging in age from 19 to 50 years. They were on a basal low-protein diet with approximately 50% of the protein supplied by white bread, 12% by other cereals, 30% by vegetables, and 8% by fruits, protein requirements were between 30 and 40 gms. per 70 kilograms of body weight. With supplements of meat or wheat germ added to the above diet, even less total food protein was required for healthy maintenance. They concluded that the National Research Council allowance for protein of 1 gm. per kilogram of body weight was generous and the allowance could be reduced to 50 gms. for a 70 kilogram adult and still provide approximately 30% margin above requirement.

Calcium

The National Research Council's recommended allowances aims to cover the needs of not less than about 99% of the normal adults of the U. S. population. Leitch (15) concluded that the maintenance requirement is approximately 0.55 gms. of calcium per day for normal human adults regardless of body weight. The calcium requirements are being reviewed again by a subcommittee of the Committee of Dietary Allowances of the Food and Nutrition Board. New allowances will be recommended soon.

Vitamin A

Sherman (16) in his book says, "There is no reason to doubt and good reason to suppose that, in human as in rat nutrition, best results in long-term experience will require at least 2 to 4 times as much Vitamin A value as suffices for minimal adequacy. If the minimal adequate amount is taken, it is about 3000 I. U. for normal adult maintenance, from 6000 to 12,000 would be scientifically more logical allowance (than the 5000 I. U. allowance of the National Research Council) to provide both for individual variations in requirement and for the maintenance of such a bodily reserve as has been found to be favorable to higher health and longer life."

"Vitamin A values of dietaries depend largely upon the precursor carotene rather than on vitamin A itself, and the doubts as to the completeness of availability of these precursors in digestion and assimilation, one will logically prefer to have his intake of vitamin A value nearer the top than the bottom of the 6000-12,000 I. U. zone...."

"Also it is scientifically sound in principle to provide liberal intakes of a nutrient which seems to be involved in so many different functions and in so many major and minor ills as is vitamin A, even if some of these involvements are not entirely clear."

Thiamine

Daum et al (17) concluded that the minimal daily thiamine requirement of young adults of twenty-one to thirty-eight years of age, weighing 55 to 64 kg. and requiring approximately 2500 calories per day for maintenance of body weight was adjusted to be very close to 0.63 mg. thiamine or on the order of 0.25 to 0.30 mg. thiamine per 1000 calories of mixed diet. The NRC allowance of thiamine is approximately 100 percent more than the minimal requirements. The minimum daily requirements, Food and Drug Administration, Federal Security Agency, (18) for thiamine is given as 1.00 mg. daily for adults.

Riboflavin

Horwitt et al (19) observed the effects of diets restricted in riboflavin in 15 male subjects. They studied the excretion of riboflavin in the urine and suggested that the riboflavin requirement of a resting adult to be between 1.1 and 1.6 mgs. per day. They concluded that allowances below 0.6 mg. per day are insufficient to support normal tissue repair, and that a reserve of riboflavin could not be maintained on levels of intake below 1.1 mg. The NRC allowances are based on body weight and allow about 25 percent margin of safety.

Niacin

The amino acid tryptophane can be converted to niacin in the human body, therefore, the requirements for niacin depends on intakes of food containing tryptophane.

The NRC allowance of niacin was set at ten times the corresponding allowances of thiamine for both sexes and all ages. According to Sherman (20), "As yet, we do not know: (1) what part of the niacin requirement will be 'biologically enriched' in niacin by the bacteria of the digestive tract; or (2) the degree of trustworthiness of present estimates either of the niacin requirements of human nutrition or the niacin content of some types of food."

Ascorbic acid

The following data are given by Sherman (21) as standards for ascorbic acid: "A daily intake of 25 milligrams of vitamin C by normal adults (other than women in pregnancy and lactation who need decidedly more) or 1.0 milligrams per 100 calories of food in family dietaries, might be regarded as a minimum sufficing for prevention of the gross signs of scurvy. Fifty milligrams for adult maintenance and 2 milligrams per 100 calories for family dietaries, might be regarded as medium standard. One hundred milligrams per adult, or 4 mg. per 100 calories of family food, one may approximate the presumably optimal allowance sufficing to keep the body 'saturated'."

"The values given in the (National Research Council's) Table represent a conservative appraisal of all the evidence that is available, but they should not be regarded as 'saturation' levels. More generous intakes (may) result in considerably higher concentrations in the tissues." (22)

Goldsmith (23) concluded "that the purposes and philosophy behind any dietary standard must be appreciated for proper application. In some situations, standard based on minimal requirements are useful and in others, standards representing nutritional goals are more durable. For certain nutrients, recommendations should be related to body size, for caloric consumption, or for still others, to active metabolizing tissue or to the individual. There are many gaps in our knowledge of even minimal requirements and very few quantitative data relative to optimal needs."

SUMMARY

Weekly dietary records of one hundred sixty-one subjects of Majuro village, Majuro Island, Marshall Islands, from the ages of 1 through 70 years of age, were studied for daily quantities of calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. These figures were then compared with National Research Council Allowances.

Taking the total group of one hundred sixty-one subjects, the following results were obtained when daily intakes were compared with National Research Council allowances:

1. Calories: one hundred fifty-seven subjects or 97% were below allowances, four subjects or 3% were above allowances.

2. Protein: one hundred thirty subjects or 81% were below allowances, thirty-one subjects or 19% were above allowances.

3. Fat: one hundred fifty-seven subjects or 97% were below allowances, four subjects or 3% were above allowances.

4. Calcium: one hundred fifty-eight subjects or 98% were below allowances, three subjects or 2% were above allowances.

5. Phosphorus: one hundred fifty-three subjects or 95% were below allowances, eight subjects or 5% were above allowances.

6. Iron: one hundred five subjects or 65% were below allowances, fifty-six subjects or 35% were above allowances.

7. Vitamin A: one hundred forty subjects or 87% were below allowances, twenty-one subjects or 13% were above allowances.

8. Thiamine: one hundred thirty-six subjects or 85% were below allowances, twenty-five subjects or 15% were above allowances.

9. Riboflavin: one hundred sixty subjects or 99% were below allowances, one subject or 1% was above allowances.

10. Niacin: seventy-nine subjects or 49% were below allowances, eighty-two subjects or 51% were above allowances.

11. Ascorbic acid: one hundred fifty-one subjects or 94% were below allowances, ten subjects or 6% were above allowances.

The percentage of subjects who failed to meet NRC allowances was greater than those who did meet allowances for the following nutrients: calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, and ascorbic acid.

Ninety-nine percent of the subjects were below allowances for riboflavin; 98% of the subjects were below allowances for calcium; 97% of the subjects were below allowances for calories and fat; 95% of the subjects were below allowances for phosphorus; 94% of the subjects were below allowances for ascorbic acid; 87% of the subjects were below allowances for vitamin A; 85% of the subjects were below allowances for thiamine; 81% of the subjects were below allowances for protein; and 65% of the subjects were below allowances for iron.

Eighty-two subjects or 51% were above allowances for niacin, and seventy-nine subjects or 49% were below allowances.

There were forty-eight children, males and females, forty-six males and sixty-seven females. Of these, there were twenty-four male and female children between the ages of 1 through 3 years of age; twelve male and female children between the ages of 4 through 6 years of age; six male and female children between the ages of 7 and 9 years of age; and six male and female subjects between the ages of 10 through 12 years of age.

Of the males, there were three subjects, ages 13 through 15 years of age; two subjects, 16 through 20 years; thirty-three subjects, 21 to 60 years; eight subjects, 61 to 70 years of age.

Of the females, there were three subjects, 13 through 15 years; four subjects, 16 through 20 years; thirty-six subjects, 21 to 60 years; nine subjects, 61 through 70 years; four pregnant women, and eleven lactating women.

Taking each age group separately, the following results were obtained when daily intakes were compared with National Research Council Allowances:

I. Children

a. <u>1 to 3 years of age</u>. One hundred percent of the subjects were below allowances for calcium and phosphorus with all twenty-four subjects below allowances. Ninety-six percent of the subjects were below allowances for fat and riboflavin; 92% of the subjects were below allowances for calories; 88% of the subjects were below allowances for protein; 83% of the subjects were below allowances for both vitamin A and ascorbic acid; 75% of the subjects were below allowances for thiamine; and 62% of the subjects were below allowances for iron. Only 33% of the subjects were below allowances for niacin and 67% were above allowances.

b. 4 to 6 years of age. One hundred percent of the subjects were below allowances for calcium, phosphorus, and riboflavin, with twelve subjects below allowances. Ninety-two percent of the subjects were below allowances for fat and calories; 83% of the subjects were below allowances for vitamin A; 75% of the subjects were below allowances for thiamine; and 67% of the subjects were below allowances for protein and ascorbic acid. Thirty-three percent of the subjects were below allowances for iron and 42% of the subjects were below allowances for niacin. Sixty-seven percent of the subjects were above allowances for iron and 58% of the subjects were above allowances for niacin.

c. 7 to 9 years of age. One hundred percent of the subjects were below allowances for calories, fat, phosphorus, riboflavin and ascorbic acid with six subjects below allowances. Eighty-three percent of the subjects were below allowances for thiamine; 67% of the subjects were below allowances for calcium and Vitamin A. For protein and iron, the percentage of subjects were equally divided with 50% below and 50% above allowances. All subjects or 100% were above allowances for niacin.

d. 10 to 12 years of age. One hundred percent of the subjects were below allowances for calories, fat, calcium, riboflavin and ascorbic acid with six subjects below allowances. Eighty-three percent of the subjects were below allowances for protein, phosphorus, vitamin A and thiamine. Sixty-seven percent of the subjects were below allowances for iron. Thirty-three percent of the subjects were below allowances for niacin and 67% were above allowances.

II. Males

a. 13 to 15 years of age. One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin and ascorbic acid. Sixty-seven percent of the subjects were below allowances for niacin.

b. 16 to 20 years of age. One hundred percent of the subjects were below allowances for calories, fat, calcium, riboflavin and ascorbic acid; 50% of the subjects were below allowances for protein, phosphorus, iron, vitamin A, thiamine and niacin.

c. 21 to 60 years of age. One hundred percent of the subjects were below allowances for calories and riboflavin; 97% of the subjects were below allowances for fat, calcium and ascorbic acid; 91% of the subjects were below allowances for phosphorus and vitamin A; 85% of the subjects were below allowances for thiamine; and 82% of the subjects were below allowances for protein. Seventy percent of the subjects were below allowances for niacin and 64% of the subjects were below allowances for iron.

d. 61 to 70 years of age. One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, vitamin A, riboflavin and ascorbic acid; 88% of the subjects were below allowances for thiamine; and 75% of the subjects were below allowances for iron. Thirty-eight percent of the subjects were below allowances for niacin and 62% were above allowances.

III. Females

a. 13 to 15 years of age. One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin and ascorbic acid. Sixty-seven percent of the subjects were below allowances for niacin.

b. 16 to 20 years of age. One hundred percent of the subjects were below allowances for calories, fat, calcium, vitamin A, thiamine, riboflavin, and ascorbic acid. Seventy-five percent of the subjects were below allowances for protein and niacin; 50% were below allowances for both phosphorus and iron.

c. 21 to 60 years of age. One hundred percent of the subjects were below allowances for calcium and riboflavin; 97% of the subjects were below allowances for calories, fat, phosphorus, and ascorbic acid; 89% of the subjects were below allowances for vitamin A; 86% of the subjects were below allowances for thiamine; 72% of the subjects were below allowances for protein; and 67% of the subjects were below allowances for iron. Forty-seven percent of the subjects were below allowances and 53% were above allowances for niacin.

d. 61 to 70 years of age. One hundred percent of the subjects were below allowances for calories, fat, calcium, phosphorus, riboflavin and ascorbic acid; 89% of the subjects were below allowances for vitamin A and thiamine; 78% of the subjects were below allowances for protein and iron. Forty-four percent of the subjects were below allowances for niacin and 56% were above allowances.

e. Pregnant women. One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin, niacin and ascorbic acid. Fifty percent of the subjects were below allowances for vitamin A.

f. Lactating women. One hundred percent of the subjects were below allowances for calories, protein, fat, calcium, phosphorus, riboflavin and ascorbic acid; 91% of the subjects were below allowances for vitamin A and thiamine; and 73% of the subjects were below allowances for iron. Forty-five percent of the subjects were below allowances for niacin and 55% were above allowances.

RECOMMENDATIONS BASED ON DIETARY STUDIES

Food consumption in the Marshall Islands is dependent on seasonal changes due to the ripening of various plant foods. The breadfruit season begins in May and is picked through the summer until September. In the latter part of the summer, bwiro and jankwin, the preserved forms are made which are eaten after the season is over, particularly in the period from March to May, when food is not so plentiful. In October the pandanus season begins, and they provide the principal food until March; pandanus is preserved as mokan. In the winter, arrowroot is made into flour. Taro can be eaten all year round but in the summer breadfruit is preferred. At other times of the year it (taro) is popular, principally in spring and fall, between the breadfruit and pandanus seasons. Thus, nutrient contents of the diets differ at various times of the year.

There is no storage of fresh foods; the usual procedure is to collect food for the day in Majuro village.

Imported foods have become a very important part of their diet. The food patterns are a combination of local food products and imported foods.

A list is given of the food items commonly consumed by Marshallese studied in this dietary survey.

FOOD ITEMS COMMONLY CONSUMED BY MARSHALLESE STUDIED IN THIS DIETARY SURVEY

1. BREADS

   Bread, white

   Doughnuts

2. CEREALS AND CEREAL DISHES

   Rice, white

   Rice, soft - polished white rice, coconut sap and coconut milk, boiled

   Jaibo - mixture of coconut sap, coconut milk and white flour

3. CRACKERS

   Soda crackers

4. FISH, CRUSTACEA AND SIMILAR FOODS

Marshallese Name	Scientific Name	Common Name
Ail	Acanthurus olivaceus Bloch	Surgeon Fish or Tang
Autok	Chelon vaigiensis (Quoy & Gaimard)	Mullet
Baru lep	Birgus latro	Coconut or Robber crab
Baruwan	Cardisoma hirtipes	Just plain land crab
Bulok	Naso lituratus (Bloch)	Surgeon fish Tang
Bwebwe	Neothunnus macropterus (Temminck & Schlege)	Yellow fin Tuna
Chilu	Katsuwonus pelamis (Linnaeus)	Skipjack
Chiriul	Turbo setosus Gmelin	Cat's eye (most common)
	Turbo argyrostomus Linne	Cat's eye
Imim	Melichthys vidua (Solander) Rhinecanthus aculeatus (Linnaeus)	Trigger fish
Jawe	Plectropomus truncatus (Fowler)	Jewfish or Grouper
Jo	Mulloidichthys samoensis (Günther)	Goatfish - Red mullet
Kuban	Acanthus triostegus triostegus (Linnaeus)	Surgeon fish, Tang
Lere	Balistidae	Trigger fish
Likup	Cymolutes praetextatus (Quoy & Gaimard)	Wrasse
Meret (Mera)	Family Scaridae	Parrotfish
Mermer	Siganus punctatus (Bloch)	
Momo	Epinephelus merra Bloch	Sea Bass, grouper
Molle	Siganus rostratus (Valenciennes)	
Ikmouij	Scaridae	Parrotfish
Pako	probably Carcharhinus melanopterus (Quoy & Gaimard)	Shark

4. FISH (continued)

Marshallese Name	Scientific Name	Common Name
Jojo	Exocoetidae	Flying fish
Lukerr	Canarium Luhuanum Luhuanum (Linné)	

Canned

Salmon, entire content, natural

Sardines, Pacific, entire content

Sardines, Pacific, tomato sauce

Sardines, Maine, in oil

5. FRUITS

Banenas (Kābran)

Eating - Jibuki and Marshallese varieties (Musa sapientum)

Cooking - Mokarkar

Breadfruit (Mā)

Seeded Mijiwan roasted, baked, or boiled (seeded variety, Artocarpus incisus)

Seedless Batakdak roasted, baked, or boiled (seedless variety, Artocarpus incisus)

Bukdrol roasted, baked, or boiled (seedless variety, Artocarpus incisus)

Preserved Bwiro

Coconut sap Jekaro

Coconut sap, boiled Jejajeje

Limes (Citrus aurantifolia)

Pandanus (Pandanus sp.)

Lojekerer variety fresh and boiled

Joibeb fresh and boiled

Paste bop, mokan

5. FRUITS (continued)

Papayas (<u>Carica papaya</u> L.)

6. MEATS, FRESH

Pork

7. MEAT, SAUSAGE AND SIMILAR PRODUCTS

Beef, corned

Meat, luncheon

Sausage, Vienna

8. MILK

Milk, canned, evaporated (mostly for infants, not for general population)

9. NUTS

Coconut	meat of mature nut	waini (<u>Cocos nucifera</u>)
	drinking fluid of immature nut	ni
	meat of immature nut	mere
	embryo of sprouting nut	iu

10. SUGAR

Sugar, white, granulated

11. SWEETS - CANDY AND SIMILAR FOODS

Candies, hard

Gum

12. VEGETABLES

Taro	Wan	<u>Cyrtosperma chamissonis</u> (Schott) Merr.
	Kaliklik	<u>Cyrtosperma chamissonis</u> (Schott) Merr.
	Buroro	<u>Cyrtosperma chamissonis</u> (Schott) Merr.

13. MISCELLANEOUS

Tea

Good food consumption depends on both education and economics. Better levels of consumption of the right foods should be taught to all the people.

1. Calories and fat

A constant supply of fuel is required by the body. This need is met by the carbohydrate, fat and protein foods. Carbohydrate and fatty foods are the chief source of energy as protein is used mainly for body building. The combustion of foods to carbon dioxide, water and nitrogen yields the energy which permits the body to carry on its activities. The calorie is the standard for the measurement of the energy value of foods and is also used to express the energy requirements of the body.

In this study, from the total of one hundred sixty-one subjects, one hundred fifty-seven subjects of Majuro village or 97% were below NRC allowances for calories for their age and sex.

To increase the caloric intake, food consumption must be increased, especially the foods high in fat and carbohydrate. Fats widely distributed in both plants and animals, and are contained in varying proportions in nearly all the natural foods. Fats constitute the most concentrated food. They yield two and a half times more calories than carbohydrates or proteins. Fats are known to be carriers of vitamins and fatty acids which are now recognized to be essential. Carbohydrate foods are good economical fuel sources, while both the carbohydrate and fatty foods have a protein sparing power.

The energy foods are the following:

1. Starches and sugars: cereals, macaroni, spaghetti, bread, potatoes, white and sweet; corn, beans, rice, sugar, sugar syrup, coconut syrup, jellies, and jams, fruits and vegetables, especially <u>Cyrtosperma chamissonis</u> (iaraj), breadfruit (mā), bananas (kābran), and arrowroot flour (mokmok).

2. Fats: vegetable and animal oils; nuts, mature coconuts (waini), flesh of the immature coconut (Mere), and peanut butter.

2. Protein

Protein, an organic compound which contains nitrogen, is necessary to build, maintain, and repair various tissues of the body. The greatest proportion of the body tissues is composed of protein and it is an indispensable constituent of every living cell.

Out of one hundred and sixty-one subjects of Majuro village, one hundred thirty or 81% were below NRC allowances for protein.

Protein is supplied largely from animal sources, such as meat, poultry, fish, crustacea, eggs, milk, and also from vegetable sources particularly seeds and nuts. Unfortunately, protein foods are expensive food items, but for the money expended, milk is an economical food as it supplies besides protein of high quality, fat, carbohydrate, calcium, phosphorus, iron, vitamin A, riboflavin, niacin and vitamin D. Children should have 3 to 4 cups daily; adolescents, boys and girls 1 quart; pregnant and lactating women 1 quart; and everyone else 1 to 3 cups daily. Eggs constitute a relatively costly food compared with their contribution of nutrients. More fresh fish could be included in the diets and dried beans and legumes, such as soybeans, can be a good source of protein. In general, protein from animal sources are more often of higher quality than those from plant origin.

Protein foods are as follows: meats, eggs, fish, eels, sea fowls, ducks, whales, turtles, turtle eggs, crustacea, nuts, whole cereals, dried peas and beans. Legumes are rich in protein and can be a partial substitute for meat in the diet. Breadfruit, fresh and preserved (bwiro, jankwin, manakajen); breadfruit seeds (colé); sweet potatoes (iaraj); Cyrtosperma chamissonis; coconuts; pandanus (bop, mokan), fresh and paste are sources.

3. Calcium and phosphorus

The two minerals, calcium and phosphorus, are essential for proper bone and teeth development. They also play a part in the regulation of the internal activities of the body.

Calcium participates in blood coagulation, shares in regulation of cardiac and uterine muscle action, is important to capillary permeability, activates many enzymes and is essential for the functioning of voluntary and autonomic nervous systems.

Phosphorus is an essential constituent of all cells, is a constituent of various enzymes, is essential for protein metabolism, for formation of phospholipids, participates in the carbohydrate cycle and muscle metabolism, and is interrelated with the action of calcium, vitamin D, and the parathyroid hormones.

Out of one hundred sixty-one subjects, one hundred fifty-eight subjects or 98% were below allowances for calcium. One hundred fifty-three subjects or 95% were below allowances for phosphorus. Milk is the best source of calcium and it also contains considerable phosphorus. Phosphorus is more generally distributed in both animal and vegetable foods than calcium. Fish is an excellent source of phosphorus and meat is a very good source. Dried beans are excellent sources of phosphorus. Green leaves have a fairly liberal amount of calcium in relation to their total solids. Bones of small fish supply calcium and phosphorus. Vegetables and fruits are on the whole low in phosphorus. Bananas (kăbran), pandanus (bop), breadfruit (mā) seeded and seedless), breadfruit seeds (colé), sweet potatoes, Cyrtosperma chamissonis (iaraj), coconuts (waini), coconut embryo (iu), flesh of immature coconuts (mere), sweet potato leaves, and other edible green leaves are sources.

4. Iron

The amount of iron in the body is small but the role it plays is very important. Iron is an essential part of hemoglobin of blood and the main function is to carry oxygen so that oxidation and reduction processes are carried on within the cells. It is also a component of chromatin which is found in all living cells and plays a fundamental part in their activity. Lack of iron in the diet can cause nutritional anemia.

Of one hundred sixty-one subjects of Majuro village, one hundred five subjects or 65% were below NRC allowances.

Since enriched flour was used, iron intakes were higher than expected. Flour is used extensively in breads, doughnuts, pancakes, jaibo and other prepared dishes. When flour is imported from other countries, there is no assurance that it is enriched and iron intake values will be lowered to a great extent. Enriched flour has added iron, thiamine, riboflavin, and niacin.

Iron is found in lean meat, fish, eggs, liver, dried beans, green vegetables, potatoes, dried fruits and mature legumes. Iaraj (Cyrtosperma chamissonis), mature coconuts (waini), flesh of immature coconuts (mere), breadfruit (mā), fresh and preserved; (bwiro, jankwin and manakajin) and breadfruit seeds (colé) are vegetable sources.

5. Vitamin A

Vitamin A is necessary for normal growth and development. It is needed to protect and keep healthy the epithelial cells which line the tracts and organs of the body. These cells become stratified and keratinized and result in disease, lowered resistance and failure to reproduce. The adaptation of the eye to a change in light is related to vitamin A and is a cause of night blindness. Vitamin A is also important in the formation of teeth as the enamel forming cells are like epithelia and are affected by a lack of vitamin A.

One hundred sixty-one subjects of Majuro Village, one hundred forty subjects or 87% were below NRC allowances.

Orange yellow and green parts of plants are superior to other parts of the plant for vitamin A such as yellow squash, yellow sweet potatoes, yellow turnips, and yellow corn. Bright green thinner leaves are richer than pale thick ones. Green vegetables: spinach, cabbage, mustard green and sweet potato tops. Fruits: bananas, papayas, cantaloupes, pineapples and oranges. Fish liver oils, milk, eggs, flesh of fish such as tuna, mackeral, swordfish, whale, salmon and shark are good sources of vitamin A. Pandanus (bop, mokan), fresh and preserved; breadfruit (ma, bwiro, jankwin and manakajin), fresh and preserved are good sources.

6. Thiamine

Thiamine is involved in carbohydrate metabolism and is essential for maintenance of good appetite, normal digestion and intestinal tonus.

It is also necessary for growth, fertility and the normal functioning of the nervous tissue.

Of one hundred sixty-one subjects of Majuro village, one hundred thirty-six subjects or 85% were below NRC allowances.

Thiamine added to enriched flour helps to increase the intake of thiamine. White milled rice is one of the most popular foods but is low in thiamine. Converted rice has a higher thiamine value than milled white rice. Enriched rice is now on the market and the effectiveness of improving the diet is still in the experimental stages.

Thiamine is found in the following foods: Animal: milk, liver, kidney, heart, egg yolk and especially pork. Seeds: whole grains, wheat and corn. All nuts. Legumes: beans, peas, and lentils. Bananas (kābran), breadfruit (mā), fresh and preserved (bwiro, jankwin and manakajin); breadfruit seeds (colé); sweet potatoes; iaraj (Cyrtosperma chamissonis); coconut embryo (iu); pandanus (bop, mokan), fresh and paste.

7. Riboflavin

Riboflavin along with thiamine and niacin is involved in the oxidation and reduction processes which are concerned with energy metabolism of the tissues. Lack of this vitamin affects growth, the skin, eyes and nerves. Dimness of vision, and invasion of the cornea by the capillaries is caused by a lack.

Of one hundred sixty-one subjects of Majuro village, one hundred sixty or 99% were below NRC allowances.

Of all the nutrients studied, riboflavin showed the greatest number of subjects failing to meet NRC allowances. This nutrient intake was helped by riboflavin in enriched flour. Riboflavin is found in liver, muscles of animals and fish, milk and eggs. Among the plant sources the actively growing leaves; legumes, including peanuts are good. Bananas (kābran); breadfruit (mā), fresh and preserved (bwiro, jankwin and manakajen); breadfruit seeds (colé); iaraj (Cyrtosperma chamissonis); coconut embryo (iu); pandanus fruit (bop), fresh and paste (mokan) are other sources.

8. Niacin

Niacin is essential in the enzyme system of the body. A lack affects the skin, gastro-intestinal tract, and the nervous system. In severe cases, pellagra is the result.

Of one hundred sixty-one subjects of Majuro village, seventy-nine subjects or 49% were below NRC allowances.

High values for niacin are found in liver, kidney, lean muscle of meat, fish, poultry, brain, salmon, peanuts, peanut butter, yeast, milk, plants: leaf type vegetables. Coconut syrup (jekamai); coconut embryo (iu); mature coconut (waini); breadfruit (mā), fresh and preserved (bwiro, jankwin and manakajen); breadfruit seeds (colé); iaraj (Cyrtosperma chamissonis); pandanus (bop) fresh and paste (mokan); and sweet potatoes are sources.

9. Ascorbic acid

Ascorbic acid is involved in the metabolism of intercellular tissue and plays an important part in the structure and functioning of bones and teeth, capillaries, muscle and glandular organs.

Lack of ascorbic acid results in hemorrhage, soft swollen gums, teeth with resorbed porotic dentine, malformed and weak bones, and degeneration of muscle fibers.

Out of one hundred sixty-one subjects of Majuro village, one hundred fifty-one subjects or 94% were below NRC allowances.

Citrus fruits, such as lime, orange, grapefruits, lemons, are the best sources, others are tomatoes, cantaloupes, cabbage, papayas and peppers. Bananas (kabran); coconut sap (jekaro); pandanus (bop), fresh and paste (mokan); breadfruit (ma), fresh and preserved (bwiro, jankwin and manakajen); and coconut embryo (iu) are sources.

For future planning, the target for good nutrition is a well balanced meal. Foods from each group should be eaten daily: the fat and sugars; bread, flour and cereals; green and yellow vegetables; limes, papayas and other fruits; vegetables and fruits; milk and milk products; fish, eggs, meat and poultry.

Special attention should be paid to the growing children, pregnant and lactating women.

The first years of a child's life is a period of very rapid growth and good nutrition is important. The Recommended Daily Dietary Allowances for a child under 1 year are as follows: calories, 100 calories/2.2 lbs. or 1 kilogram; protein, 3.5/2.2 lbs.; calcium 1 gm.; iron 6 mgs.; vitamin A 1500 I. U.; thiamine 0.4 mgs.; riboflavin 0.6 mgs.; niacin 4 mgs.; ascorbic acid 30 mgs.; vitamin D 400 I. U. These allowances can be met by including the easily digested foods of the various groups mentioned previously.

The few instances in which data were collected, the child was breast fed until about 8 months. Usually a child is weaned at 12 months. In many instances, canned evaporated milk diluted with equal amounts of boiled water, was given as supplementary food to breast feeding. Drinking fluid of the immature nut was taken as early as three months. At about six months, cooked breadfruit mixed with boiled water and boiled coconut sap was given. At about 11 to 12 months, foods found in an adult diet were given as fast as tolerated.

For growing children all food nutrients including calories must cover requirements for growth as well as maintenance and activity. Liberal calcium intake is needed by the body of infants and children as they must retain a large amount of calcium than of any other building material. A low intake of calcium and phosphorus during growth will prevent normal development and calcification of the bones and teeth. All other nutrients must be carefully considered for optimum health.

Pregnancy is also a period of growth. There is an extra demand for body building materials and body regulating materials needed for maintenance requirements for the woman, for fetal tissue, and for a reserve for lactation. All nutrient intakes should be liberal.

Lactation requires energy to carry on work of women and energy to manufacture milk. Liberal feeding is not only important for conservation of energy of the mother but may prolong the period of lactation.

DIETARY STUDIES OF THREE MARSHALLESE SCHOOLS

DIETARY STUDY OF FEMALE STUDENTS OF THE MARSHALL CHRISTIAN TRAINING SCHOOL, ROÑRQÑ, MARSHALL ISLANDS

PURPOSE

1. To determine the nutritional adequacy of the diet for calories and nutrients; 2. To study food consumption of studnets in a school supervised and financed by Marshallese in order to make a comparative study of diets of students of a Marshallese school and students of the Marshall Island Intermediate School and Teacher Training School in Uliga, which was supervised by the U. S. Navy; 3. To gather more data about female students as most of the subjects at the Marshall Island Intermediate School were males.

SCHOOL

The students came from all the atolls in the Marshall Islands except Ujelang. The school is owned and financed by the Association of Marshall Island Churches. Financial support is obtained from a fund created by Marshallese Congregational church members paying a dollar a year. School teachers' salaries and food for faculty and students are paid from this fund.

FOOD SUPPLIES

The Council of Majuro village had given the school certain lands and trees, such as breadfruit, coconuts, and pandanus, which are used for food. Bananas, limes, and taro are usually given to the school as gifts from the Council of Majuro village. Church members and churches of the other atolls in the Marshall Islands send arrowroot flour, preserved pandanus and salted fish as gifts.

Supplies such as rice, sugar, shoyu, and flour are bought from the Majuro Wholesale Company at retail prices.

MEALS

Two meals are served to the students daily. Breakfast at about 9:30 a.m. and the evening meal at 5:30 p.m. One food was usually served at each meal such as soft rice cooked with coconut milk and coconut sap; jaibo, a mixture of flour, coconut milk, and boiled coconut sap; jekara bread made with coconut sap; or rice. Other food that students ate were bought individually at a store that the school maintained for students, where canned fish, crackers, and other food were sold.

Schedule of activities for the day

6:00 a.m. Rising bell

6:30 a.m. Hymn and prayer at girls' dormitory

7:00 a.m. Cleaning of dormitory

8:00 a.m. Bible reading

9:15-10:00 a.m. Breakfast

10:00 a.m. to 12:30 p.m. English, arithmetic, geography, music

12:30-2:00 p.m. Study, rest, and play

2:00-4:30 p.m. Work period

Girls - Embroidery, handicraft, or washing and ironing

Boys - Feeding pigs, morning, noon and night

Feeding hens, morning, noon and night

Carpentry

Cleaning grounds

Planting

Fishing

Building

Kitchen duties -

Cooking - boys only - one week at a time

Married students act as supervisors

Girls do the washing of kitchen utensils

FOOD PREPARATION

Food was prepared at the cookhouse. The cookhouse had facilities for cooking food by baking (umum) or boiling (ainbat). Dried pandanus husks, wood or coconut husks were used for fuel. After the food was prepared, the boys took the food to the girls' dormitory where monitors for the day divided the food equally for each girl. Food was then eaten from enamelware plates or coconut husks. Since there were no dining rooms, the students ate in groups around the school grounds. After eating, each student washed her own dish in the lagoon. In case of rain, the students ate in the dormitory.

SUPPLEMENTARY FOODS

Pigs and chickens raised on the premises were used for food only on special occasions, such as chicken for Easter and roast pig on New Year's day.

FISHING

The school owned three fish traps; two were always left in the lagoon. The students went fishing with nets on Saturday. Since there were no storage facilities;the fish was eaten the day of the catch. Crabs and lobsters were caught at certain times of the year. At low tide, girls gathered clams and shellfish on the coral reefs.

STUDY

Food record method was followed. Food was weighed at each meal on a Chatillon gram scale. Left over food was weighed and subtracted from the amount originally served. Between meal feedings with quantities eaten were listed,

Forms used were the same as those used in the study at the Marshall Island Intermediate School at Uliga. Food consumption for a period of one week for each subject was recorded. Medical information was also noted.

Example

Student B   Age: 19   Sex: F   Marital status: S

Address: Marshall Christian Training School

District: Ebon

Weight: 143 lbs.   Height: 62 1/2 inches

Medical record:

Physical complaints: none

Defects noted on general inspection

Ecthyma, legs

Hypertrophic tonsils

Chest X-ray

Negative

Tuberculin skin

T negative

C negative

H negative

Kahn

222

Stools

negative

Food intake record for Student B from April 2 through April 8, 1951

April 2, 1951

Soft rice	760 gms.
Taro	340 gms.
Between meals	
Bananas, Marshallese	2
Coconut, mature	200 gms.

April 3, 1951

Soft rice	704 gms.
Rice, white, boiled	640 gms.
Between meals	
Bananas, Marshallese	4
Pandanus, fresh	300 gms.
Candies, hard	50 gms.
Bread, white	224 gms.

April 4, 1951

Jaibo	650 gms.
Soft rice	620 gms.
Between meals	
Bananas, Jibuki	2
Coconuts	600 gms.
Bread, white	224 gms.

April 5, 1951

Soft rice	566 gms.
Jaibo	504 gms.

Between meals

Pandanus, fresh	300 gms.
Shellfish, Lukerr	100 gms.

April 6, 1951

Jaibo	440 gms.
Rice, boiled white	560 gms.
Between meals	
Bread, white	224 gms.
Coconut, embryo, iu	500 gms.
Bread, white	224 gms.

April 7, 1951

Jaibo	600 gms.
Soft rice	620 gms.
Between meals	
Coconut, mature	300 gms.
Bread, white	224 gms.
Fish, Kuban	200 gms.

April 8, 1951

Rice, white, boiled	686 gms.
Between meals	
Bread, white	448 gms.
Pandanus, fresh	375

Typical Menus Served by School

April 2, 1951

Breakfast

Soft rice

Supper

Taro

April 3, 1951

Breakfast

Soft rice

Supper

Rice

April 4, 1951

Breakfast

Jaibo

Supper

Soft rice

April 5, 1951

Breakfast

Soft rice

Supper

Jaibo

April 6, 1951

Breakfast

Jaibo

Supper

Rice, boiled, white

April 7, 1951

Breakfast

Jaibo

Supper

Soft rice

RESULTS

The results of the dietary study of female students at the Marshall Christian Training School, Ronron, Marshall Islands are given in Table 10.

The daily quantities of various nutrients per person and comparison with National Research Council Allowances for fifty-two female students from the ages of 10 through 20 years of age are noted.

The subjects are divided into different age groups, giving the number of subjects in each group, sex, range of each nutrient, number of subjects in each group, sex, range of each nutrient, number of subjects in each group, average, NRC allowances and number below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin and ascorbic acid.

Table 10.

Dietary Study of Students at Marshall Christian Training School,
Roñroñ, Marshall Islands

by Mary Murai

Daily Quantities of Various Nutrients per Person
and Comparison with National Research Council Allowances

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Calories									
10-12	4	F	1413-2947	1400-2399	1	2300	2500	3	75
				2400-3399	3				
13-15	14	F	1646-2391	1600-2599	14	2070	2600	14	100
16-20	34	F	1578-2927	1500-2499	25	2178	2400	25	73
				2500-3499	9				
Protein (gm.)									
10-12	4	F	59-77	50-69	3	66	70	3	75
				70-89	1				
13-15	14	F	42-73	40-59	7	58	80	14	100
				60-79	7				
16-20	34	F	38-76	30-49	5	59	75	31	91
				50-69	23				
				70-89	6				
Fat (gm.)									
10-12	4	F	30-57	30-89	4	42	69	4	100
13-15	14	F	8-70	< 10	2	39	72	14	100
				10-39	6				
				40-69	5				
				70-99	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects iin group	Aver- age	NRC allow- ances	Number below allowances	Percent below allowances
16-20	34	F	7-88	< 10	3	42	67	29	85
				10-39	16				
				40-69	11				
				70-99	4				
Calcium (mg.)									
10-12	4	F	334-541	300-499	3	440	1200	4	100
				500-699	1				
13-15	14	F	205-738	200-399	3	496	1300	14	100
				400-599	8				
				600-799	3				
16-20	34	F	208-731	200-399	11	445	1000	34	100
				400-599	18				
				600-799	5				
Phosphorus (mg.)									
10-12	4	F	1014-1208	1000-1199	3	1132	1200	3	75
				1200-1399	1				
13-15	14	F	904-1230	900-1099	9	1054	1200	13	93
				1100-1299	5				
16-20	34	F	853-1728	800-999	10	1102	1200	28	82
				1000-1199	18				
				1200-1399	5				
				1600-1799	1				
Iron (mg.)									
10-12	4	F	7-11	5-9	2	9	12	4	100
				10-14	2				
13-15	14	F	5-18	5-9	12	9	15	13	93
				10-14	1				
				15-19	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	34	F	5-14	5-9	27	9	15	34	100
				10-14	7				
Vitamin A (I.U.)									
10-12	4	F	219-3492	< 499	1	1796	4500	4	100
				1000-1999	1				
				2000-2999	1				
				3000-3999	1				
13-15	14	F	649-5156	500-999	2	2845	5000	13	93
				1000-1999	1				
				2000-2999	3				
				3000-3999	6				
				4000-4999	1				
				5000	1				
16-20	34	F	144-9550	< 499	3	2885	5000	32	94
				500-999	1				
				1000-1999	5				
				2000-2999	12				
				3000-3999	7				
				4000-4999	4				
				>5000	2				
Thiamine (mcg.)									
10-12	4	F	625-1592	600-899	2	1056	1200	3	75
				900-1199	1				
				1500-1799	1				
13-15	14	F	366-1188	300-599	2	690	1300	14	100
				600-899	11				
				900-1199	1				
16-20	34	F	348-1367	300-599	8	756	1200	32	94
				600-899	19				
				900-1199	5				
				1200-1499	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Riboflavin (mcg.)									
10-12	4	F	417-979	400-699	3	672	1800	4	100
				700-999	1				
13-15	14	F	241-799	200-499	8	498	2000	14	100
				500-799	6				
16-20	34	F	311-922	300-599	23	552	1800	34	100
				600-899	10				
				900-1199	1				
Niacin (mg.)									
10-12	4	F	9-15	< 10	1	13	12	1	25
				10-19	3				
13-15	14	F	7-16	< 10	6	10	13	10	71
				10-19	8				
16-20	34	F	7-20	< 10	10	12	12	19	56
				10-19	23				
				20-29	1				
Ascorbic Acid (mg.)									
10-12	4	F	11-23	10-19	3	16	75	4	100
				20-29	1				
13-15	14	F	7-25	< 10	1	17	80	14	100
				10-19	8				
				20-29	5				
16-20	34	F	8-61	< 10	1	22	80	34	100
				10-19	18				
				20-29	7				
				30-39	4				
				40-49	2				
				50-59	1				
				60-69	1				

1. CALORIES

For four female subjects, 10 to 12 years of age, the range was from 1413 to 2947 calories, and the average per person was 2300 calories. The average figure was 92% of the NRC allowances of 2500 calories. Three subjects or 75% were below allowances and one or 25% was above the allowance.

For fourteen female subjects, 13 to 15 years of age, the range was from 1646 to 2391 calories, and the average per person was 2070 calories. The average figure was 80% of the NRC allowances of 2600 calories. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 1578 to 2927 calories, and the average per person was 2178 calories. The average figure was 91% of the NRC allowances of 2400 calories. Twenty-five subjects or 73% were below allowances and nine or 27% were above allowances.

For the total group of fifty-two subjects, forty-two or 81% were below allowances and ten or 19% were above allowances.

2. PROTEIN

For four female subjects, 10 to 12 years of age, the range was from 59 to 77 gms., and the average per person was 66 gms. The average figure was 94% of the NRC allowances of 70 gms. Three subjects or 75% were below allowances and one or 25% was above the allowance.

For fourteen female subjects, 13 to 15 years of age, the range was from 42 to 73 gms., and the average per person was 58 gms. The average figure was 72% of the NRC allowances of 80 gms. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 38 to 76 gms., and the average per person was 59 gms. The average figure was 79% of the NRC allowances of 75 gms. Thirty-one or 91% were below allowances and three or 9% were above allowances.

For the total group of fifty-two subjects, forty-eight or 92% were below allowances and four or 8% were above allowances.

3. FAT

For four female subjects, 10 to 12 years of age, the range was from 30 to 57 gms., and the average per person was 42 gms. The average figure was 61% of the NRC allowances of 69 gms. Four subjects or 100% were below allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 8 to 70 gms., and the average per person was 39 gms. The average figure was 54% of the NRC allowances of 72 gms. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 7 to 88 gms., and the average per person was 42 gms. The average figure was 63% of the NRC allowances of 67 gms. Twenty-nine subjects or 85% were below allowances and five or 15% were above allowances.

For the total group of fifty-two subjects, forty-seven or 90% were below allowances, and five or 10% were above allowances.

4. CALCIUM

For four female subjects, 10 to 12 years of age, the range was from 334 to 541 mgs., and the average per person was 440 mgs. The average figure was 37% of the NRC allowances of 1200 mgs. Four subjects or 100% were below allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 205 to 738 mgs., and the average per person was 496 mgs. The average figure was 38% of the NRC allowances of 1300 mgs. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 208 to 731 mgs., and the average per person was 445 mgs. The average figure was 44% of the NRC allowances of 1000 mgs. Thirty-four subjects or 100% were below allowances.

For the total group of fifty-two subjects, fifty-two subjects or 100% were below allowances.

5. PHOSPHORUS

For four female subjects, 10 to 12 years of age, the range was from 1014 to 1208 mgs., and the average per person was 1132 mgs. The average figure was 94% of the NRC allowances of 1200 mgs. Three subjects or 75% were below allowances and one or 25% was above the allowance.

For fourteen female subjects, 13 to 15 years of age, the range was from 904 to 1230 mgs., and the average per person was 1054 mgs. The average figure was 88% of the NRC allowances of 1200 mgs. Thirteen or 93% were below allowances and one subject or 7% was above the allowance.

For thirty-four female subjects, 16 to 20 years of age, the range was from 853 to 1728 mgs., and the average per person was 1102 mgs. The average figure was 92% of the NRC allowances of 1200 mgs. Twenty-eight subjects or 82% were below allowances and six subjects or 18% were above allowances.

For the total group of fifty-two subjects, forty-four subjects or 85% were below allowances and eight subjects or 15% were above allowances.

6. IRON

For four female subjects, 10 to 12 years of age, the range was from 7 to 11 mgs., and the average per person was 9 mgs. The average figure was 75% of the NRC allowances of 12 mgs. Four subjects or 100% were below allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 5 to 18 mgs., and the average per person was 9 mgs. The average figure was 60% of the NRC allowances of 15 mgs. Thirteen subjects or 93% were below allowances and one subject or 7% was above the allowance.

For thirty-four female subjects, 16 to 20 years of age, the range was from 5 to 14 mgs., and the average per person was 9 mgs. The average figure was 60% of the NRC allowances of 15 mgs. Thirty-four subjects or 100% were below allowances.

For the total group of fifty-two subjects, fifty-one subjects or 98% were below allowances and one subject or 2% was above the allowance.

7. VITAMIN A

For four female subjects, 10 to 12 years of age, the range was from 219 to 3492 I. U., and the average per person was 1796 I. U. The average figure was 40% of the NRC allowances of 4500 I. U. Four subjects or 100% were below allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 649 to 5156 I. U., and the average per person was 2845 I. U. The average figure was 57% of the NRC allowances of 5000 I. U. Thirteen subjects or 93% were below allowances and one subject or 7% was above the allowance.

For thirty-four female subjects, 16 to 20 years of age, the range was from 144 to 9550 I. U., and the average per person was 2885 I. U. The average figure was 58% of the NRC allowances of 5000 I. U. Thirty-two subjects or 94% were below allowances and two subjects or 6% were above allowances.

For the total group of fifty-two subjects, forty-nine subjects or 94% were below allowances and three subjects or 6% were above allowances.

8. THIAMINE

For four female subjects, 10 to 12 years of age, the range was from 625 to 1592 mcgs., and the average per person was 1056 mcgs. The average figure was 88% of the NRC allowances of 1200 mcgs. Three subjects or 75% were below allowances and one subject or 25% was above the allowance.

For fourteen female subjects, 13 to 15 years of age, the range was from 366 to 1188 mcgs., and the average per person was 690 mcgs. The average figure was 53% of the NRC allowances of 1300 mcgs. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 348 to 1367 mcgs., and the average per person was 756 mcgs. The average figure was 63% of the NRC allowances of 1200 mcgs. Thirty-two subjects or 94% were below allowances and two or 6% were above allowances.

For the total group of fifty-two subjects, forty-nine subjects or 94% were below allowances and three subjects or 6% were above allowances.

9. RIBOFLAVIN

For four female subjects, 10 to 12 years of age, the range was from 417 to 979 mcgs., and the average per person was 672 mcgs. The average figure was 37% of the NRC allowances of 1800 mcgs. Four subjects or 100% were below allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 241 to 799 mcgs., and the average per person was 498 mcgs. The average figure was 25% of the NRC allowances of 2000 mcgs. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 311 to 922 mcgs., and the average per person was 552 mcgs. The average figure was 31% of the NRC allowances of 1800 mcgs. Thirty-four subjects or 100% were below allowances.

For the total group of fifty-two subjects, fifty-two subjects or 100% were below allowances.

10. NIACIN

For four female subjects, 10 to 12 years of age, the range was from 9 to 15 mgs., and the average per person was 13 mgs. The average figure was 108% of the NRC allowances of 12 mgs. One subject or 25% was below the allowance and three subjects or 75% were above allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 7 to 16 mgs., and the average per person was 10 mgs. The average figure was 77% of the NRC allowances of 13 mgs. Ten or 71% were below allowances and four subjects or 29% were above allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 7 to 20 mgs., and the average per person was 12 mgs. The average figure was 100% of the NRC allowances of 12 mgs. Nineteen subjects or 56% were below allowances and fifteen subjects or 44% were above allowances.

For the total group of fifty-two subjects, thirty subjects or 58% were below allowances and twenty-two subjects or 42% were above allowances.

11. ASCORBIC ACID

For four female subjects, 10 to 12 years of age, the range was from 11 to 23 mgs., and the average per person was 16 mgs. The average figure was 21% of the NRC allowances of 75 mgs. Four subjects or 100% were

below allowances.

For fourteen female subjects, 13 to 15 years of age, the range was from 7 to 25 mgs., and the average per person was 80 mgs. The average figure was 21% of the NRC allowances of 80 mgs. Fourteen subjects or 100% were below allowances.

For thirty-four female subjects, 16 to 20 years of age, the range was from 8 to 61 mgs., and the average per person was 22 mgs. The average figure was 27% of the NRC allowances of 80 mgs. Thirty-four subjects or 100% were below allowances.

For the total group of fifty-two subjects, fifty-two subjects or 100% were above allowances.

SUMMARY

Weekly dietary records of fifty-two female students of the Marshall Christian Training School at Ronron, Marshall Islands, from the ages of 10 through 20 years of age, were studied for daily quantities of calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid. These figures were then compared with National Research Council Allowances.

Taking the total group of fifty-two students, the following results were obtained when daily intakes were compared with National Research Council allowances:

1. Calories: Forty-two or 81% were below allowances, ten or 19% were above allowances.

2. Protein: Forty-eight or 92% were below allowances, four subjects or 8% were above allowances.

3. Fat: Forty-seven subjects or 90% were below allowances, five subjects or 10% were above allowances.

4. Calcium: Fifty-two subjects or 100% were below allowances.

5. Phosphorus: Forty-four subjects or 85% were below allowances, eight subjects or 15% were above allowances.

6. Iron: Fifty-one subjects or 98% were below allowances, one subject or 2% was above the allowance.

7. Vitamin A: Forty-nine subjects or 94% were below allowances, three subjects or 6% were above allowances.

8. Thiamine: Forty-nine subjects or 94% were below allowances, three subjects or 6% were above allowances.

9. Riboflavin: Fifty-two subjects or 100% were below allowances.

10. Niacin: Thirty subjects or 58% were below allowances, twenty-two subjects or 42% were above allowances.

11. Ascorbic acid: Fifty-two subjects or 100% were above allowances.

All subjects or 100% did not meet NRC allowances for calcium, riboflavin, and ascorbic acid. Ninety-eight percent of the subjects were below allowances for iron, 94% of the subjects were below allowances for thiamine and vitamin A.

Ninety-two percent of the subjects were below allowances for protein; 90% of the subjects were below allowances for fat; 85% of the subjects were below allowances for phosphorus; 81% of the subjects were below allowances for calories; and 58% of the subjects were below allowances for niacin.

DIETARY STUDY OF STUDENTS AT THE MISSION SCHOOL, MAJURO VILLAGE, MAJURO ISLAND, MARSHALL ISLANDS

PURPOSE

1. To determine the nutritional adequacy of the diet for calories and nutrients.

2. To study food consumption of students in a school administered and financed by Marshallese.

3. To complete the survey of subjects of Majuro Village.

SUBJECTS

The students were all residents of Majuro Village except for three students who were from Arno atoll. This study included twenty-four students--one male subject, 13 to 15 years of age; ten male subjects, 16 to 20 years of age; ten female subjects, 13 to 15 years of age; and three female subjects, 16 to 20 years of age. These students lived at the school.

SCHOOL

The school was built by the Council of Majuro Village. The maintenance of the school and the teachers' salaries are financed by the Marshallese Christian Association.

The students do not pay tuition and were all recommended by church members and the pastor.

Students are responsible for bringing their own bedding and for buying their own school supplies such as pencils and tablets. The better students go to the Elementary school at Ronron̄.

Classes are in session from January to the end of May, and from September through December.

The classes are held in the church building from 8 to 11:30 a.m. Subjects taught are: Bible studies, English, arithmetic, and singing. After a year and a half, they continue their education at the Marshall Christian Training School at Ronron̄.

FOOD

Supplying food to the students is the responsibility of the Majuro Village Council. Students cook their own food at the cookhouse, which is outdoors where an open fire is used. Two meals are served daily. One in the morning and the other in the evening. Two male students and two female students were cooks on rotation. On Saturdays, male students went fishing for the school.

The school owned two pigs and some chickens, which were eaten only on special occasions. The school did not maintain a store where students could buy food for between feedings or to supplement their diets.

STUDY

The interview method was used and food records were kept. Between meal feedings and quantities eaten were listed. Method used was the same as that followed for other subjects of Majuro Village. Food consumption records were kept for a period of one week, for each subject.

FOOD INTAKE RECORD

An example of one of the intake records of a student is given.

TYPICAL MENUS

This is the same as the intake record. There were no supplementary feedings.

EXAMPLE
FOOD INTAKE RECORD FOR J

Name: J   Sex: M   Age: 15

April 18, 1951
Wednesday

Jaibo	500 gms.
Jekara	1 cup

April 19, 1951
Thursday

Jaibo	600 gms.
Rice	300 gms.

April 20, 1951
Friday

Jaibo	500 gms.
Rice	300 gms.
Sardines, fresh	60 gms.

April 21, 1951
Saturday

Jaibo	750 gms.
Breadfruit, baked	350 gms.
Sardines, canned	100 gms.

April 22, 1951
Sunday

Breadfruit, baked	400 gms.
Sardines, canned	100 gms.
Bread	4 ozs.

April 23, 1951
Monday

Jaibo	600 gms.
Soft rice	800 gms.
Jekara	1 cup

April 24, 1951
Tuesday

Rice	700 gms.
Breadfruit, baked	300 gms.

RESULTS

The results of the dietary study of students at the Mission School, Majuro Village, Majuro Island, Marshall Islands are given in Table 11.

The daily quantities of various nutrients per person and comparison with National Research Council Allowances for twenty-four students from the ages of 13 through 20 years of age are noted.

The subjects are divided into different age groups, giving the number of subjects in each group, sex, range of each nutrient, number of subjects in each group, averages, NRC allowances, number below allowances and percent of subjects below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin, and ascorbic acid.

1. Calories

For one male subject, 13 to 15 years of age, the daily intake was 1098 calories, which was 34% of the NRC allowances of 3200 dalories. This subject was below allowances.

For ten male subjects, 16 to 20 years of age, the range was from 932 to 1912 calories, and the average per person was 1332 calories. The average figure was 35% of the NRC allowances of 3800 calories. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 930 to 1340 calories, and the average per person was 1217 calories.

Table 11.

Dietary Study of Students at Mission School,
Majuro Island, Marshall Islands by Mary Murai

Daily Quantities of Various Nutrients per Person
and Comparison with National Research Council Allowances

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Calories									
13-15	1	M	1098	1000-1999	1	1098	3200	1	100
16-20	10	M	932-1912	<1000 1000-1999	1 9	1332	3800	10	100
13-15	10	F	930-1340	<1000 1000-1999	1 9	1217	2600	10	100
16-20	3	F	1172-1420	1000-1999	3	1277	2400	3	100
Protein (gm.)									
13-15	1	M	23	20-39	1	23	85	1	100
16-20	10	M	20-38	20-39	10	28	100	10	100
13-15	10	F	25-38	20-39	10	29	80	10	100
16-20	3	F	29-33	20-39	3	31	75	3	100
Fat (gm.)									
13-15	1	M	7	<20	1	7	89	1	100
16-20	10	M	3-66	<20 20-39 >50	6 3 1	19	105	10	100
13-15	10	F	5-16	<20	10	8	72	10	100
16-20	3	F	6-16	<20	3	10	67	3	100

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Calcium (mg.)									
13-15	1	M	228	200-399	1	228	1400	1	100
16-20	10	M	116-195	< 200	11	148	1400	10	100
13-15	10	F	122-419	< 200	6	209	1300	10	100
				200-399	3				
				419	1				
16-20	3	F	136-170	< 200	3	157	1000	3	100
Phosphorus (mg.)									
13-15	1	M	493	400-599	1	493	1320	1	100
16-20	10	M	324-699	300-499	8	453	1320	10	100
				500-699	2				
13-15	10	F	402-612	400-599	9	484	1200	10	100
				600-799	1				
16-20	3	F	455-524	400-599	3	484	1200	3	100
Iron (mg.)									
13-15	1	M	7	5-9	1	7	15	1	100
16-20	10	M	5-12	5-9	8	7	15	10	100
				10-14	2				
13-15	10	F	4-8	5-9	10	6	15	10	100
16-20	3	F	7	5-9	3	7	15	3	100
Vitamin A (I.U.)									
13-15	1	M	50	< 100	1	50	5000	1	100
16-20	10	M	10-66	< 100	10	29	6000	10	100

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
13-15	10	F	19-51	< 100	10	40	5000	10	100
16-20	3	F	40-73	< 100	3	54	5000	3	100
Thiamine (mcg.)									
13-15	1	M	565	500-799	1	565	1500	1	100
16-20	10	M	393-993	< 500 500-799 800-1099	3 4 3	650	1700	10	100
13-15	10	F	366-820	< 500 500-799 800-1099	1 7 2	633	1300	10	100
16-20	3	F	652-1064	500-799 800-1099	1 2	840	1200	3	100
Riboflavin (mcg.)									
13-15	1	M	449	400-699	1	449	2000	1	100
16-20	10	M	263-584	< 500 500-799	6 4	432	2500	10	100
13-15	10	F	233-557	< 500 500-799	8 2	450	2000	10	100
16-20	3	F	465-586	< 500 500-799	1 2	530	1800	3	100
Niacin (mg.)									
13-15	1	M	11	10-19	1	11	15	1	100
16-20	10	M	8-13	< 10 10-19	3 7	10	17	10	100
13-15	10	F	9-12	< 10 10-19	2 8	11	13	10	100
16-20	3	F	10-11	10-19	3	10	12	3	100

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
<u>Ascorbic Acid</u> (mg.)									
13-15	1	M	29-	10-29	1	29	30	1	100
16-20	10	M	3-21	< 10	3	12	100	10	100
				10-29	7				
13-15	10	F	4-20	< 10	3	15	80	10	100
				10-29	7				
16-20	3	F	7-20	< 10	2	12	80	3	100
				10-29	1				

The average figure was 47% of the NRC allowances of 2600 calories. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 1172 to 1420 calories, and the average per person was 1277 calories. The average figure was 53% of the NRC allowances of 2400 calories. Three subjects or 100% were below allowances.

Of the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

2. Protein

For one male subject, 13 to 15 years of age, the daily intake was 23 gms., which was 27% of the NRC allowances of 85 gms. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 20 to 38 gms., and the average per person was 28 gms. The average figure was 28% of the NRC allowances of 100 gms. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 25 to 38 gms., and the average per person was 29 gms. The average figure was 36% of the NRC allowances of 80 gms. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 29 to 33 gms., and the average per person was 31 gms. The average figure was 41% of the NRC allowances of 75 gms. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

3. Fat

For one male subject, 13 to 15 years of age, the daily intake was 7 gms., which was 8% of the NRC allowances of 89 gms. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 3 to 66 gms., and the average per person was 19 gms. The average figure was 18% of the NRC allowances of 105 gms. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 5 to 16 gms., and the average per person was 8 gms. The average figure was 11% of the NRC allowances of 72 gms. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 6 to 16 gms., and the average per person was 10 gms. The average figure was 15% of the NRC allowances of 67 gms. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four or 100% were below allowances.

4. Calcium

For one male subject, 13 to 15 years of age, the daily intake was 228 mgs., which was 16% of the NRC allowances of 1400 mgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 116 to 195 mgs., and the average per person was 148 mgs. The average figure was 11% of the NRC allowances of 1400 mgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 122 to 419 mgs., and the average per person was 209 mgs. The average figure was 16% of the NRC allowances of 1300 mgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 136 to 170 mgs., and the average per person was 157 mgs. The average figure was 16% of the NRC allowances of 1000 mgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

5. Phosphorus

For one male subject, 13 to 15 years of age, the daily intake was 493 mgs., which was 37% of the NRC allowances of 1320 mgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 324 to 699 mgs., and the average per person was 453 mgs. The average figure was 34% of the NRC allowances of 1320 mgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 402 to 612 mgs., and the average per person was 484 mgs. The average figure was 40% of the NRC allowances of 1200 mgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 455 to 524 mgs., and the average per person was 484 mgs. The average figure was 40% of the NRC allowances of 1200 mgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four or 100% were below allowances.

6. Iron

For one male subject, 13 to 15 years of age, the daily intake was 7 mgs., which was 47% of the NRC allowances of 15 mgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 5 to 12 mgs., and the average per person was 7 mgs. The average figure was 47% of the NRC allowances of 15 mgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 4 to 8 mgs., and the average per person was 6 mgs. The average figure was 40% of the NRC allowances of 15 mgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, there is no range of nutrient value given. The average per person was 7 mgs. The average figure was 47% of the NRC allowances of 15 mgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

7. Vitamin A

For one male subject, 13 to 15 years of age, the daily intake was 50 I. U., which was 1% of the NRC allowances of 5000 I. U. This subject was below the allowance,

For ten male subjects, 16 to 20 years of age, the range was from 10 to 66 I. U., and the average per person was 29 I. U. The average figure was 0.5% of the NRC allowances of 6000 I. U. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 19 to 51 I. U., and the average per person was 40 I. U. The average figure was 0.8% of the NRC allowances of 5000 I. U. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 40 to 73 I. U., and the average per person was 54 I. U. The average figure was 1% of the NRC allowances of 5000 I. U. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four or 100% were below allowances.

8. Thiamine

For one male subject, 13 to 15 years of age, the daily intake was 565 mcgs., which was 38% of the NRC allowances of 1500 mcgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 393 to 993 mcgs., and the average per person was 650 mcgs. The average figure was 38% of the NRC allowances of 1700 mcgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 336 to 820 mcgs., and the average per person was 633 mcgs. The average figure was 49% of the NRC allowances of 1300 mcgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 652 to 1064 mcgs., and the average per person was 840 mcgs. The average figure was 70% of the NRC allowances of 1200 mcgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

9. Riboflavin

For one male subject, 13 to 15 years of age, the daily intake was 449 mcgs., which was 22% of the NRC allowances of 2000 mcgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 263 to 584 mcgs., and the average per person was 432 mcgs. The average figure was 17% of the NRC allowances of 2500 mcgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 233 to 557 mcgs., and the average per person was 450 mcgs. The average figure was 22% of the NRC allowances of 2000 mcgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 465 to 586 mcgs., and the average per person was 530 mcgs. The average figure was 24% of the NRC allowances of 1800 mcgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four or 100% were below allowances.

10. Niacin

For one male subject, 13 to 15 years of age, the daily intake was 11 mgs., which was 73% of the NRC allowances of 15 mgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 8 to 13 mgs., and the average per person was 10 mgs. The average figure was 59% of the NRC allowances of 17 mgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 9 to 12 mgs., and the average per person was 11 mgs. The average figure was 85% of the NRC allowances of 13 mgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 10 to 11 mgs., and the average per person was 10 mgs. The average figure was 83% of the NRC allowances of 12 mgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

11. Ascorbic Acid

For one male subject, 13 to 15 years of age, the daily intake was 29 mgs., which was 32% of the NRC allowances of 90 mgs. This subject was below the allowance.

For ten male subjects, 16 to 20 years of age, the range was from 3 to 21 mgs., and the average per person was 12 mgs. The average figure was 12% of the NRC allowances of 100 mgs. Ten subjects or 100% were below allowances.

For ten female subjects, 13 to 15 years of age, the range was from 4 to 20 mgs., and the average per person was 15 mgs. The average figure was 19% of the NRC allowances of 80 mgs. Ten subjects or 100% were below allowances.

For three female subjects, 16 to 20 years of age, the range was from 7 to 20 mgs., and the average per person was 12 mgs. The average figure was 15% of the NRC allowances of 80 mgs. Three subjects or 100% were below allowances.

For the total group of twenty-four subjects, twenty-four subjects or 100% were below allowances.

SUMMARY

Weekly dietary records of twenty-four students of the Mission School, Majuro Village, Majuro Island, from the age of 13 through 20 years of age, were studied for daily quantities of calories, protein, fat, calcium, phosphorus, iron, Vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. These figures were then compared with National Research Council Allowances.

Taking the total group of twenty-four students, the following results were obtained when daily intakes were compared with National Research Council Allowances:

1. Calories: Twenty-four subjects or 100% were below allowances.

2. Protein: Twenty-four subjects or 100% were below allowances.

3. Fat: Twenty-four subjects or 100% were below allowances.

4. Calcium: Twenty-four subjects or 100% were below allowances.

5. Phosphorus: Twenty-four subjects or 100% were below allowances.

6. Iron: Twenty-four subjects or 100% were below allowances.

7. Vitamin A: Twenty-four subjects or 100% were below allowances.

8. Thiamine: Twenty-four subjects or 100% were below allowances.

9. Riboflavin: Twenty-four subjects or 100% were below allowances.

10. Niacin: Twenty-four subjects or 100% were below allowances.

11. Ascorbic acid: Twenty-four subjects or 100% were below allowances.

All twenty-four subjects or 100% did not meet NRC allowances for any of the nutrients studied, namely, calories, protein, fat, calcium, phosphorus, iron, Vitamin A, thiamine, riboflavin, niacin, and ascorbic acid.

DIETARY STUDY OF STUDENTS OF THE MARSHALL ISLAND INTERMEDIATE SCHOOL AND THE TEACHER TRAINING SCHOOL

PURPOSE

1. To determine the nutritional adequacy of the diet for calories and nutrients; 2. To compare total calories and nutrients of this school which was supervised by the United States Navy with others supervised by Marshallese; [In this school, the dietary patterns had changed from the use of native foods to the use of imported foods;] 3. To complete the survey on Majuro village since most of the children of ages 13 to 15 were at school.

SUBJECTS

The subjects were students of the Intermediate school who were on scholarships from twenty-four islands and atolls of the Marshall Islands. The teacher trainees were also included. The study included 87 students. There were 72 male students; of these, 11 students were from 13 to 15 years of age, 48 students were 16 to 20 years of age, and 13 students over 20 years of age. There were 15 female students; of these, 6 students were 13 to 15 years of age, 8 students were 16-20 years of age; and 1 over 20 years of age.

SCHOOLS

The school was located at Uliga, which was the naval base. The Intermediate school was composed of the 7th and 8th grades; while the teacher trainees were on rotation, spending one year as teachers in the field and one year as trainee in the Teacher Training school. The school was financed by funds which were included in the Navy budget for the Marshall Islands. The food allowance for each student was about ten dollars per month. An increase to about thirteen dollars per person had been anticipated. Food supplies were secured through the Naval Supply Office. Canned fruits and vegetables, evaporated milk, sugar, rice and shortening were available. Fresh fruits and vegetables could be ordered but since they were sent on logistic flights once a week, it was difficult to supply the whole school with these items. The students were given three dollars per month for their toilet articles and for other personal items. This allowance did not give them enough money to indulge in between meal feedings, so they were dependent on three meals a day at school for their nutritional requirements. The students lived in dormitories at the school.

ACTIVITIES OF STUDENTS

The daily schedule for the students was as follows:

6:30 a. m.	Reveille
6:30-7:30 a. m.	Clean dormitory and yard
7:30-8:00 a. m.	Breakfast
8:45-11:55 a. m.	Academic classes

12 noon-1:30 p. m.	Lunch period
1:30-3:30 p. m.	Work period

Male students (teacher trainees and Intermediate school students)

1. Cleaning
2. Building
3. Painting
4. Repairing fish nets
5. Copra production
6. Working with cement to repair buildings, walks and other places in need of repair
7. New construction of buildings and other necessary places
8. Fishing for school

Women students

1. Classes in sewing and handicrafts

4:45-5:45 p. m.	Supper period
7:00-9:00 p. m.	Study period (when electricity is available)

Once a month three boys or six girls rotate on kitchen duty. A day was spent cooking and cleaning the kitchen.

The kitchen and dining rooms were in a separate building on the school grounds. Kerosene lamps were used for light. A wood stove was used for cooking and an oven for baking. These rooms were dark with cement flooring. Dishes were washed with cold water; soap was used when available. There were no facilities for sterilization. Food was prepared in the kitchen or outdoors. A well outside of the kitchen supplied water for washing rice and for dishwashing, rainwater from a cistern was used for drinking. Adequate storage space for perishables, such as fresh fish, was lacking. Therefore, whenever, fish was caught in large numbers, they had to be eaten at once.

METHOD USED FOR STUDY

Food records were kept for three consecutive days on mimeographed sheets. They were for breakfast, lunch, supper and between meal feeding. Food was weighed at each meal on Chatillon gram scales and uneaten food was reweighed. Between meal feedings were recorded and quantities estimated. For composite food products, the weights of the ingredients in the recipe, and the weight of the resulting food after cooking, were determined in order to calculate from tables of food composition, the nutritive value of each food combination.

Other data collected were name, age, sex, marital status, address, district, weight, height, medical record, and dental record.

RESULTS

FOOD INTAKE RECORDS

An example of one of the student's intake record is given.

Example

Name: E Age: 14 Sex: M Marital status: S

Address: Majuro Intermediate School

District: Rongelap

Weight: 92 pounds Height: 58 inches

Medical record:

Physical complaints: none

Defects noted on general inspection
Chronic tonsilitis
Ecthyma buttocks

Chest X-ray
Negative

Tuberculin skin
T Negative
C Negative
H Negative

Kahn
Negative

Stools
Negative

Summary or defect
Dental - none
Emergency treatment given - dental none
Treatment required - none

February 2, 1951

Breakfast

Pancake	230 gms.
Sugar cane syrup	20 gms.
Rice, boiled	200 gms.

Water	300 gms.
Lunch	
Rice, boiled	290 gms.
Kuban fish, boiled	250 gms.
Water	500 gms.
Supper	
Rice, boiled	280 gms.
Salmon, canned	120 gms.
Water	300 gms.
Between meals	
Drinking coconut, ni (fluid)	340 gms.
mere (meat)	120 gms.
Waini (mature coconut meat)	135 gms.

February 5, 1951

Breakfast	
Rice, boiled	185 gms.
Salmon, canned	65 gms.
Water	400 gms.
Lunch	
Doughnut	160 gms.
Rice, boiled	125 gms.
Water	300 gms.
Supper	
Rice, boiled	420 gms.
Salmon, canned	100 gms.
Water	500 gms.
Between meals	
Drinking coconut, ni (fluid)	300 gms.
mere (meat)	100 gms.
Waini (mature coconut meat)	125 gms.

February 6, 1951

Breakfast

Pancake	140 gms.
Sugar cane syrup	20 gms.

Lunch

Rice, boiled	180 gms.
Salmon, canned	120 gms.
Water	500 gms.

Supper

Rice, boiled	260 gms.
Salmon, canned	140 gms.
Water	500 gms.

Between meals

Waini (mature coconut meat)	135 gms.

TYPICAL MENUS

These menus show the type of meals which were served in the school.

January 30, 1951

Breakfast

Boiled rice Canned red sockeye salmon

Black tea with sugar

Lunch

Doughnut Water

Supper

Boiled rice Canned red sockeye salmon

February 2, 1951

Breakfast

Boiled rice　　　　Pancake with syrup

Black tea with sugar

Lunch

Boiled rice　　　　Boiled fresh Kuban fish

Black tea with sugar

February 5, 1951

Breakfast

Boiled rice　　　　Canned red sockeye salmon

Black tea with sugar

Lunch

Doughnut　　　　Canned sardines in cottonseed oil

Canned evaporated milk with water

Supper

Boiled rice　　　　Canned red sockeye salmon

Canned milk with water

INGREDIENTS USED IN SOME OF THE FOODS ON THE MENUS

Beverages

For each 300 grams of tea, 17.43 grams of sugar were added.
For each 300 grams of evaporated milk with water, there were 12.64 grams of evaporated milk.

Doughnuts

Yield: 165 doughnuts

Ingredients

Flour	33 pounds
Eggs, powdered (whole)	2 pounds
Yeast	3.1 oz.
Sugar	2 pounds

Method

Ingredients were mixed together by hand and fried in deep fat until brown. They were eaten cold.

Bread

Yield: 18 loaves

Ingredients

Flour	35 pounds
Sugar	3 pounds
Yeast	1/4 pound
Dried milk	1 pound

Method

Regular bread making procedures were followed. Cook was trained in Navy bakery. Baked in wood fire oven.

Ingredients used in cooking

Flour--wheat, hard, enriched bleached
Sugar--fine granulated white
Yeast--active dry yeast
Dried milk--dried whole milk, 26% butter fat
Dried eggs--spray dried whole eggs
Sardines--packed in cottonseed and/or soy bean oil
Rice--converted, 100 pound sacks, Houston Texas brand
Salmon--Red Sockeye Salmon, canned

RESULTS

Table 12 gives the results of the dietary study of students of the Marshall Island Intermediate School and the Teacher Training School, Uliga, Marshall Islands.

The daily quantities of various nutrients per person and comparison with National Research Council Allowances for eighty-seven male and female students from the ages of thirteen to over 20 years of age were noted.

The subjects are divided into different age groups, giving the number of subjects in each group, sex, range of each nutrient, number of subjects in each group, average, NRC allowances, number below allowances, and percent of subjects below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin, and ascorbic acid.

1. Calories

For eleven male subjects, 13 to 15 years of age, the range was from 2608 to 4571 calories, and the average per person was 3858 calories. The average figure was 120% of the NRC allowances of 3200 calories. Three subjects or 27% were below allowances and eight or 73% were above these allowances.

For six female subjects, 13 to 15 years of age, the range was from 1841 to 3733 calories, and the average per person was 3281 calories. The average figure was 125% of the NRC allowances of 2600 calories. One subject or 17% was below allowance and five subjects or 83% were above these allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 1851 to 5655 calories, and the average per person was 3253 calories. The average figure was 86% of the NRC allowances of 3800 calories. Thirty-nine or 81% were below allowances and nine or 19% were above allowances.

For eight female subjects, 16 to 20 years of age, the range was from 2279 to 4161 calories, and the average per person was 3011 calories. The average figure was 125% of the NRC allowances of 2400 calories. Two subjects or 25% were below allowances and six subjects or 75% were above allowances.

For thirteen male subjects, 20 years and over, the range was from 2290 to 3733 calories, and the average per person was 2972 calories. The average figure was 99% of the NRC allowances of 3000 calories. Six subjects or 46% were below allowances, and seven subjects or 54% were above allowances.

For one female subject, 20 years and over, 2236 calories were consumed. This figure was 111% of the NRC allowances of 2000 calories. This subject was above allowances.

For the total group of eighty-seven subjects, fifty-one subjects or 59% were below allowances, thirty-six subjects or 41% were above allowances.

2. Protein

For eleven male subjects, 13 to 15 years of age, the range was from 85 to 142 grams, and the average per person was 115 grams. The average was 135% of the NRC allowances of 85 grams. Eleven subjects or 100% were above allowances.

For six female subjects, 13 to 15 years of age, the range was from 65 to 137 grams, and the average per person was 104 grams. The average was 130% of the NRC allowances of 80 grams. One subject or 17% was below allowances and five subjects or 83% were above these allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 73 to 178 grams, and the average per person was 116 grams. The average was 116% of the NRC allowances of 100 grams. Fourteen subjects or 29% were below allowances and thirty-four or 71% were above the allowances.

For eight female subjects, 16 to 20 years of age, the range was from 48 to 153 grams, and the average per person was 98 grams. Two subjects or 25% were below allowances and 6 subjects or 75% were above these allowances.

For thirteen male subjects, 20 years and over, the range was from 96 to 168 grams, and the average per person was 118 grams. The average was 168% of the NRC allowances of 70 grams. No one was below allowances and thirteen or 100% were above the allowances.

Table 12.

Dietary Study of Students at the Marshall Island
Intermediate School and the Teacher Training School, Uliga, Marshall Islands

by Mary Murai

Daily Quantities of Various Nutrients per Person
and Comparison with National Research Council Allowances

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Calories									
13-15	11	M	2608-4571	2000-2999	2	3858	3200	3	27
				3000-3999	6				
				4000-4999	3				
13-15	6	F	1841-3733	1800-2799	1	3281	2600	1	17
				3000-3999	5				
16-20	48	M	1851-5655	1800-2799	11	3253	3800	39	81
				3000-3799	38				
				3800-4799	7				
				4800-5799	2				
16-20	8	F	2279-4161	2000-2999	5	3011	2400	2	25
				3000-3999	2				
				4000-4999	1				
20/	13	M	2290-3733	2000-2999	6	2972	3000	6	46
				3000-3999	7				
20/	1	F	2236	2000-2999	1	2236	2000	0	0
Protein (gm.)									
13-15	11	M	85-142	80-99	2	115	85	0	0
				100-119	4				
				>120	5				
13-15	6	F	65-137	60-79	1	104	80	1	17
				100-119	4				
				130-149	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	48	M	73-178	70-89	12	116	100	14	29
				90-109	4				
				>110	32				
16-20	8	F	48-153	40-59	2	98	75	2	25
				80-99	3				
				>100	3				
20+	13	M	96-168	90-109	3	118	70	0	0
				110-129	6				
				130-149	3				
				>150	1				
20+	1	F	83	80-99	1	83	60	0	0
Fat (gm.)									
13-15	11	M	31-141	30-59	2	85	89	6	55
				60-89	4				
				90-119	3				
				>120	2				
13-15	6	F	29-118	20-49	2	81	72	2	33
				80-109	3				
				110-139	1				
16-20	48	M	21-200	20-49	15	70	105	42	88
				50-79	20				
				80-109	7				
				>110	6				
16-20	8	F	27-148	20-49	4	70	67	5	63
				50-79	1				
				>80	3				
20+	13	M	29-87	20-49	3	61	83	11	85
				50-79	8				
				80-109	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
20+	1	F	42	30-59	1	42	56	1	100
Calcium (mg.)									
13-15	11	M	492-1052	400-599	4	784	1400	11	100
				700-899	4				
				900-1099	3				
13-15	6	F	405-1163	400-599	1	725	1300	6	100
				600-799	4				
				>800	1				
16-20	48	M	436-1911	< 700	19	825	1400	46	96
				700-899	14				
				900-1099	8				
				1100-1299	5				
				>1400	2				
16-20	8	F	216-1432	< 500	3	675	1000	7	88
				600-799	2				
				800-999	2				
				>1000	1				
20+	13	M	607-1712	600-799	6	926	1000	9	69
				800	3				
				>1000	4				
20+	1	F	631	600- 799	1	631	1000	1	100
Phosphorus (mg.)									
13-15	11	M	1079-2089	1000-1199	2	1487	1320	4	36
				1200-1399	3				
				> 1400	6				
13-15	6	F	751-1637	700-899	1	1362	1200	1	17
				1200-1399	1				
				>1400	4				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	48	M	996-2159	900-1099	1	1515	1320	12	25
				1100-1299	11				
				1300-1499	13				
				> 1500	23				
16-20	8	F	597-2064	< 700	1	1230	1200	4	50
				700-899	1				
				900-1099	1				
				1100-1299	2				
				> 1300	3				
20+	13	M	1018-2135	1000-1199	3	1480	1320	3	23
				1200-1399	3				
				> 1400	7				
20+	1	F	1118	1000-1199	1	1118	1320	1	100
<u>Iron</u> (mg.)									
13-15	11	M	7-26	5-9	2	16	15	5	45
				10-14	3				
				> 15	6				
13-15	6	F	5-21	5-9	1	13	15	4	67
				10-14	3				
				> 15	2				
16-20	48	M	5-28	5-9	13	13	15	29	60
				10-14	16				
				> 15	19				
16-20	8	F	6-17	5-9	4	11	15	6	75
				10-14	2				
				> 15	2				
20+	13	M	7-18	5-9	4	11	12	7	54
				10-14	7				
				> 15	2				
20+	1	F	7	7	1	7	12	1	100

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Vitamin A (I.U.)									
13-15	11	M	320-5844	< 499	2	1666	5000	10	91
				500-999	2				
				1000-1999	5				
				2000-2999	1				
				> 5000	1				
13-15	6	F	286-609	< 499	3	479	5000	6	100
				500-999	3				
16-20	48	M	233-7085	< 499	16	1805	6000	45	94
				500-999	7				
				1000-1999	12				
				2000-2999	4				
				3000-3999	3				
				4000-4999	2				
				> 7500	4				
16-20	8	F	306-10187	< 499	2	2431	5000	7	88
				500-999	1				
				1000-1999	3				
				2000-2999	1				
				> 5000	1				
20+	13	M	482-5530	< 499	1	2062	5000	11	85
				500-999	4				
				1000-1999	4				
				2000-2999	1				
				4000-4999	1				
				> 5000	2				
20+	1	F	1171	1000-1999	1	1171	5000	1	100
Thiamine (mcg.)									
13-15	11	M	934-3049	900-1199	4	1686	1500	5	45
				1200-1499	1				
				> 1500	6				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver-age	NRC allow-ances	Number below allowances	Percent below al-lowances
13-15	6	F	767-1822	700-999	1	1450	1300	1	17
				1300-1599	3				
				1600-1899	2				
16-20	48	M	572-3188	500-799	3	1410	1700	39	81
				800-1099	8				
				1100-1399	20				
				1400-1699	8				
				>1700	9				
16-20	8	F	831-1600	800-1099	4	1162	1200	5	63
				1100-1399	2				
				1400-1699	2				
20+	13	M	993-2112	800-1099	3	1361	1500	9	69
				1100-1399	5				
				1400-1699	3				
				>1700	2				
20+	1	F	826	826	1	826	1000	1	100
Riboflavin (mcg.)									
13-15	11	M	605-2396	600-899	3	1109	2000	10	91
				900-1199	3				
				1200-1499	2				
				1500-1799	2				
				>2000	1				
13-15	6	F	496-1255	<500	1	966	2000	6	100
				600-899	1				
				900-1199	3				
				1200-1499	1				
16-20	48	M	511-2107	500-799	6	1147	2500	48	100
				800-1099	17				
				1100-1399	15				
				1400-1699	9				
				>2100	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver-age	NRC allow-ances	Number below allowances	Percent below al-lowances
16-20	8	F	464-1495	500	1	912	1800	8	100
				500-799	3				
				800-1099	1				
				1100-1399	2				
				1400-1699	1				
20+	13	M	840-1936	800-1099	7	1179	1800	12	92
				1100-1399	4				
				1400-1699	1				
				1700-1999	1				
20+	1	F	814	800-1099	1	814	1500	1	100
<u>Niacin</u> (mg.)									
13-15	11	M	11-41	10-19	1	27	15	1	9
				20-39	9				
				40-59	1				
13-15	6	F	15-31	10-19	1	26	13	0	0
				20-39	5				
16-20	48	M	13-37	10-19	5	26	17	1	2
				20-39	43				
16-20	8	F	17-35	10-19	5	20	12	0	0
				20-39	3				
20+	13	M	7-31	< 10	1	24	15	1	8
				10-19	1				
				20-39	11				
20+	1	F	15	10-19	1	15	10	0	0
<u>Ascorbic Acid</u> (mg.)									
13-15	11	M	0-120	< 10	4	27	90	10	91
				10-29	4				
				30-49	2				
				> 90	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Aver-age	NRC allow-ances	Number below allowances	Percent below allowances
13-15	6	F	0-29	< 10	2	14	80	6	100
				10-29	4				
16-20	48	M	0-129	< 10	30	23	100	43	90
				10-29	9				
				50-69	2				
				70-89	2				
				90-109	1				
				>110	4				
16-20	8	F	0-224	< 10	2	40	80	7	88
				10-29	4				
				30-49	1				
				>110	1				
20+	13	M	0-44	< 10	10	8	75	13	100
				10-29	1				
				30-49	2				
20+	1	F	9	< 10	1	9	70	1	100

For one female subject, 20 years and over, the daily intake was 83 grams. This was 138% of the NRC allowances of 60 grams. This subject was above the allowance.

For the total group of eighty-seven subjects, seventeen subjects or 20% were below allowances and seventy subjects or 80% were above allowances.

3. Fat

For eleven male subjects, 13 to 15 years of age, the range was from 31 to 141 grams, and the average per person was 85 grams. The average was 95% of the NRC allowances of 89 grams. Six subjects or 55% were below allowances and five subjects or 45% were above the allowance.

For six female subjects, 13 to 15 years of age, the range was from 29 to 118 grams, and the average per person was 81 grams. The average was 112% of the NRC allowances of 72 grams. Two subjects or 33% were below allowances and four subjects or 67% were above allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 21 to 200 grams, and the average per person was 70 grams. The average was 67% of the NRC allowances of 105 grams. Forty-two subjects or 88% were below allowances and six subjects or 12% were above allowances.

For eight female subjects, 16 to 20 years of age, the range was from 27 to 148 grams, and the average per person was 70 grams. The average was 104% of the NRC allowances of 67 grams. Five subjects or 63% were below allowances and three subjects or 37% were above these allowances.

For thirteen male subjects, 20 years and over, the range was from 29 to 87 grams, and the average per person was 61 grams. The average was 73% of the NRC allowances of 83 grams. Eleven subjects or 85% were below allowances and two or 15% were above the allowances.

For one female subject, 20 years and over, the total grams of fat was 42 grams. This was 75% of the NRC allowances of 56 grams. This subject was below allowances.

For the total group of eighty-seven subjects, sixty-seven subjects or 77% were below allowances and twenty subjects or 23% were above allowances.

4. Calcium

For eleven male subjects, 13 to 15 years of age, the range was from 492 to 1052 mgs., and the average per person was 784 mgs. The average was 56% of the NRC allowances of 1400. Eleven subjects or 100% were below allowances.

For six female subjects, 13 to 15 years of age, the range was from 405 to 1163 mgs., and the average per person was 725 mgs. The average was 56% of the NRC allowances of 1300 mgs. Six subjects or 100% were below allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 436 to 1911 mgs., and the average per person was 825 mgs. The average was 59% of the NRC allowances of 1400 mgs. Forty-six subjects or 96% were below allowances and two or 4% were above allowances.

For eight female subjects, 16 to 20 years of age, the range was from 216 to 1432 mgs., and the average per person was 675 mgs. The average was 67% of the NRC allowances of 1000 mgs. Seven subjects or 88% were below allowances and one subject or 12% was above the allowance.

For thirteen male subjects, 20 years and over, the range was from 607 to 1712 mgs., and the average per person was 926 mgs. The average was 93% of the NRC allowances of 1000 mgs. Nine subjects or 69% were below allowances and four subjects or 31% were above allowances.

For one female subject, 20 years and over, the total intake of calcium was 631 mgs. This was 63% of the NRC allowances of 1000 mgs. This subject was below allowances.

For the total group of eighty-seven subjects, eighty subjects or 92% were below allowances and seven subjects or 8% were above allowances.

5. Phosphorus

For eleven male subjects, 13 to 15 years of age, the range was from 1079 to 2089 mgs., and the average per person was 1487 mgs. The average was 112% of the NRC allowances of 1320 mgs. Four subjects or 36% were below allowances and seven subjects or 64% were above allowances.

For six female subjects, 13 to 15 years of age, the range was from 751 to 1637 mgs., and the average per person was 1362 mgs. The average was 113% of the NRC allowances of 1200 mgs. One subject or 17% was below the allowance and five subjects or 83% were above allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 996 to 2159 mgs., and the average per person was 1515 mgs. The average was 115% of the NRC allowances of 1320 mgs. Twelve subjects or 25% were below allowances and thirty-six subjects or 75% were above allowances.

For eight female subjects, 16 to 20 years of age, the range was from 597 to 2064 mgs., and the average per person was 1230 mgs. The average was 102% of the NRC allowances of 1200 mgs. Four subjects or 50% were below allowances and four subjects or 50% were above allowances.

For thirteen male subjects, 20 years and over, the range was from 1018 to 2135 mgs., and the average per person was 1480 mgs. The average was 111% of the NRC allowances of 1320 mgs. Three subjects or 23% were below allowances and ten subjects or 77% were above allowances.

For one female subject, 20 years and over, the total mgs. of phosphorus was 1118 mgs. This was 85% of the NRC allowances of 1320 mgs. This subject was below the allowance.

For the total group of eighty-seven subjects, twenty-five subjects or 29% were below allowances and sixty-two subjects or 71% were above allowances.

6. Iron

For eleven male subjects, 13 to 15 years of age, the range was from 7 to 26 mgs., and the average per person was 16 mgs. The average was 107% of the NRC allowances of 15 mgs. Five subjects or 45% were below allowances and six subjects or 55% were above allowances.

For six female subjects, 13 to 15 years of age, the range was from 5 to 21 mgs. and the average per person was 13 mgs. The average was 87% of the NRC allowances of 15 mgs. Four subjects or 67% were below allowances and two subjects or 33% were above allowances.

For forty-eight male subjects, 15 to 20 years of age, the range was from 5 to 28 mgs., and the average per person was 13 mgs. The average was 87% of the NRC allowances of 15 mgs. Twenty-nine subjects or 60% were below allowances and nineteen subjects or 40% were above allowances.

For eight female subjects, 16 to 20 years of age, the range was from 6 to 17 mgs., and the average per person was 11 mgs. The average was 73% of the NRC allowances of 15 mgs. Six subjects or 75% were below allowances and two subjects or 25% were above allowances.

For thirteen male subjects, 20 years and over, the range was from 7 to 18 mgs., and the average per person was 11 mgs. The average was 92% of the NRC allowances of 12 mgs. Seven subjects or 54% were below allowances and six subjects or 46% were above allowances.

For one female subject, 20 years and over, the iron content was 7 mgs. This was 58% of the NRC allowances of 12 mgs. This subject was below the allowance.

For the total group of eighty-seven students, fifty-two subjects or 60% were below allowances and thirty-five subjects or 40% were above allowances.

7. Vitamin A

For eleven male subjects, 13 to 15 years of age, the range was from 320 to 5844 I. U. and the average per person was 1666 I. U. The average was 33% of the NRC allowances of 5000 I. U. Ten subjects or 91% were below allowances and one subject or 9% was above the allowance.

For six female subjects, 13 to 15 years of age, the range was from 286 to 609 I. U. and the average per person was 479 I. U. The average was 10% of the NRC allowances of 5000 I. U. Six subjects or 100% were below allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 233 to 7085 I. U. and the average per person was 1805 I. U. The average was 30% of the NRC allowances of 6000 I. U. Forty-five subjects or 94% were below allowances and three subjects or 6% were above allowances.

For eight female subjects, 16 to 20 years, the range was from 306 to 10,187 I. U. and the average per person was 2431 I. U. The average was 49% of the NRC allowances of 5000 I. U. Seven subjects or 88% were below allowances and one subject or 12% was above the allowance.

For thirteen male subjects, 20 years and over, the range was from 482 to 5530 I. U. and the average per person was 2062 I. U. The average was 41% of the NRC allowances of 5000 I. U. Eleven subjects or 85% were below allowances and two subjects or 15% were above allowances.

For one female subject, 20 years and over, the vitamin A content was 1171 I. U. This was 23% of the NRC allowances of 5000 I. U. This subject was below the allowance.

For the total group of eighty-seven students, eighty subjects or 92% were below allowances and seven subjects or 8% were above allowances.

8. Thiamine

For eleven male subjects, 13 to 15 years of age, the range was from 934 to 3049 mcgs., and the average per person was 1686 mcgs. The average was 112% of the NRC allowances of 1500 mcgs. Five subjects or 45% were below allowances and six subjects or 55% were above allowances.

For six female subjects, 13 to 15 years of age, the range was from 767 to 1822 mcgs. and the average per person was 1450 mcgs. The average was 111% of the NRC allowances of 1300 mcgs. One subject or 17% was below the allowance and five subjects or 83% were above allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 572 to 3188 mcgs., and the average per person was 1410 mcgs. The average was 83% of the NRC allowances of 1700 mcgs. Thirty-nine subjects or 81% were below allowances and nine subjects or 19% were above allowances.

For eight female subjects, 16 to 20 years, the range was from 831 to 1600 mcgs., and the average per person was 1162 mcgs. The average was 97% of the NRC allowances of 1200 mcgs. Five subjects or 63% were below allowances and three subjects or 37% were above allowances.

For thirteen male subjects, 20 years and over, the range was from 993 to 2112 mcgs., and the average per person was 1361 mcgs. The average was 91% of the NRC allowances of 1500 mcgs. Nine subjects or 69% were below allowances and four subjects or 31% were above allowances.

For one female subject, 20 years and over, the thiamine content was 826 mcgs. This was 83% of the NRC allowances of 1000 mcgs. This subject was below the allowance.

For the total group of eighty-seven students, sixty subjects or 69% were below allowances and twenty-seven subjects or 31% were above allowances.

9. Riboflavin

For eleven male subjects, 13 to 15 years of age, the range was from 605 to 2396 mcgs., and the average per person was 1109 mcgs. The average was 55% of the NRC allowances of 2000 mcgs. Ten subjects or 91% were below allowances and one subject or 9% was above the allowance.

For six female subjects, 13 to 15 years of age, the range was from 496 to 1255 mcgs., and the average per person was 966 mcgs. The average was 48% of the NRC allowances of 2000 mcgs. Six subjects or 100% were below allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 511 to 2107 mcgs., and the average per person was 1147. The average was 46% of the NRC allowances of 2500 mcgs. Forty-eight subjects or 100% were below allowances.

For eight female subjects, 16 to 20 years, the range was from 464 to 1495 mcgs., and the average per person was 912 mcgs. The average was 51% of the NRC allowances of 1800 mcgs. Eight subjects or 100% were below allowances.

For thirteen male subjects, 20 years and over, the range was from 840 to 1936 mcgs., and the average per person was 1179 mcgs. The average was 65% of the NRC allowances of 1800 mcgs. Twelve subjects or 92% were below allowances and one subject or 8% was above the allowance.

For one female subject, 20 years and over, the riboflavin content was 814 mcgs. This was 54% of the NRC allowances of 1500 mcgs. This subject was below the allowance.

For the total group of eighty-seven students, eighty-five subjects or 98% were below allowances and two subjects or 2% were above allowances.

10. Niacin

For eleven male subjects, 13 to 15 years of age, the range was from 11 to 41 mgs., and the average per person was 27 mgs. The average was 180% of the NRC allowances of 15 mgs. One subject or 9% was below the allowance and ten subjects or 91% were above allowances.

For six female subjects, 13 to 15 years of age, the range was from 15 to 31 mgs., and the average per person was 26 mgs. The average was 200% of the NRC allowances of 13 mgs. Six subjects or 100% were above allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 13 to 37 mgs., and the average per person was 26 mgs. The average was 153% of the NRC allowances of 17 mgs. One subject or 2% was below allowances and forty-seven subjects or 98% were above allowances.

For eight female subjects, 16 to 20 years, the range was from 17 to 35 mgs., the average per person was 20 mgs. The average was 166% of the NRC allowances of 12 mgs. Eight subjects or 100% were above allowances.

For thirteen male subjects, 20 years and over, the range was from 17 to 31 mgs., and the average per person was 24 mgs. The average was 160% of the NRC allowances of 15 mgs. One subject or 8% was below the allowance and twelve subjects or 92% were above allowances.

For one female subject, 20 years and over, the niacin content was 15 mgs. This was 150% of the NRC allowances of 10 mgs. This subject was above the allowance.

For the total group of eighty-seven students, three subjects or 4% were below allowances and eighty-four subjects or 96% were above allowances.

11. Ascorbic Acid

For eleven male subjects, 13 to 15 years of age, the range was from 0 to 120 mgs., and the average per person was 27 mgs. The average was 30% of the NRC allowances of 90 mgs. Ten subjects or 91% were below allowances and one subject or 9% was below the allowance.

For six female subjects, 13 to 15 years of age, the range was from 0 to 29 mgs., and the average per person was 14 mgs. The average was 17% of the NRC allowances of 80 mgs. Six subjects or 100% were below allowances.

For forty-eight male subjects, 16 to 20 years of age, the range was from 0 to 129 mgs., and the average per person was 23 mgs. The average was 23% of the NRC allowances of 23 mgs. Forty-three subjects or 90% were below allowances and five subjects or 10% were above allowances.

For eight female subjects, 16 to 20 years, the range was from 0 to 224 mgs., and the average per person was 40 mgs. The average was 50% of the NRC allowances of 80 mgs. Seven subjects or 88% were below allowances and one subject or 12% was above the allowance.

For thirteen male subjects, 20 years and over, the range was from 0 to 44 mgs., and the average per person was 8 mgs. The average was 11% of the NRC allowances of 75 mgs. Thirteen subjects or 100% were below allowances.

For one female subject, 20 years and over, the total niacin content was 9 mgs. This was 13% of the NRC allowances of 70 mgs. This subject was below the allowance.

For the total group of eighty-seven students, eighty subjects or 92% were below allowances and seven subjects or 8% were above allowances.

SUMMARY

Three day dietary records of eighty-seven students at the Marshall Island Intermediate School and Teacher Training School at Uliga, Marshall Islands, from the ages of 13 to 20 years and over, were studied for daily quantities of calories, protein, fat, calcium, phosphorus, iron vitamin A, thiamine, riboflavin, niacin and ascorbic acid. These figures were then compared with National Research Council Allowances.

Taking the total group of eighty-seven students, the following results were obtained when daily intakes were compared with NRC allowances.

1. Calories: Fifty-one subjects or 59% were below allowances, thirty-six subjects or 41% were above allowances.

2. Protein: Seventeen subjects or 20% were below allowances, seventy subjects or 80% were above allowances.

3. Fat: Sixty-seven subjects or 77% were below allowances, twenty subjects or 23% were above allowances.

4. Calcium: Eighty subjects or 92% were below allowances, seven subjects or 8% were above allowances.

5. Phosphorus: Twenty-five subjects or 29% were below allowances, sixty-two subjects or 71% were above allowances.

6. Iron: Fifty-two subjects or 60% were below allowances, thirty-five subjects or 40% were above allowances.

7. Vitamin A: Eighty subjects or 92% were below allowances, seven subjects or 8% were above allowances.

8. Thiamine: Sixty subjects or 69% were below allowances, twenty-seven subjects or 31% were above allowances.

9. Riboflavin: Eighty-five subjects or 98% were below allowances, two subjects or 2% were above allowances.

10. Niacin: Three subjects or 4% were below allowances, eighty-four subjects or 96% were above allowances.

11. Ascorbic acid: Eighty subjects or 92% were below allowances, seven subjects or 8% were above allowances.

Ninety-six percent of the subjects met the NRC allowances for niacin; 80% of the subjects met the NRC allowances for protein; and 71% of the subjects met the NRC allowances for phosphorus.

Ninety-eight percent of the subjects were below allowances for riboflavin. Ninety-two percent of the subjects were below allowances for calcium, vitamin A, and ascorbic acid. Seventy-seven percent of the subjects failed to meet NRC allowances for fat; 69% of the subjects failed to meet NRC allowances for thiamine; 60% of the subjects failed to meet NRC allowances for iron; and 59% of the subjects failed to meet NRC allowances for calories.

SUMMARY OF DAILY QUANTITIES OF VARIOUS NUTRIENTS PER PERSON IN THE THREE MARSHALLESE SCHOOLS AND COMPARISON WITH NATIONAL RESEARCH COUNCIL ALLOWANCES.

PURPOSE

To compare the daily quantities of various nutrients per person and comparison with National Research Council Allowances between three Marshallese Schools. The Marshall Island Intermediate School and Teacher Training School (an example of a school for Marshallese students administered and financed by the U. S. Navy); the other two, the Marshall Christian Training School and the Mission School, were examples of schools for Marshallese students administered and financed by Marshallese.

PROCEDURE AND METHODS USED

Given under section for each individual school.

RESULTS

Table 13 summarizes the daily quantities of various nutrients per person and compares them with National Research Council Allowances for female subjects from three schools in the Marshall Islands: The Marshall Island Intermediate School and the Teacher Training School at Uliga, the Marshall Christian Training School at Rohron, and the Mission School at Majuro Village, Majuro Island.

There were 163 male and female subjects, of which 80 were female students.

There were four subjects, ages 10 to 12 years from the Marshall Christian Training School.

Thirty subjects, ages 13 to 15 years; of these, fourteen were from the Marshall Christian Training School, ten subjects from the Mission School, and six subjects from the Marshall Island Intermediate School.

There were 45 subjects ages 16 to 20 years: 34 subjects from the Marshall Christian Training School; three subjects from the Mission School; and eight subjects from the Marshall Island Intermediate School. There was one subject over 20 years of age from the Marshall Island Intermediate School.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given.

I. FEMALES

a. <u>10 to 12 years of age</u>

1. For four female subjects, 10 to 12 years of age from the Marshall Christian Training School, the daily quantities of various nutrients

Table 13.

Summary of Daily Quantities of Various Nutrients per Person in the
Three Marshallese Schools and Comparisons with National Research Council Allowances

by Mary Murai

Females

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Ages 10 to 12 years											
Marshall Christian Training School (4)*											
Average intake	2300	66	42	440	1132	9	1796	1056	672	13	16
NRC allowances	2500	70	69	1200	1200	12	4500	1200	1800	12	75
% of allowances	92	94	61	37	94	75	40	88	37	108	21
% of subjects below allowances	75	75	100	100	75	100	100	75	100	25	100
Ages 13 to 15 years											
Marshall Christian Training School (14)											
Average intake	2070	58	39	496	1054	9	2845	690	498	10	17
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	80	72	54	38	88	60	57	53	25	77	21
% of subjects below allowances	100	100	100	100	93	93	93	100	100	71	100
Mission School (10)											
Average intake	1217	29	8	209	484	6	40	633	450	11	15
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	47	36	11	16	40	40	0.8	49	22	85	19
% of subjects below allowances	100	100	100	100	100	100	100	100	100	100	100
Marshall Island Intermediate School (6)											
Average intake	3281	104	81	725	1362	13	479	1450	966	26	14
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	125	130	112	56	113	87	10	111	48	200	17
% of subjects below allowances	17	17	33	100	17	67	100	17	100	0	100

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Ribcflavin	Niacin	Ascorbic Acid
Ages 16 to 20 years											
Marshall Christian Training School (34)											
Average intake	2178	59	42	445	1102	9	2885	756	552	12	22
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	91	79	63	44	92	60	58	63	31	100	27
% of subjects below allowances	73	91	85	100	82	100	94	94	100	56	100
Mission School (3)											
Average intake	1277	31	10	157	484	7	54	840	530	10	12
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	53	41	15	16	40	47	1	70	24	83	15
% of subjects below allowances	100	100	100	100	100	100	100	100	100	100	100
Marshall Island Intermediate School (8)											
Average intake	3011	98	70	675	1230	11	2431	1162	912	20	40
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	125	131	104	67	102	73	49	97	51	166	50
% of subjects below allowances	25	25	63	88	50	75	88	63	100	0	88
Ages 20 years and over											
Marshall Island Intermediate School (1)											
Average intake	2236	83	42	631	1118	7	1171	826	814	15	9
NRC allowances	2000	60	56	1000	1320	12	5000	1000	1500	10	70
% of allowances	111	138	75	63	85	58	23	83	54	150	13
% of subjects below allowances	0	0	100	100	100	100	100	100	100	0	100

* Figure in ( ) indicate number of subjects studied.

per person and comparison with NRC allowances are summarized here:

1. Calories: average intake was 2300 calories, which was 92% of the NRC allowances of 2500 calories. 75% of the subjects were below allowances.

2. Protein: average intake was 66 gms., which was 94% of the NRC allowances of 70 gms. 75% of the subjects were below allowances.

3. Fat: average intake was 42 gms., which was 61% of the NRC allowances of 69 gms. 100% of the subjects were below allowances.

4. Calcium: average intake was 440 gms., which was 37% of the NRC allowances of 1200 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 1132 mgs., which was 94% of the NRC allowances of 1200 mgs. 75% of the subjects were below allowances.

6. Iron: average intake was 9 mgs., which was 75% of the NRC allowances of 12 mgs. 100% of the subjects were below allowances.

7. Vitamin A: average intake was 1796 I. U., which was 40% of the NRC allowances of 4500 I. U. 100% of the subjects were below allowances.

8. Thiamine: average intake was 1056 mcgs., which was 88% of the NRC allowances of 1200 mcgs. 75% of the subjects were below allowances.

9. Riboflavin: average intake was 672 mcgs., which was 37% of the NRC allowances of 1800 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 13 mgs., which was 108% of the NRC allowances of 12 mgs. 25% of the subjects were below allowances.

11. Ascorbic acid: average intake was 16 mgs., which was 21% of the NRC allowances of 75 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for fat, calcium, iron, vitamin A, riboflavin, and ascorbic acid; 75% of the subjects were below allowances for calories, protein, phosphorus, and thiamine. 25% of the subjects were below allowances for niacin and 75% were above allowances.

b. <u>13 to 15 years of age</u>

1. For fourteen female subjects, 13 to 15 years of age from the Marshall Christian Training School, the daily quantities of various nutrients per person and comparison with NRC allowances are summarized here:

1. Calories: average intake was 2070 calories which was 80% of the NRC allowances of 2600 calories. 100% of the subjects were below allowances.

2. Protein: average intake was 58 gms., which was 72% of the NRC allowances of 80 gms. 100% of the subjects were below allowances.

3. Fat: average intake was 39 gms., which was 54% of the NRC allowances of 72 gms. 100% of the subjects were below allowances.

4. Calcium: average intake was 496 mgs., which was 38% of the NRC allowances of 1300 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 1054 mgs., which was 88% of the NRC allowances of 1200 mgs. 93% of the subjects were below allowances.

6. Iron: average intake was 9 mgs., which was 60% of the NRC allowances of 15 mgs. 93% of the subjects were below allowances.

7. Vitamin A: average intake was 2845 I. U., which was 57% of the NRC allowances of 5000 I. U. 93% of the subjects were below allowances.

8. Thiamine: average intake was 690 mcgs., which was 53% of the NRC allowances of 1300 mcgs. 100% of the subjects were below allowances.

9. Riboflavin: average intake was 498 mcgs., which was 25% of the NRC allowances of 2000 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 10 mgs., which was 77% of the NRC allowances of 13 mgs. 71% of the subjects were below allowances.

11. Ascorbic acid: average intake was 17 mgs., which was 21% of the NRC allowances of 80 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for calories, protein, fat, calcium, thiamine, riboflavin, and ascorbic acid; 93% of the subjects were below allowances for phosphorus, iron and vitamin A; 71% of the subjects were below allowances for niacin.

2. For ten female subjects, 13 to 15 years of age, from the Mission School, the daily quantities of various nutrients per person and comparison with NRC allowances are summarized here:

1. Calories: average intake was 1217 calories which was 47% of the NRC allowances of 2600 calories. 100% of the subjects were below allowances.

2. Protein: average intake was 29 gms., which was 36% of the NRC allowances of 80 gms. 100% of the subjects were below allowances.

3. Fat: average intake was 8 gms., which was 11% of the NRC allowances of 72 gms. 100% of the subjects were below allowances.

4. Calcium: average intake was 209 mgs., which was 16% of the NRC allowances of 1300 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 484 mgs., which was 40% of the NRC allowances of 1200 mgs. 100% of the subjects were below allowances.

6. Iron: average intake was 6 mgs., which was 40% of the NRC allowances of 15 mgs. 100% of the subjects were below allowances.

7. Vitamin A: average intake was 40 I. U., which was 0.8% of the NRC allowances of 5000 I. U. 100% of the subjects were below allowances.

8. Thiamine: average intake was 633 mcgs., which was 49% of the NRC allowances of 1300 mcgs. 100% of the subjects were below allowances.

9. Riboflavin: average intake was 450 mcgs., which was 22% of the NRC allowances of 2000 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 11 mgs., which was 85% of the NRC allowances of 13 mgs. 100% of the subjects were below allowances.

11. Ascorbic acid: average intake was 15 mgs., which was 19% of the NRC allowances of 80 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for all the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid.

3. For six female subjects, 13 to 15 years of age, from the Marshall Island Intermediate School, the daily quantities of various nutrients per person and comparison with NRC allowances are summarized here:

1. Calories: average intake was 3281 calories, which was 125% of the NRC allowances of 2600 calories. 17% of the subjects were below allowances.

2. Protein: average intake was 104 gms., which was 130% of the NRC allowances of 80 gms. 17% of the subjects were below allowances.

3. Fat: average intake was 81 gms., which was 112% of the NRC allowances of 72 gms. 33% of the subjects were below allowances.

4. Calcium: average intake was 725 mgs., which was 56% of the NRC allowances of 1300 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 1362 mgs., which was 113% of the NRC allowances of 1200 mgs. 17% of the subjects were below allowances.

6. Iron: average intake was 13 mgs., which was 87% of the NRC allowances of 15 mgs. 67% of the subjects were below allowances.

7. Vitamin A: average intake was 479 I. U., which was 10% of the NRC allowances of 5000 I. U. 100% of the subjects were below allowances.

8. Thiamine: average intake was 1450 mcgs., which was 111% of the NRC allowances of 1300 mcgs. 17% of the subjects were below allowances.

9. Riboflavin: average intake was 966 mcgs., which was 48% of the NRC allowances of 2000 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 26 mgs., which was 200% of the NRC allowances of 13 mgs. None of the subjects were below allowances.

11. Ascorbic acid: average intake was 14 mgs., which was 17% of the NRC allowances of 80 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for calcium, vitamin A, riboflavin, and ascorbic acid; and 67% of the subjects were below allowances for iron. 33% of the subjects were below allowances for fat. For calories, protein, phosphorus, and thiamine only 17% of the subjects were below allowances and 83% of the subjects were above allowances. All subjects or 100% were above allowances for niacin.

c. <u>16 to 20 years of age</u>

1. For thirty-four female subjects, 16 to 20 years of age, from the Marshall Christian Training School, the daily quantities of various nutrients per person and comparison with NRC allowances are summarized here:

1. Calories: average intake was 2178 calories, which was 91% of the NRC allowances of 2400 calories. 73% of the subjects were below allowances.

2. Protein: average intake was 59 gms., which was 79% of the NRC allowances of 75 gms. 91% of the subjects were below allowances.

3. Fat: average intake was 42 gms., which was 63% of the NRC allowances of 67 gms. 85% of the subjects were below allowances.

4. Calcium: average intake was 445 mgs., which was 44% of the NRC allowances of 1000 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 1102 mgs., which was 92% of the NRC allowances of 1200 mgs. 82% of the subjects were below allowances.

6. Iron: average intake was 9 mgs., which was 60% of the NRC allowances of 15 mgs. 100% of the subjects were below allowances.

7. Vitamin A: average intake was 2885 I. U., which was 58% of the NRC allowances of 5000 I. U. 94% of the subjects were below allowances.

8. Calcium: average intake was 756 mgs., which was 63% of the NRC allowances of 1200 mgs. 94% of the subjects were below allowances.

9. Phosphorus: average intake was 552 mgs., which was 31% of the NRC allowances of 1800 mgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 12 mgs., which was 100% of the NRC allowances of 12 mgs. 56% of the subjects were below allowances.

11. Ascorbic acid: average intake was 22 mgs., which was 27% of the NRC allowances of 80 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for calcium, iron, riboflavin, and ascorbic acid; 94% of the subjects were below allowances for vitamin A and thiamine; 91% of the subjects were below allowances for protein; 85% of the subjects were below allowances for fat; 82% of the subjects were below allowances for phosphorus; 73% of the subjects were below allowances for calories; and 56% of the subjects were below allowances for niacin.

2. For three female subjects, 16 to 20 years of age, from the Mission School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 1277 calories, which was 53% of the NRC allowances of 2400 calories. 100% of the subjects were below allowances.

2. Protein: average intake was 31 gms., which was 41% of the NRC allowances of 75 gms. 100% of the subjects were below allowances.

3. Fat: average intake was 10 gms., which was 15% of the NRC allowances of 67 gms. 100% of the subjects were below allowances.

4. Calcium: average intake was 157 mgs., which was 16% of the NRC allowances of 1000 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 484 mgs., which was 40% of the NRC allowances of 1200 mgs. 100% of the subjects were below allowances.

6. Iron: average intake was 7 mgs., which was 47% of the NRC allowances of 15 mgs. 100% of the subjects were below allowances.

7. Vitamin A: average intake was 54 I. U., which was 1% of the NRC allowances of 5000 I. U. 100% of the subjects were below allowances.

8. Thiamine: average intake was 840 mcgs., which was 70% of the NRC allowances of 1200 mcgs. 100% of the subjects were below allowances.

9. Riboflavin: average intake was 530 mcgs., which was 24% of the NRC allowances of 1800 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 10 mgs., which was 83% of the NRC allowances of 12 mgs. 100% of the subjects were below allowances.

11. Ascorbic acid: average intake was 12 mgs., which was 15% of the NRC allowances of 80 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for all the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid.

3. For eight female subjects, 16 to 20 years of age from the Marshall Island Intermediate School, the daily quantities of various nutrients per person with the NRC allowances are summarized here:

1. Calories: average intake was 3011 calories, which was 125% of the NRC allowances of 2400 calories. 25% of the subjects were below allowances.

2. Protein: average intake was 98 gms., which was 131% of the NRC allowances of 75 gms. 25% of the subjects were below allowances.

3. Fat: average intake was 70 gms., which was 104% of the NRC allowances of 67 gms. 63% of the subjects were below allowances.

4. Calcium: average intake was 675 mgs., which was 67% of the NRC allowances of 1000 mgs. 88% of the subjects were below allowances.

5. Phosphorus: average intake was 1230 mgs., which was 102% of the NRC allowances of 1200 mgs. 50% of the subjects were below allowances.

6. Iron: average intake was 11 mgs., which was 73% of the NRC allowances of 15 mgs. 75% of the subjects were below allowances.

7. Vitamin A: average intake was 2431 I. U., which was 49% of the NRC allowances of 5000 I. U. 88% of the subjects were below allowances.

8. Thiamine: average intake was 1162 mcgs., which was 97% of the NRC allowances of 1200 mcgs. 63% of the subjects were below allowances.

9. Riboflavin: average intake was 912 mcgs., which was 51% of the NRC allowances of 1800 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 20 mgs., which was 166% of the NRC allowances of 12 mgs. None of the subjects were below allowances.

11. Ascorbic acid: average intake was 40 mgs., which was 50% of the NRC allowances of 80 mgs. 88% of the subjects were below allowances.

100% of the subjects were below allowances for riboflavin; 38% of the subjects were below allowances for calcium, vitamin A, and ascorbic acid; 75% of the subjects were below allowances for iron; 63% of the subjects were below allowances for fat and thiamine; and 50% of the subjects were below allowances for phosphorus. 25% of the subjects were below allowances for calories and protein and 75% of the subjects were above allowances. All of the subjects or 100% were above allowances for niacin.

d. <u>20 years of age and over</u>

1. For one female subject over 20 years of age, from the Marshall Island Intermediate School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 2236 calories, which was 111% of the NRC allowances of 2000 calories. The subject was above allowances.

2. Protein: average intake was 83 gms., which was 138% of the NRC allowances of 60 gms. This subject was above allowances.

3. Fat: average intake was 42 gms., which was 75% of the NRC allowances of 56 gms. This subject was below allowances.

4. Calcium: average intake was 631 mgs., which was 63% of the NRC allowances of 1000 mgs. This subject was below allowances.

5. Phosphorus: average intake was 1118 mgs., which was 85% of the NRC allowances of 1320 mgs. This subject was below allowances.

6. Iron: average intake was 7 mgs., which was 58% of the NRC allowances of 12 mgs. This subject was below allowances.

7. Vitamin A: average intake was 1171 I. U., which was 23% of the NRC allowances of 5000 I. U. This subject was below allowances.

8. Thiamine: average intake was 826 mcgs., which was 83% of the NRC allowances of 1000 mcgs. This subject was below allowances.

9. Riboflavin: average intake was 814 mcgs., which was 54% of the NRC allowances of 1500 mcgs. This subject was below allowances.

10. Niacin: average intake was 15 mgs., which was 150% of the NRC allowances of 10 mgs. This subject was above allowances.

11. Ascorbic acid: average intake was 9 mgs., which was 13% of the NRC allowances of 70 mgs. This subject was below allowances.

This subject was below allowances for fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, and ascorbic acid; and above allowances for calories, protein, and niacin.

Table 14 summarized the quantities of various nutrients per person and comparison with National Research Council Allowances for male subjects from three schools in the Marshall Islands: the Marshall Island Intermediate School and the Teacher Training School, at Uliga; the Marshall Christian Training School at Ronron; and the Mission School at Majuro Village, Majuro Island.

There were one hundred and sixty-three male and female subjects. There were eighty-three male subjects.

There were twelve subjects, ages 13 to 15 years; one subject from the Mission School, and eleven subjects from the Marshall Island Intermediate School.

There was a total of fifty-eight subjects, ages 16 to 20 years. Of these, ten subjects were from the Mission School; forty-eight subjects from the Marshall Island Intermediate School.

For the thirteen students who were over 20 years of age, there were thirteen subjects from the Marshall Island Intermediate School.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given.

II. MALES

a. 13 to 15 years of age

1. For one male subject, 13 to 15 years of age, from the Mission School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 1098 calories, which was 34% of the NRC allowances of 3200 calories. This subject was below allowances.

2. Protein: average intake was 23 gms., which was 27% of the NRC allowances of 85 gms. This subject was below allowances.

3. Fat: average intake was 7 gms., which was 8% of the NRC allowances of 89 gms. This subject was below allowances.

4. Calcium: average intake was 228 mgs., which was 16% of the NRC allowances of 1400 mgs. This subject was below allowances.

5. Phosphorus: average intake was 493 mgs., which was 37% of the NRC allowances of 1320 mgs. This subject was below allowances.

6. Iron: average intake was 7 mgs., which was 47% of the NRC allowances of 15 mgs. This subject was below allowances.

7. Vitamin A: average intake was 50 I. U., which was 1% of the NRC allowances of 5000 I. U. This subject was below allowances.

8. Thiamine: average intake was 565 mcgs., which was 38% of the NRC allowances of 1500 mcgs. This subject was below allowances.

9. Riboflavin: average intake was 449 mcgs., which was 22% of the NRC allowances of 2000 mcgs. This subject was below allowances.

10. Niacin: average intake was 11 mgs., which was 73% of the NRC allowances of 15 mgs. This subject was below allowances.

11. Ascorbic acid: average intake was 29 mgs., which was 32% of the NRC allowances of 90 mgs. This subject was below allowances.

This subject was below allowances for all of the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, riboflavin, niacin, and ascorbic acid.

Table 14.

Summary of Daily Quantities of Various Nutrients per Person in the Three Marshallese Schools and Comparisons with National Research Council Allowances.

by Mary Murai

Males

	Calories	Protein gm.	Fat gm.	Calcium mg.	Phosphorus mg.	Iron mg.	Vitamin A I.U.	Thiamine mcg.	Riboflavin mcg.	Niacin mg.	Ascorbic Acid mg.
Ages 13 to 15 years											
Mission School (1)*											
Average intake	1098	23	7	228	493	7	50	565	449	11	29
NRC allowances	3200	85	89	1400	1320	15	5000	1500	2000	15	90
% of allowances	34	27	8	16	37	47	1	38	22	73	32
% of subjects below allowances	100	100	100	100	100	100	100	100	100	100	100
Marshall Island Intermediate School (11)											
Average intake	3858	115	85	784	1487	16	1666	1686	1109	27	27
NRC allowances	3200	85	89	1400	1320	15	5000	1500	2000	15	90
% of allowances	120	135	95	56	112	107	33	1121	55	180	30
% of subjects below allowances	27	0	55	100	36	45	91	45	91	9	91
Ages 16 to 20 years											
Mission School (10)											
Average intake	1332	28	19	148	453	7	29	650	432	10	12
NRC allowances	3800	100	105	1400	1320	15	6000	1700	2500	17	100
% of allowances	35	28	18	11	34	47	0.5	38	17	59	12
% of subjects below allowances	100	100	100	100	100	100	100	100	100	100	100
Marshall Island Intermediate School (48)											
Average intake	3253	116	70	825	1515	13	1805	1410	1147	26	23
NRC Allowances	3800	100	105	1400	1320	15	6000	1700	2500	17	100
% of allowances	86	116	67	59	115	87	30	83	46	153	23
% of subjects below allowances	81	29	42	96	25	60	94	81	100	2	90

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Ages 20 years and over											
Marshall Island Intermediate School (13)											
Average intake	2972	118	61	926	1480	11	2062	1361	1179	24	8
NRC allowances	3000	70	83	1000	1320	12	5000	1500	1800	15	75
% of allowances	99	168	73	93	111	92	41	91	65	160	11
% of subjects below allowances	46	0	85	69	23	54	85	69	92	8	100

* Figure in ( ) indicate number of subjects studied.

2. For eleven male subjects, 13 to 15 years of age, from the Marshall Island Intermediate School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 3858 calories, which was 120% of the NRC allowances of 3200 calories. 27% of the subjects were below allowances.

2. Protein: average intake was 115 gms., which was 135% of the NRC allowances of 85% gms. None were below allowances.

3. Fat: average intake was 85 gms., which was 95% of the NRC allowances of 89 gms. 55% were below allowances.

4. Calcium: average intake was 784 mgs., which was 56% of the NRC allowances of 1400 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 1487 mgs., which was 112% of the NRC allowances of 1320 mgs. 36% of the subjects were below allowances.

6. Iron: average intake was 16 mgs., which was 107% of the NRC allowances of 15 mgs. 45% of the subjects were below allowances.

7. Vitamin A: average intake was 1666 I. U., which was 33% of the NRC allowances of 5000 I. U. 91% of the subjects were below allowances.

8. Thiamine: average intake was 1686 mcgs., which was 112% of the NRC allowances of 1500 mcgs. 45% of the subjects were below allowances.

9. Riboflavin: average intake was 1109 mcgs., which was 55% of the NRC allowances of 2000 mcgs. 91% of the subjects were below allowances.

10. Niacin: average intake was 27 mgs., which was 180% of the NRC allowances of 15 mgs. 9% of the subjects were below allowances.

11. Ascorbic acid: average intake was 27 mgs., which was 30% of the NRC allowances of 90 mgs. 91% of the subjects were below allowances.

100% of the subjects were below allowances for calcium; 91% of the subjects were below allowances for vitamin A, riboflavin, and ascorbic acid; and 55% of the subjects were below allowances for fat. 36% of the subjects were below allowances for phosphorus and 64% of the subjects were above allowances. 45% of the subjects were below allowances for iron and thiamine, while 55% of the subjects were above allowances. 27% of the subjects were below allowances for calories and 73% of the subjects were above allowances. All subjects or 100% were above allowances for protein. 9% of the subjects were below allowances for niacin and 91% of the subjects were above allowances.

b. <u>16 to 20 years of age</u>

1. For ten male subjects, 16 to 20 years of age, from the Mission School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 1332 calories, which was 35% of the NRC allowances of 3800 calories. 100% of the subjects were below allowances.

2. Protein: average intake was 28 gms., which was 28% of the NRC allowances of 100 gms. 100% of the subjects were below allowances.

3. Fat: average intake was 19 gms., which was 18% of the NRC allowances of 105 gms. 100% of the subjects were below allowances.

4. Calcium: average intake was 148 gms., which was 11% of the NRC allowances of 1400 mgs. 100% of the subjects were below allowances.

5. Phosphorus: average intake was 453 mgs., which was 34% of the NRC allowances of 1320 mgs. 100% of the subjects were below allowances.

6. Iron: average intake was 7 mgs., which was 47% of the NRC allowances of 15 mgs. 100% of the subjects were below allowances.

7. Vitamin A: average intake was 29 I. U., which was 0.5% of the NRC allowances of 6000 I. U. 100% of the subjects were below allowances.

8. Thiamine: average intake was 650 mcgs., which was 38% of the NRC allowances of 1700 mcgs. 100% of the subjects were below allowances.

9. Riboflavin: average intake was 432 mcgs., which was 17% of the NRC allowances of 2500 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 10 mgs., which was 59% of the NRC allowances of 17 mgs. 100% of the subjects were below allowances.

11. Ascorbic acid: average intake was 12 mgs., which was 12% of the NRC allowances of 100 mgs. 100% of the subjects were below allowances.

2. For forty-eight male subjects, 16 to 20 years of age, from the Marshall Island Intermediate School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 3253 calories, which was 86% of the NRC allowances of 3800 calories. 81% of the subjects were below allowances.

2. Protein: average intake was 116 gms., which was 116% of the NRC allowances of 100 gms. 29% of the subjects were below allowances.

3. Fat: average intake was 70 gms., which was 67% of the NRC allowances of 105 gms. 42% of the subjects were below allowances.

4. Calcium: average intake was 825 mgs., which was 59% of the NRC allowances of 1400 mgs. 96% of the subjects were below allowances.

5. Phosphorus: average intake was 1515 mgs., which was 115% of the NRC allowances of 1320 mgs. 25% of the subjects were below allowances.

6. Iron: average intake was 13 mgs., which was 87% of the NRC allowances of 15 mgs. 60% of the subjects were below allowances.

7. Vitamin A: average intake was 1805 I. U., which was 30% of the NRC allowances of 6000 I. U. 94% of the subjects were below allowances.

8. Thiamine: average intake was 1410 mcgs., which was 83% of the NRC allowances of 1700 mcgs. 81% of the subjects were below allowances.

9. Riboflavin: average intake was 1147 mcgs., which was 46% of the NRC allowances of 2500 mcgs. 100% of the subjects were below allowances.

10. Niacin: average intake was 26 mgs., which was 153% of the NRC allowances of 17 mgs. 2% of the subjects were below allowances.

11. Ascorbic acid: average intake was 23 mgs., which was 23% of the NRC allowances of 100 mgs. 90% of the subjects were below allowances.

100% of the subjects were below allowances for riboflavin; 96% of the subjects were below allowances for calcium; 94% of the subjects were below allowances for vitamin A; 90% of the subjects were below allowances for ascorbic acid; 81% of the subjects were below allowances for calories and thiamine; and 60% of the subjects were below allowances for iron. 42% of the subjects were below allowances for fat and 58% were above allowances. 29% of the subjects were below allowances for protein and 71% were above. 25% of the subjects were below allowances and 75% of the subjects were above allowances for phosphorus. 2% of the subjects were below allowances and 98% of the subjects were above allowances for niacin.

c. 20 years of age and over

1. For thirteen male subjects, 20 years and over, from the Marshall Island Intermediate School, the daily quantities of various nutrients per person and comparison with the NRC allowances are summarized here:

1. Calories: average intake was 2972 calories, which was 99% of the NRC allowances of 3000 calories. 46% of the subjects were below allowances.

2. Protein: average intake was 118 gms., which was 168% of the NRC allowances of 70 gms. None of the subjects were below allowances.

3. Fat: average intake was 61 gms., which was 73% of the NRC allowances of 83 gms. 85% of the subjects were below allowances.

4. Calcium: average intake was 926 mgs., which was 93% of the NRC allowances of 1000 mgs. 69% of the subjects were below allowances.

5. Phosphorus: average intake was 1480 mgs., which was 111% of the NRC allowances of 1320 mgs. 23% of the subjects were below allowances.

6. Iron: average intake was 11 mgs., which was 92% of the NRC allowances of 12 mgs. 54% of the subjects were below allowances.

7. Vitamin A: average intake was 2062 I. U., which was 41% of the NRC allowances of 5000 I. U. 85% of the subjects were below allowances.

8. Thiamine: average intake was 1361 mcgs., which was 91% of the NRC allowances of 1500 mcgs. 69% of the subjects were below allowances.

9. Riboflavin: average intake was 1179 mcgs., which was 65% of the NRC allowances of 1800 mcgs. 92% of the subjects were below allowances.

10. Niacin: average intake was 24 mgs., which was 160% of the NRC allowances of 15 mgs. 8% of the subjects were below allowances.

11. Ascorbic acid: average intake was 8 mgs., which was 11% of the NRC allowances of 75 mgs. 100% of the subjects were below allowances.

100% of the subjects were below allowances for ascorbic acid; 92% of the subjects were below allowances for riboflavin; 85% of the subjects were below allowances for both fat and vitamin A; 69% of the subjects were below allowances for calcium and thiamine; and 54% of the subjects were below allowances for iron. 46% of the subjects were below allowances for calories and 54% were above allowances. 23% of the subjects were below allowances and 77% were above allowances for phosphorus. 8% of the subjects were below allowances and 92% of the subjects were above allowances for niacin. 100% of the subjects were above allowances for protein.

SUMMARY

The dietary records of 163 subjects who were students of three schools in the Marshall Islands, namely, the Marshall Island Intermediate School and the Teacher Training School, at Uliga; the Marshall Christian School at Rong̃rong̃; and the Mission School at Majuro Village, Majuro, were studied for daily consumption of calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. These figures were then compared with National Research Council Allowances.

There were eighty female students.

a. Ages 10 to 12 years - Total, four subjects

1. Marshall Christian Training School - four subjects

b. Ages 13 to 15 years - Total, thirty subjects

1. Marshall Christian Training School - fourteen subjects

2. Mission School - ten subjects

3. Marshall Intermediate School - six subjects

c. Ages 16 to 20 years - Total - forty-five subjects

1. Marshall Christian Training School - thirty-four subjects.

2. Mission School - three subjects

3. Marshall Island Intermediate School -eight subjects

d. Ages 20 years and over - Total, one subject

1. Marshall Island Intermediate School - one subject.

There were eighty-three male subjects.

a. Ages 13 to 15 years - Total, twelve subjects

1. Mission School - one subject

2. Marshall Island Intermediate School - eleven subjects

b. Ages 16 to 20 years - Total, fifty-eight subjects

1. Mission School - ten subjects

2. Marshall Island Intermediate School - forty-eight subjects

c. Ages 20 years and over - Total, thirteen subjects

1. Marshall Island Intermediate School - thirteen subjects.

Taking the total group of 163 subjects and grouping them as above, the following results were obtained when daily intakes were compared with National Research Council allowances.

I. FEMALES

a. <u>10 to 12 years of age</u>

1. Marshall Christian Training School

All of the subjects, or 100% were below allowances for fat, calcium, iron, vitamin A, riboflavin, and ascorbic acid. 75% of the subjects were below allowances for calories, protein, phosphorus, and thiamine. 25% of the subjects were below allowances for niacin.

b. <u>13 to 15 years of age</u>

1. Marshall Christian Training School

100% of the subjects were below allowances for calories, protein, fat, calcium, thiamine, riboflavin, and ascorbic acid. 93% of the subjects were below allowances for phosphorus, iron, and vitamin A; and 71% of the subjects were below allowances for niacin.

2. Mission School

100% of the subjects were below allowances for all of the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid.

3. Marshall Island Intermediate School

100% of the subjects were below allowances for calcium, vitamin A, riboflavin, and ascorbic acid; and 67% of the subjects were below allowances for iron. 33% of the subjects were below allowances and 67% were above allowances for fat. For calories, protein, phosphorus, and thiamine only 17% of the subjects were below allowances and 83% of the subjects were above allowances. All subjects or 100% were above allowances for niacin.

c. 16 to 20 years of age

1. Marshall Christian Training School

100% of the subjects were below allowances for calcium, iron, riboflavin, and ascorbic acid; 94% of the subjects were below allowances for vitamin A and thiamine; 91% of the subjects were below allowances for protein; 85% of the subjects were below allowances for fat; 82% of the subjects were below allowances for phosphorus; 73% of the subjects were below allowances for calories; 56% of the subjects were below allowances for niacin.

2. Mission School

100% of the subjects were below allowances for all the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid.

3. Marshall Island Intermediate School

100% of the subjects were below allowances for riboflavin; 88% of the subjects were below allowances for calcium, vitamin A, and ascorbic acid; 75% of the subjects were below allowances for iron; 63% of the subjects were below allowances for fat and thiamine; and 50% of the subjects were below allowances for phosphorus. For calories and protein, 25% of the subjects were below allowances and 75% of the subjects were above allowances. All of the subjects, or 100% were above allowances for niacin.

d. 20 years of age and over

1. Marshall Island Intermediate School

The subject was below allowances for fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, and ascorbic acid; and above allowances for calories, protein and niacin.

II. MALES

a. 13 to 15 years of age

1. Mission School

The subject was below allowances for all of the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, riboflavin, niacin, and ascorbic acid.

2. Marshall Island Intermediate School

100% of the subjects were below allowances for calcium;

91% of the subjects were below allowances for vitamin A, riboflavin, and ascorbic acid; and 55% of the subjects were below allowances for fat. 36% of the subjects were below allowances for phosphorus and 64% of the subjects were above allowances. 45% of the subjects were below allowances for iron and thiamine, while 55% of the subjects were above allowances. 27% of the subjects were below allowances for calories and 73% were above allowances. All subjects or 100% were above allowances for protein. 9% were below allowances for niacin and 91% were above allowances.

b. 16 to 20 years of age

1. Mission School

100% of the subjects were below allowances for all the nutrients, namely, calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid.

2. Marshall Island Intermediate School

100% of the subjects were below allowances for riboflavin; 96% of the subjects were below allowances for calcium; 94% of the subjects were below allowances for vitamin A; 90% of the subjects were below allowances for ascorbic acid; 81% of the subjects were below allowances for calories and thiamine; and 60% of the subjects were below allowances for iron. 42% of the subjects were below allowances for fat and 58% were above allowances. 29% of the subjects were below allowances for protein and 71% were above allowances. 25% of the subjects were below and 75% above allowances for phosphorus. 2% of the subjects were below allowances and 98% were above allowances for niacin.

c. 20 years of age and over

1. Marshall Island Intermediate School

100% of the subjects were below allowances for ascorbic acid; 92% of the subjects were below allowances for riboflavin; 85% of the subjects were below allowances for both fat and vitamin A; 69% of the subjects were below allowances for calcium and thiamine; and 54% of the subjects were below allowances for iron. 46% of the subjects were below allowances for calories and 54% were above allowances. 23% of the subjects were below allowances and 77% were above allowances for phosphorus. 8% of the subjects were below and 92% were above allowances for niacin. 100% of the subjects were above allowances for protein.

In comparing the three schools, the Marshall Island Intermediate School students had the best dietary; the Marshall Christian Training School, second; and the Misssion School, third. However, all of the NRC allowances were not met by the meals served in any of the schools; so there is much to be done for the improvement of the nutrient content of the diets.

DISCUSSION

In all the schools, the diets can be improved by including some of the protective foods, such as the green leafy vegetables and milk. The other foods which are good sources of the various nutrients as noted in the previous section should be included for a well balanced diet. Marshallese diets in most instances are low in the protective foods.

The students of the Navy operated school, Marshall Island Intermediate School and the Teacher Training School had the best diet. The diet was known to be insufficient in the nutrients and an effort had been made to include beans, dried eggs, meat, milk, fruits and vegetables in the diet. In the other schools, there was little knowledge of the nutritional aspects of foods. Meals were served to fill empty stomachs. The Marshall Christian Training School was second in quality and the Mission School at Majuro Village had the poorest diet.

In the study by Faine and Hereus (24), of the nutritional status of Cook Islanders, 1951, stated that milk ration was introduced in all the schools in Rarotonga and had been in operation for 18 months and the teachers were enthusiastic.

Such steps are encouraging and indicate that better nutrition for the students is possible and practical. A target for future planning should be well balanced diets for the school children of the Marshall Islands for through better health they will become better citizens in the world of tomorrow.

The average of nutrient intake of 163 students from the three Marshallese schools are classified in relation to NRC Recommended Dietary Allowances. The average intakes are given as percentages of NRC Recommended Dietary Allowances. The results are given in Table 15.

The intakes of fat, calcium, iron, vitamin A, thiamine, riboflavin and ascorbic acid were much below recommended allowances. Ascorbic acid intakes were lowest for the greatest number of individuals; riboflavin was next, followed by vitamin A, calcium, fat, iron and thiamine.

For the nutrients with average intake of 90 to 100% or more of NRC recommended allowances, niacin intakes were met by the greatest number of subjects; phosphorus was next, followed by protein and calories.

Table 15.

Classification of Averages of Nutrient Intake of One Hundred Sixty-Three Students of Three Marshallese Schools in Relation to NRC Recommended Dietary Allowances.

Nutrient	Classification of Average Intake As Percentage of NRC Recommended Dietary Allowances		
	90 to 100% and over	70 to 89%	Under 70%
	(Number of Individuals)		
Calories	69	54	40
Protein	93	30	40
Fat	36	24	103
Calcium	11	16	136
Phosphorus	96	39	28
Iron	44	31	88
Vitamin A	13	10	140
Thiamine	38	47	78
Riboflavin	2	12	149
Niacin	113	24	26
Ascorbic Acid	8	3	152

FOOD HABITS AND DIETARY PATTERNS IN OUTLYING SECTIONS OF THE MARSHALL ISLANDS.

PURPOSE

1. To observe food patterns of the outlying islands as the Marshall Islands consisting of twenty-nine coral atolls and five small coral islands which are scattered over an ocean area of nearly 200,000 square miles.

2. To observe the Marshallese in their own environment with the minimum of foreign influence.

3. To gather information to help in understanding their food problems.

PROCEDURE

A field trip was taken on an LST for the period of February 16 to March 2, 1951. The following places were visited:

1. Mejit Atoll, Mejit Island
2. Utirik Atoll, Utirik Island
3. Ailuk Atoll, Ailuk Island
4. Likiep Atoll, Likiep Island
5. Wotje Atoll, Ormej Island
6. Maloelap Atoll, Kaben Island
7. Aur Atoll, Tabal Island
8. Arno Atoll, Ine Island
9. Kili Atoll, Kili Island
10. Mili Atoll, Nallu Island

RESULTS

As the time spent at each island was of short duration it was not possible to do any detailed study, but some information was acquired which is recorded in summarized form.

MEJIT

Mejit Atoll, Mejit Island. Arrived on February 17, 1951 at 7:40 a. m. and departed on the same day at 5:00 p. m. Location: Latitude 10 degrees 15'N., Longitude 170 degrees 52'E.

Pandanus fruit was plentiful. Adults and children were eating raw pandanus fruit. They were constantly eating these "keys" for meals and also for between meal snacks. Pandanus fruit was also boiled and eaten. In many homes, the women took the boiled pandanus and used an instrument called the "beka" to scrape the edible portion from the fibrous material to make a puree which had a consistency of mashed sweet potatoes. This mixture also tasted very much like sweet potatoes. Pandanus was eaten as a puree, or in many instances, mokmok (arrowroot flour) and grated coconuts were added and the mixture made into a large patty. This was wrapped in dried pandanus leaves.

Walking along the main road, a family invited us to lunch. The family group was seated around the cooking pit and they were eating their noon meal. They were baking fish in the pit where coconut husks and pandanus husks were used for firewood. By removing skins and bones, only the flesh of the fish was eaten. Bones were thrown to the dogs and cats. A large tuna was caught that day so chunks of fish about an inch square were sliced and eaten raw with chunks of mature coconut meat. Drinking coconuts were used in place of water. Hands were used in eating, and at the end of the meal, a bucket of water was brought to the guests so that their hands may be washed. Iu (embryo of the sprouting coconut) was tasted. Several children ate with us. They were eating mere (spoon meat) and jekaro (coconut sap). There were many pandanus, breadfruit, and coconut trees on the island. Most of the homes had for cooking facilities a pit for baking and roasting and a separate place for boiling food. These cooking areas were near the lagoon under the shade of the coconut trees.

UTIRIK

Utirik Atoll, Utirik Island. Arrived February 18, 1951 at 7 a. m. departed same day at 6:00 p. m. Location: Latitude 11 degrees 15'N., Longitude 169 degrees 45'E.

Arrived on a Sunday. On the island were coconut palms, pandanus trees, and arrowroot; but no taro. A delicacy made of cooked pureed pandanus fruit and grated coconuts wrapped in dried pandanus leaf was tasted. It was sweet and tasted like a sweet potato pudding. They were unable to catch fresh fish at this time of the year.

AILUK

Ailuk Atoll, Ailuk Island. Arrived on February 19, 1951 at 6:00 a. m. departed on February 21, 1951 at 9:00 a. m. Location: Latitude 10 degrees 20' N., Longitude 169 degrees 55'E.

Bananas, pandanus, coconuts, arrowroot and breadfruit were available on this island, although breadfruit was not yet in season.

Observed the making of mokmok (arrowroot flour). Raw arrowroot resembles a small potato.

Steps taken in the making of mokmok:

1. Peel arrowroot

2. Take raw arrowroot and grind in pan with a stone

3. Put ground raw arrowroot in a cloth such as cheesecloth.

4. Put the mixture in the cheesecloth on a sieve placed over a large tub half filled with salt water.

5. Take a dipper of salt water from this pan of salt water, pour over mixture on the sieve, while stirring

6. Continue process until all starch is washed out. Throw away waste product

7. The product in tub usually is milky white in the beginning and becomes yellowish brown as starch settles to bottom

8. After starch settles at bottom, decant salt water

9. Starch stays on the bottom of the tub

10. Fill tub half full of salt water and stir all over again

11. Let starch settle and decant salt water to get rid of bitter taste

12. Put in cloth, tie at top and let hang from ceiling until it hardens

13. Dry outside in sun until powdery

14. Scrape mokmok from cloth

15. Put in woven basket and use as needed

Mokmok is boiled in water and jekaro is added to this mixture. It is then boiled until it becomes a translucent starchy mixture. While hot, it is made into large patties and rolled in grated coconuts. Jekaro is collected in bottles. These bottles of jekaro are kept hanging under the beams in their homes. Jekaro is used for drinking purposes and also in cooking. As it was pandanus season both raw and boiled pandanus fruit was tasted.

Chickens and pigs and sea fowls called "nana," which are used for food was observed.

In going through the cook houses, observed that the standard equipment were as follows:

a beka--grater used for pandanus fruit

a ranke--grater for coconuts

um--pit for baking and roasting

large pot--to boil food

knife

They did not seem to observe regular hours for meals but ate whenever they felt like eating. Food was distributed to everyone. Drinking coconuts were used extensively.

LIKIEP

Likiep Atoll, Likiep Island. Arrived on February 21, 1951 at 3:00 p. m. and departed on February 23, 1951 at 7:00 a. m. Location: Latitude 09 degrees 45'N., Longitude 159 degrees 10'E.

Visited the native village and observed people cooking. "Iu" (coconut embryo) was the predominant food used at this time. Many bottles were seen hanging on coconut trees for collecting jekaro.

At one cookhouse, iu was pounded with a wooden mallet and mixed with jekaro to make lukor. At another place, they were making ainbat iu with mokmok and jekaro (boiled coconut embryo with arrowroot flour and coconut sap).

Yellow pumpkin was popular. Rice was used in their diet as a staple food. A family was seated in their home where they were eating rice with canned salmon and tea. A small child was eating pancakes and pandanus fruit.

Chickens and pigs were seen. Very little fresh fish was found in and around cookhouses.

WOTJE

Wotje Atoll, Ormej Island. Arrived on February 23, 1951 at 5:30 p. m., departed on February 24, 1951 at 4:00 p. m. Location: Latitude 09 degrees 25' N., Longitude 170 degrees E.

On arrival, went with interpreter and visited all the cookhouses in the island. Chief Lanimoj, their Chief, was to attend the council meeting so much of the food preparation for the day was for food offerings which were brought to pay homage to him. Many of the dishes were made of mokmok or arrowroot flour.

Chief Lanimoj had baked turtle, baked fish, drinking coconuts and jekaro for lunch. Food was carried in small baskets made of coconut leaves. Coconuts, mokmok, pandanus fruit, chicken, breadfruit and other gift items were presented to Chief Lanimoj.

MALOELAP

Maloelap Atoll, Kaben Island. Arrived on February 25, 1951 at 7:00 a. m. departed same day at 11:00 a. m. Location: Latitude 08 degrees 42'N., longitude 171 degrees E. This is a low, flat coral island located at the northwestern end of the atoll. It is 1 1/2 miles long and 1/4 mile wide.

Coconuts, pandanus, arrowroot, papayas, bananas, pumpkins, chicken, pork and sweet potatoes were seen. Breadfruit will be added to their diet when the breadfruit season begins. Fish is added to the diet when fresh fish or canned fish is available.

AUR

Aur Atoll, Tabal Island. Arrived on February 25, 1951 at 2:00 p. m. and departed same day at 6:30 p. m. Location: Latitude 8 degrees 10'N., longitude 171 degrees 10'E. Tabal is the largest island of Aur Atoll and lies in the center of the atoll. It is a low flat coral island about 1 1/2 miles long and about 1/2 mile wide.

There were coconut trees, breadfruit, pandanus, papayas, sweet potatoes, few bananas, pumpkin, pork and chicken. Rice, flour, sugar, tea and coffe were bought in from the outside.

ARNO

Arno Atoll, Ine Island. Arrived on February 26, 1951 at 7:00 a. m. and departed same day at 11:00 a. m. Location: Latitude 7 degrees 5'N., longitude 171 degrees 40'E.

Ine Island, is a low, flat coral island, located on the southern rim of the atoll. It is about 13 miles long and about 1/4 mile wide. The island has coconut trees, breadfruit and pandanus trees.

Coconuts, pandanus, breadfruit, bananas, papayas, limes, fish, pork and chicken were available. Rice, sugar, flour and live ducks were left by the field party.

They were preparing boiled breadfruit and chicken but did not stay long enough to taste the finished product.

KILI

Kili Atoll, Kili Island. Arrived on March 1, 1951 at 6:00 a. m. departed same day at 7:00 p. m. Location: Latitude, 5 degrees 30'N., longitude 169 degrees 00'E.

MILI

Mili Atoll, Nallu Island. Arrived on March 2, 1951 at 7:00 a. m. and departed same day at 12:00 m. Location: Latitude, 6 degrees 15'N., longitude 172 degrees 00'E.

Kili and Mili were not visited as it was not possible to go ashore.

Returned to Majuro Atoll at Uliga on March 2, 1951 at 7:00 p. m.

On many islands, rice, flour, sugar, biscuit, coffee and tea were left in exchange for copra. Rice was imported from Siam, flour and biscuits from Japan. Tea, soy sauce, sugar, and coffee from the U. S. A., and corned beef from Argentina. Such items were sent in from either Kwajalein or Majuro. Utirik and Ailuk were the poorer islands and not owning boats to bring in supplies and take out copra, they are dependent on the field trip ship for supplies. In Mejit, native boats were available, so there is regular transportation between Mejit and the other atolls. Kwajalein supplied Kili with food.

The transportation of food to the outlying atolls is a difficult task. Often a sailing craft gets close to an island or atoll but is not able to go ashore because of coral reefs and the tide. For atolls such as Mejit or Kili, a small boat is necessary in order to go over the reefs, which means that getting food ashore is dangerous and supplies often get so wet before they get to shore that they have to be left in the sun to dry.

Often the larger vessels will anchor outside of the lagoon and all supplies including food have to be taken over by a smaller boat. In many places there were three transfers, one from the LST to an LCVP, second, to an outrigger canoe which carried food to a place near shore, and third, to a man who had to carry food on his back and wade to shore. For instance, at Arno a box of ducks were to be left but since it was impossible to carry the large box on an outrigger it was necessary to have the ducks swim ashore.

DISCUSSION AND CONCLUSION

The extensive use of arrowroot flour, mokmok (Tacca leontopetaloides (L) Ktze. was noted. In the Northern islands, arrowroot flour was used much more extensively than on Majuro island during the same period.

Pandanus was in season and many prepared dishes of pandanus fruit were observed. More time was spent in food preparation than on Majuro and more local foods were used. However they were still dependent on imported foods as some of the vegetable and fruit crops are not grown on the islands; for example, Utirik, did not have a taro crop. In Ailuk, the breadfruit season had not started and imported foods were a necessity until the breadfruit season began.

It was extremely difficult to get food to some of the outlying districts, due in part to an inadequate transportation system. Coral reefs made the approach to Kili hazardous.

PART II

NUTRITION STUDY ON UDOT ISLAND, TRUK DISTRICT, EASTERN CAROLINE ISLANDS

Udot Island lies 7°23' North, 151°43' East and about 3 miles westward of Fefan Island. It is about 2 1/4 miles long, east and west, and the highest point is 791 feet at its northwestern part. There are six villages on the island.

I. Planning and organizing the survey.

Much of the planning and organizing of the survey was done on Udot Island. Unlike the study in the Marshall Islands, it was not possible to learn about the Trukese foods, native terminology for common foods, and preparation of foods as done previously at the base before going to the island to be studied, as most of the administrative staff members were new and were not familiar with the Trukese way of life and transportation was difficult to obtain.

By observing the native village on Moen, Truk, where the base was located, it was noted that many of the foods consumed were similar to those of the Marshall Islands, although the language was different, and new food terms would have to be learned. The knowledge gained from the research in the Marshall Islands helped the investigator gather information quickly as compared to the first study.

The chief of Truk atoll was visited with a gift and the survey was explained through an interpreter. The discussions with the anthropologist about the manner of life, religion, and politics of the Trukese gave background material for the study.

1. Unit of survey

A household was used. A group who lived and ate together, usually consisting of blood relatives and relatives by adoption, was considered a household group.

2. Sampling

Statistics were not available and since there were six villages relatively close together, in order to get a representative sample all the inhabitants of the island, who were residing on the island at that time, were included in the study. The six villages included were Wonip, Tunnuk, Fonomo, Monowe, Ilitu and Pinine.

3. Time Period

A seven-day period was chosen. The diet on Udot Island goes through seasonal changes, and there was monotony of diet and very little day to day variation during the period observed.

4. Interpreter

The interpreter hired lived in the village and knew local foods and sources from which they were obtained.

5. Record forms

Formal record forms were not used. Informal records of diary type were kept in bound notebooks in a uniform manner.

6. Publicity

Personal visits with gifts were made to the leaders of their different villages who passed the information on to their subjects. Most of the villagers had read an article in a Honolulu Japanese paper about the study in the Marshall Islands, so they knew about the study.

II. Nutrition Survey

1. Preparation for survey on Udot Island.

After making arrangements with Ayster Irons for housing on Udot Island, and taking the necessary provisions, mattress, kerosene lamps, mosquito netting, pots and pans, his boat was taken to Udot Island. He took the investigator over to the island and introduced her to his family but returned the same day to Moen, as he made his headquarters on Moen, Truk.

The housekeeping and cooking units were set up in the house. Little pilot work was done on Moen as the time spent was of short duration. It was, therefore, necessary that observations of the local situation be made and contacts made before actual field work could get underway.

Each survey is unique and has its own problems. The villages were separate units and as Udot was a "high" volcanic island, to get from one village to another was difficult as trails went up and down hills and over rough terrain. Many of the paths were overgrown with grass and foliage and were difficult to follow. Homes were scattered in the hills. After rainfall, roads were washed out or they were so slippery that it was dangerous to try and climb the hill paths so the lagoon paths along the boulders were used in most cases. Instead of taking the inland trails, taking the shoreline and going up the rocky roads was time saving and safer.

With the help of the interpreter, formal visits were made with gifts to the headman of each village. At this time, the survey was outlined with each one and their permission was obtained to proceed with the survey.

This island was predominantly Catholic but they had one church for Protestants.

Before any home visits could be started, the Trukese terms for common, native foods, the preparation of foods, the ingredients and methods of preparation all had to be learned.

A LIST OF TRUKESE FOODS WITH A BRIEF DESCRIPTION IN ENGLISH OF EACH FOOD

TRUKESE	ENGLISH
Mei	Breadfruit.
Varieties of breadfruit	
Achapar	Second largest variety.
Enim	
Faine	
Faiton	
Faiyor	
Fanpuasuk	
Kisengei	
Meikoch	
Meiyon	Make into kon only.
Meichon	Can be eaten any way.
Napar	
Neisoso	Largest variety.
Newota	
Pono	
Sawan	
Unikko	
Uwanau	
Oneas	Seeded variety, flesh can be eaten raw.
Mei um	Breadfruit, baked in earth oven
Mei ainbat	Breadfruit, boiled
Notsupost	Breadfruit, roasted. After roasting, put in water, scrape off skin, and eat.

TRUKESE	ENGLISH
Kon	A breadfruit preparation. Breadfruit is first steamed then pounded until consistency is like dough. Made into loaves about 10 pounds each. Most popular staple food during breadfruit season.
Ror or opou	Breadfruit is first roasted and charred. Skin is removed. Remaining edible portion is pounded or sliced and coconut milk added.
Ammach	A very ripe meichon breadfruit which had been kept 10 days until soft is used. It is then baked and coconut milk added.
Emesefich	Steamed breadfruit is pounded and coconut oil added.
Arung or appuch	Breadfruit is roasted and skin removed. Edible portion is pounded. Faster pounding movements are used than for kon. This is necessary to keep breadfruit sticky. Small pieces are taken and made into dumplings and coconut milk is added. "Arung" means coconut milk. This preparation is called arung or appuch.
Apot	Breadfruit preserved by fermentation. Left to ferment in holes dug in earth for about two to three months. Can be kept for a year or more in these holes. After a year, the food is called autam.
Apot mei mon	A preserved breadfruit preparation. After removing apot from earth, it is then cleaned and kneaded. Water is added and apot is made into a soft dough. This is either baked or steamed.
Apot mei pupu	A preserved breadfruit preparation. After removing from earth, apot is cleaned and kneaded. Coconut milk is added and mixture is steamed or baked.
Nu	Coconuts.

Kinds of coconuts

Nu yon	
Nu won	Yellow
Nu cha	Reddish tinge to ripening nuts
Nu arau	Green

TRUKESE	ENGLISH
Nu setsusen	Sweet but small, ripen all at the same time.
Nu min	Large nuts
Taka	Meat of mature coconut. A grater called a pweiker is often used to grate coconuts. After grating, coconut milk or oil is extracted which is used for flavoring food.
Nu	Drinking fluid of the immature nut.
Appun	Soft spoon meat of the immature drinking nut.
Trofal	Embryo of the sprouting coconut.
Utsu	Banana.
Varieties of bananas	
Utsupun	
Amesebok	Large bananas.
Samawa	
Ujirek	
Ujitopu	
Pannu	
Puupu	
Nukisa	
Peressin	Brazilian variety.
Ponapei	Ponape.
Tanan	
Utsu Feiru	Large bananas baked with grated cooonuts.
Annira	Trukese chestnuts.
Mangko	Mangoes.
Peinaper	Pineapple.
Sassaf	Soursop.
Naimis	Lime.

ENGLISH	TRUKESE
Kurukur	Orange.
Sennia	Watermelon.
Kitppau	Papaya.
Oni	Dry and wetland taro. Colocasia esculenta.
Ka	Dry land. Alocasia macrorrhiza.
Puna	Wetland. Cyrtosperma chamissonis.
Simiden	Swamp taro, imported from the Marshalls or Nukuoro.
Nopur	Morinda citrifolia, eaten only during famines.
Ep	Dioscorea alata, yam.
Apuereka	Dioscorea bulbifera, poor quality yam eaten in famines, very bitter.
Emechimech	Ipomoea digitata, like burdock root, eaten raw also.
Mon	Spondias dulcis Forst. f. Fruit with thorny center.
Apuch	Crataeva speciosa, a fruit, common on Nomwin.
Kap	Yam
Asas	Terminalia catappa, Singapore almond. Nuts used for food, eaten after drying.
Kamuti	Sweet potato.
Wo	Sugar cane.
Fats	Pandanus.
Fatsira	Edible pandanus.
Fatessis	Edible pandanus.
Moniok	Tapioca.
Mokmok	Arrowroot.
Kunger	Cucumber.
Sim	Clams.

TRUKESE	ENGLISH
To	Clams.
Nippach	Octopus.
Pik	Pig.
Pik, um	Baked pig.
Pik, sol	Salted pig.
Pik, ainbat	Boiled pig.
Iik	Fish.
Ku	Porpoise.
Poko	Shark.
Rau	Whale.
Tikit	Eel, fresh water.
Penichon	Species of black trepang, commonly known as sea slug, sea cucumber, or beche-de-mer.
Win or Puapua	Turtle.
Kutsu	Goat.
Kou	Cow.
Chuko	Chicken.
Chek	Duck.
Arar	Tern, white with black lines on head.
Esies	White or "fairy" tern, common bird.
Ponik	Tern, black with white on top of head.
Ekiek	White tern.
Nipauane	Whitish brown sea bird.
Sop	White heron.
Kunnu	Small unidentified land bird.
Amo	Large unidentified sea bird.

Next to a house where the investigator lived, was a household where they did all the cooking in their cookhouse. By observing and asking questions, all this information was collected. By walking through the village and visiting with the villagers it was possible to learn more about their food and food patterns.

At the same time, enough knowledge of the language was gained to converse in Trukese to understand the interviews between the interpreter and the subjects of the survey.

The type and extent of waste were investigated in detail. Data were acquired on how much the average loaf of "kon" weighed, the amount of drinking fluid from one immature nut, how much edible portion could be obtained from one sweet potato and other similar facts.

Foods such as boiled rice and breadfruit were weighed to determine in grams the amounts in household measurements.

Most household utensils were alike as the source of supply was the same.

Several types of fish were weighed after cooking, to determine edible portions by removing wastage and refuse such as bones, head, and entrails. Others which were eaten whole, such as Musum, small fish, were weighed per serving.

Recipes were made up for mixed cooked dishes. Many samples of these dishes were brought back to Honolulu for chemical food analyses.

2. Routine procedure of the interview

The number interviewed averaged about six households daily. The visits were fewer in number as compared to the Marshall Island survey as distances were greater from one village to another and roads were poorer. In order to avoid the hot sun, traveling was done during the cooler time of the day, the walk to another village started about 6 in the morning and the return trip was about 7 at night.

Daily visits were made to the households. The first visit was an orientation period with discussions about the survey, procedure and data to be collected. Various utensils for eating were shown so that accurate recordings could be made such as cupfuls, spoonfuls, and other household measurements. Information about the household was recorded at this time.

A day's record was to be kept in Trukese and they were to be collected the following day. It was difficult to have them give individual food intakes as they spoke in terms of how much the household unit consumed, therefore, records were kept of total consumption per household with information about special cases, such as food intake of a smaller child, who had special foods, but in most instances individual intakes were taken. Number of meals consumed daily and the time of meals varied considerably. Having more households to cover with greater distances in between and a shorter time for the survey, two interpreters were hired to help collect data. Investigator went with the interpreters on initial visits, to explain the survey, and take down the necessary information about the household. Investigator went with each one on alternate days, when they made daily visits, as they were covering villages on both ends of the island.

Data were brought back daily at the end of the day and they were recorded in notebooks. Any doubtful data or mistakes were discovered and the next time the investigator visited the households, which was each second day, they were clarified by questioning the subjects.

3. Data collected.

a. Basic data.

1. Kinds of foods eaten.

2. Distribution of foods among meals and between meal feedings.

3. Amounts eaten in terms of -- numbers of foods, servings, or household measurements.

4. Time period of seven days.

b. Information about household.

1. Composition of the family.

a. Number.

b. Sex.

c. Age to nearest year.

d. Other members of the household.

e. Names -- all names used in the past.

f. Other relevant information.

1. Pregnancy.

2. Lactation.

g. Occupation.

h. Illness.

c. Data of a household for one week.

Trukese Household

1. Information about the household.

Members of the household.

1. Male, 45 years old, husband, copra maker.

2. Female, 41 years old, wife, lactating.

3. Male, 16 years old, son.

4. Female, 5 years old, daughter.

5. Male, 2 years old, son.

2. Food data.

Tuesday

Rice, boiled, white	1500 gms. (3.3 lbs.)
Octopus, boiled	400 gms. (0.9 lb.)
Kon, steamed, pounded breadfruit	10 lbs.
Coconut, drinking, fluid only	8
Bananas, cooking	16

2 year old son

Sugar cane juice (extracted)	2 stalks
Rice, boiled, white	2 tablespoons
Milk, breast	ad libitum

Wednesday

Kon, steamed, pounded breadfruit	10 lbs.
Salmon, red, canned	1 lb.
Fish, Motsu, baked	500 gms. (1.1 lbs.)

2 year old son

Breadfruit, roasted	400 gms. (0.9 lb.)
Coconut, drinking, fluid only	1
Milk, breast	ad libitum

Thursday

Kon, steamed, pounded breadfruit	10 lbs.
Fish, Motsu, baked	500 gms. (1.1 lbs.)

2 year old son

Breadfruit, roasted	400 gms. (0.9 lb.)
Coconut, drinking, fluid only	1
Milk, breast	ad libitum

Friday

Kon, steamed, pounded breadfruit	10 lbs.
Fish, Musum, boiled	4500 gms. (9.9 lbs.)
Coconut, drinking, fluid only	1

<u>2 year old son</u>

Breadfruit, roasted	400 gms. (0.9 lb.)
Milk, breast	ad libitum

Saturday

Kon, steamed, pounded breadfruit	10 lbs.
Fish, ekeful, baked	1000 gms. (2.2 lbs.)
Coconut, drinking, fluid only	2

<u>2 year old son</u>

Breadfruit, roasted	400 gms. (0.9 lbs.)
Coconut, drinking, fluid only	1
Milk, breast	ad libitum

Sunday

Kon, steamed, pounded breadfruit	10 lbs.
Fish, Motsu, baked	300 gms. (0.6 lb.)

<u>2 year old son</u>

Breadfruit, roasted	300 gms. (0.6 lb.)
Milk, breast	ad libitum

Monday

Kon, steamed, pounded breadfruit	10 lbs.
Fish, Ikeson, baked	300 gms. (0.6 lb.)

<u>2 year old son</u>

Cracker	20 gms. (1 cracker)
Coconut, drinking, fluid only	1
Milk, breast	ad libitum

Tuesday

Kon, steamed, pounded breadfruit	10 lbs.
Fish, Motsu, baked	400 gms. (0.9 lb.)
<u>2 year old son</u>	
Cracker	20 gms. (1 cracker)
Coconut, drinking, fluid only	1
Milk, breast	ad libitum

Treatment of Dietary Survey Data and Assessment of the Adequacy Diets

The same procedures were followed for the treatment of the dietary survey data and the assessment of the adequacy of diets as found in the nutrition study of the Marshall Islands.

RESULTS

Table 16 gives the results of the dietary study of Trukese of Udot, Truk District, Caroline Islands.

The daily quantities of various nutrients per person and comparison with National Research Council Allowances for 290 Trukese were noted.

The subjects are divided into different age groups, giving the number of subjects in each group, sex, range of each nutrient, number of subjects in each group, average, NRC allowances, number below allowances, and percent of subjects below allowances for calories, protein, fat, calcium, phosphorus, iron, thiamine, riboflavin, and ascorbic acid.

1. Calories

In each age group, some of the subjects were above allowances and others were below allowances except the males of the 16 to 20 years age group. In this instance, all seven subjects or 100% were below allowances. Among the lactating women and males of the 13 to 15 age group, the percentage below allowances were high, 89% and 86% respectively. 1 to 3 years of age group and females 21 to 60 years age group had lower percentages of subjects below allowances with 42% and 46%, respectively. Deviations of the other groups were between these two figures.

For the total group of 290 Trukese, 186 subjects or 64% were below NRC allowances, and 104 subjects or 36% were above NRC allowances.

Table 16.

Dietary Studies of the Trukese of Udot, Truk, Caroline Islands

by Mary Murai

Daily Quantities of Various Nutrients per Person
and Comparison with National Research Council Allowances

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Calories									
1-3	12	M/F	733-2178	500-1499	10	1303	1200	5	42
				1500-2499	2				
4-6	21	M/F	758-2232	500-1499	9	1451	1600	12	57
				1500-2499	12				
7-9	18	M/F	1042-2669	1000-1999	11	1913	2000	11	61
				2100-2499	3				
				2500-2599	2				
				2600-2699	2				
10-12	21	M/F	1051-3307	1000-1999	14	1948	2500	16	76
				2100-2499	2				
				2500-2899	3				
				3100-3399	2				
13-15	7	M	1389-2524	1000-1999	5	1793	3200	6	86
				2200-2299	1				
				2500-2599	1				
13-15	12	F	762-3509	500-1499	2	2141	2600	8	67
				1500-2499	6				
				2500-2999	2				
				3000-3599	2				
16-20	7	M	1332-2573	1300-1399	1	1833	3800	7	100
				1500-1599	1				
				1500-1999	2				
				2100-2599	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	12	F	1104-3520	1100-1599	3	2125	2400	7	58
				1600-1999	2				
				2000-2699	6				
				3000-3599	1				
21-60	75	M	1189-4878	1100-1599	18	2471	3000	53	70
				1600-1999	8				
				2000-2699	21				
				2700-2999	6				
				3000-3599	11				
				3600-4099	7				
				4100-4899	4				
61 and over	12	M	1583-4446	1100-1599	2	2545	2400	6	50
				1600-1999	3				
				2000-2699	3				
				3000-3599	2				
				3600-4099	1				
				4100-4446	1				
21-60	56	F	757-4877	700-899	1	2531	2400	26	46
				900-1099	1				
				1100-1599	12				
				1600-1999	8				
				2000-2999	13				
				3000-3599	11				
				3600-4099	7				
				4100-4899	3				
61 and over	10	F	1398-4420	1300-1499	1	2466	2000	5	50
				1700-1999	4				
				2000-2499	1				
				2500-2999	1				
				3000-3999	2				
				4000-4999	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
Lactating women	27	F	1189-4186	1100-1599	7	2200	3000	24	89
				1600-1999	6				
				2000-2499	6				
				2500-2999	5				
				3000-3999	1				
				4000-4999	2				
Protein (gm.)									
1-3	12	M/F	19-71	< 20	3	38	40	7	58
				20-39	4				
				40-59	3				
				60-79	2				
4-6	21	M/F	27-93	20-39	7	49	50	14	67
				40-59	10				
				60-89	2				
				90-99	2				
7-9	18	M/F	35-116	30-49	9	60	60	11	61
				50-59	2				
				60-69	3				
				70-79	1				
				90-119	3				
10-12	21	M/F	37-115	30-49	8	61	70	14	67
				50-59	5				
				60-69	1				
				70-79	4				
				80-89	1				
				90-119	2				
13-15	7	M	32-114	30-49	4	56	85	6	86
				60-69	1				
				70-79	1				
				100-119	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
13-15	12	F	35-124	30-49	4	78	80	6	50
				70-79	2				
				80-89	2				
				90-99	1				
				100-199	3				
16-20	7	M	34-88	30-49	2	63	100	7	100
				40-59	1				
				60-69	1				
				70-79	1				
				80-89	2				
16-20	12	F	40-167	40-59	5	76	75	8	67
				60-69	3				
				70-89	1				
				100-167	3				
21-60	75	M	32-196	30-49	21	76	70	34	45
				50-69	13				
				70-89	22				
				90-109	7				
				110-129	8				
				130-169	2				
				190-210	2				
21-60	56	F	32-186	30-49	14	76	60	20	36
				50-69	12				
				70-89	14				
				90-109	5				
				110-129	9				
				130-169	1				
				170-189	1				
61 and over	12	M	34-174	30-49	3	67	70	7	58
				50-69	4				
				70-89	4				
				110-129	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
61 and over	10	F	32-110	30-49	4	66	60	5	50
				50-69	2				
				70-89	2				
				90-109	1				
				110-119	1				
Lactating women	27	F	35-196	30-49	10	74	100	23	85
				50-69	4				
				70-89	8				
				90-119	2				
				120-196	3				
Fat (gm.)									
1-3	12	M/F	1-27	< 20	11	8	33	12	100
				20-30	1				
4-6	21	M/F	2-33	< 20	15	13	44	21	100
				20-30	5				
				30-40	1				
7-9	18	M/F	5-72	< 20	13	21	56	16	89
				20-30	2				
				40-72	3				
10-12	21	M/F	5-45	< 20	13	17	69	21	100
				20-30	3				
				30-40	4				
				41-45	1				
13-15	7	M	5-27	< 20	6	12	89	7	100
				20-30	1				
13-15	12	F	1-49	< 20	7	20	72	12	100
				20-30	2				
				40-50	3				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	7	M	5-22	< 20	5	13	105	7	100
				20-30	2				
16-20	12	F	6-26	< 20	9	13	67	12	100
				20-30	3				
21-60	75	M	5-72	< 20	50	17	83	75	100
				20-30	18				
				31-40	1				
				41-50	4				
				51-72	2				
61 and over	12	M	3-25	< 20	8	14	67	12	100
				20-30	4				
21-60	56	F	3-63	< 20	39	16	67	56	100
				20-30	13				
				31-40	1				
				41-50	2				
				60-70	1				
61 and over	10	F	5-49	< 20	6	19	56	10	100
				20-30	2				
				40-50	2				
Lactating women	27	F	3-72	< 20	19	16	83	27	100
				20-30	6				
				31-40	1				
				70-79	1				
Calcium (mg.)									
1-3	12	M/F	203-7365	200-399	1	1892	1000	6	50
				400-599	1				
				600-799	4				
				1000-7365	6				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
4-6	21	M/F	137-13711	< 200	2	1810	1000	9	43
				200-399	5				
				400-799	2				
				1000-1199	3				
				1300-1899	3				
				2000-2199	2				
				2600-3499	3				
				13711	1				
7-9	18	M/F	229-8538	200-399	1	2256	1000	6	33
				400-799	5				
				1000-1199	2				
				1300-1999	2				
				2000-2199	1				
				2600-3499	4				
				3500-3999	2				
				4000-8538	1				
10-12	21	M/F	173-3954	< 200	1	1463	1200	11	52
				200-399	4				
				400-799	4				
				1000-1199	2				
				1500-2199	4				
				2200-2599	2				
				2600-3499	3				
				3500-3999	1				
13-15	7	M	195-3954	< 200	1	1748	1400	4	56
				300-999	3				
				2722-3399	2				
				3900-3954	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
13-15	12	F	95-5693	< 200	1	2487	1300	4	33
				300-999	2				
				1000-2099	3				
				2600-2799	1				
				3000-3299	2				
				4000-4499	1				
				5300-5693	2				
16-20	7	M	239-13710	200-300	1	3964	1400	2	28
				1000-1999	3				
				2000-2999	1				
				7248	1				
				13710	1				
16-20	12	F	173-4529	< 200	1	2157	1000	3	25
				300-999	2				
				1000-1999	4				
				2500-4599	5				
21-60	75	M	173-14730	< 200	2	2431	1000	22	29
				200-999	20				
				1000-1999	17				
				2000-2999	20				
				3000-4999	8				
				5000-8999	6				
				13000-14999	2				
61 and over	12	M	308-9229	300-499	1	4491	1000	1	8
				1600-1699	1				
				2000-2999	3				
				3000-3999	2				
				5000-5999	1				
				7000-8999	3				
				9000-9999	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
21-60	56	F	205-14729	200-999	14	2690	1000	14	25
				1000-1999	14				
				2000-2999	15				
				3000-8999	12				
				14000-14999	1				
61 and over	10	F	829-9229	800-999	2	2886	1000	2	20
				1400-1499	3				
				2000-2199	1				
				2200-2399	1				
				4000-4999	2				
				9000-9999	1				
Lactating women	27	F	173-13711	< 200	1	2686	2000	13	48
				200-999	5				
				1000-1999	7				
				2000-2999	5				
				3000-3999	6				
				5000-5999	1				
				13711	1				
Phosphorus (mg.)									
1-3	12	M/F	394-1775	300-499	3	741	1000	11	91
				500-699	3				
				700-899	5				
				1700-1899	1				
4-6	21	M/F	283-2698	200-499	7	740	1000	18	86
				500-699	5				
				700-899	6				
				1100-1299	2				
				2500-2699	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC-allowances	Number below allowances	Percent below allowances
7-9	18	M/F	281-2199	200-499	2	938	1200	15	85
				500-699	4				
				700-999	4				
				1000-1999	7				
				2100-2199	1				
10-12	21	M/F	281-2282	200-499	2	914	1200	17	80
				500-699	5				
				700-999	9				
				1000-1999	4				
				2000-2999	1				
13-15	7	M	448-1366	400-599	3	755	1320	6	85
				600-799	2				
				800-999	1				
				1200-1399	1				
13-15	12	F	558-1740	500-699	3	1167	1200	7	58
				900-1099	3				
				1100-1299	1				
				1300-1499	3				
				1700-1899	2				
16-20	7	M	574-2698	500-999	4	1235	1320	5	71
				1000-1999	2				
				2698	1				
16-20	12	F	483-2118	400-599	2	1035	1200	9	75
				600-799	1				
				800-999	4				
				1000-1399	4				
				2100-2199	1				
21-60	75	M	281-3550	200-999	29	1237	1320	51	68
				1000-1999	36				
				2000-2999	9				
				3000-3999	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
61 and over	12	M	488-2254	400-999	2	1419	1320	7	58
				1000-1999	8				
				2000-2999	2				
21-60	56	F	281-3550	200-999	23	1254	1320	37	66
				1000-1999	24				
				2000-2999	8				
				3000-3999	1				
61 and over	10	F	506-2282	500-999	5	1284	1320	7	70
				1000-1999	2				
				2000-2999	3				
Lactating women	27	F	281-10941	200-999	13	1206	1800	22	81
				1000-1999	10				
				2000-2999	3				
				10941	1				
<u>Iron</u> (mg.)									
1-3	12	M/F	2-5	< 5	11	3	7	12	100
				5-10	1				
4-6	21	M/F	2-6	< 5	13	4	8	21	100
				5-10	8				
7-9	18	M/F	2-12	< 5	8	6	10	16	88
				5-10	9				
				11-15	1				
10-12	21	M/F	2-7	< 5	8	5	12	21	100
				5-10	13				
13-15	7	M	2-21	< 5	4	6	15	6	85
				5-21	3				
13-15	12	F	2-9	< 5	3	6	15	12	100
				5-9	9				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
16-20	7	M	3-7	< 5	5	4	15	7	100
				5-9	2				
16-20	12	F	2-8	< 5	5	5	15	12	100
				5-8	7				
21-60	75	M	3-13	< 5	21	6	12	73	97
				5-9	47				
				10-15	7				
61 and over	12	M	4-13	< 5	2	7	12	11	88
				5-9	7				
				10-15	3				
21-60	56	F	3-12	< 5	16	6	12	55	94
				5-9	34				
				10-15	6				
61 and over	10	F	3-13	< 5	2	7	12	9	90
				5-9	7				
				10-15	1				
Lactating women	27	F	2-13	< 5	9	6	15	27	100
				5-9	15				
				10-15	3				
Vitamin A (I.U.)									
1-3	12	M/F	75-1941	< 499	5	660	2000	12	100
				500-999	4				
				1000-1999	3				
4-6	21	M/F	160-5646	< 499	10	794	2500	20	95
				500-999	7				
				1000-1999	3				
				5000-5999	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
7-9	18	M-F	157-2728	< 499	1	978	3500	18	100
				500-999	12				
				1000-1999	3				
				2000-2999	2				
10-12	21	M/F	357-2720	< 499	3	972	4500	21	100
				500-999	14				
				1000-1999	1				
				2000-2999	3				
13-15	7	M	430-691	< 499	4	518	5000	7	100
				500-999	3				
13-15	12	F	516-3836	500-999	7	1303	5000	12	100
				1000-1999	3				
				2000-2999	1				
				3000-3999	1				
16-20	7	M	357-2638	< 499	2	1006	6000	7	100
				500-999	2				
				1000-1999	2				
				2000-2999	1				
16-20	12	F	567-4052	500-999	8	1442	5000	12	100
				1000-2999	2				
				3000-4999	2				
21-60	75	M	157-5925	< 499	10	1318	5000	73	97
				500-999	31				
				1000-1999	21				
				2000-2999	8				
				3000-3999	1				
				4000-4999	2				
				5000-5999	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
61 and over	12	M	474-4052	< 499	1	1351	5000	12	100
				500-999	6				
				1000-1999	3				
				2000-2999	1				
				4052	1				
21-60	56	F	320-4050	< 499	6	1296	5000	56	100
				500-999	21				
				1000-1999	20				
				2000-2999	8				
				4000-4999	1				
61 and over	10	F	43-1395	< 499	2	732	5000	10	100
				500-999	7				
				1000-1999	1				
Lactating women	27	F	157-2464	< 499	2	986	8000	27	100
				500-999	17				
				1000-1999	4				
				2000-2999	4				
<u>Thiamine</u> (mcg.)									
1-3	12	M/F	224-1211	200-499	4	595	600	4	34
				500-799	6				
				800-1399	2				
4-6	21	M/F	276-1306	200-499	5	809	800	9	43
				500-799	5				
				800-1099	6				
				1100-1399	5				
7-9	18	M/F	193-1456	< 200	1	924	1000	11	66
				200-499	1				
				500-799	4				
				800-1099	6				
				1100-1399	5				
				1400	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
10-12	21	M/F	135-1826	< 200	1	952	1200	17	80
				200-499	2				
				500-799	5				
				800-1099	7				
				1100-1399	2				
				1400-1699	2				
				1700-2099	2				
13-15	7	M	251-1420	200-499	2	806	1500	7	100
				800-1099	4				
				1400-1699	1				
13-15	12	F	401-2074	200-499	1	1297	1300	5	41
				800-1099	3				
				1100-1399	2				
				1400-1699	5				
				2000-2299	1				
16-20	7	M	695-1456	500-799	2	972	1700	7	100
				800-1099	3				
				1100-1399	1				
				1400-1699	1				
16-20	12	F	135-1855	< 200	1	889	1200	9	75
				200-499	3				
				500-799	1				
				800-1099	4				
				1400-1699	2				
				1700-1999	1				
21-60	75	M	135-2423	< 200	2	1310	1500	45	60
				500-799	12				
				800-1099	18				
				1100-1399	10				
				1400-1699	14				
				1700-2099	12				
				2100-2399	6				
				2423	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
61 and over	12	M	869-2105	800-1099	4	1429	1200	6	50
				1100-1399	3				
				1400-1699	1				
				1700-2099	3				
				2100-2399	1				
21-60	56	F	415-2423	< 400	1	1505	1200	24	42
				400-699	6				
				700-999	16				
				1000-1299	6				
				1300-1599	9				
				1600-1899	7				
				1900-2199	6				
				2200-2499	5				
61 and over	10	F	109-2663	< 200	3	1151	1000	5	50
				800-1099	2				
				1400-1699	3				
				2000-2299	1				
				2600-2999	1				
Lactating women	27	F	135-2171	< 200	1	1089	1500	21	77
				200-499	1				
				500-799	5				
				800-1099	10				
				1100-1399	4				
				1400-1699	3				
				1700-1999	1				
				2000-2299	2				
<u>Riboflavin</u> (mcg.)									
1-3	12	M/F	239-953	< 500	9	444	900	11	92
				500-799	2				
				800-1099	1				
4-6	21	M/F	187-871	< 500	10	501	1200	21	100
				500-799	10				
				800-1099	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
7-9	18	M/F	109-900	< 500	6	575	1500	18	100
				500-799	9				
				800-1099	3				
10-12	21	M/F	117-1246	< 500	7	611	1800	21	100
				500-799	10				
				800-1099	2				
				1100-1399	2				
13-15	7	M	238-730	< 500	5	462	2000	7	100
				500-799	2				
13-15	12	F	398-1302	< 500	2	801	2000	12	100
				500-799	5				
				800-1099	3				
				1100-1399	2				
16-20	7	M	463-888	< 500	3	599	2500	7	100
				500-799	3				
				800-1099	1				
16-20	12	F	158-1247	< 500	4	604	1800	12	100
				500-799	5				
				800-1099	2				
				1100-1399	1				
21-60	75	M	359-1607	< 500	16	825	1800	75	100
				500-799	23				
				800-1099	16				
				1100-1399	16				
				1400-1699	4				
61 and over	12	M	495-1254	500-799	6	847	1800	12	100
				800-1099	2				
				1100-1399	4				
21-60	56	F	331-1607	< 500	15	803	1500	55	94
				500-799	14				
				800-1099	12				
				1100-1399	13				
				1400-1699	2				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
61 and over	10	F	462-1482	< 500	1	797	1500	10	100
				500-799	6				
				800-1099	1				
				1100-1399	1				
				1400-1699	1				
Lactating women	27	F	290-1562	< 500	7	707	3000	27	100
				500-799	13				
				800-1099	3				
				1100-1399	2				
				1400-1699	2				
Niacin (mg.)									
1-3	12	M/F	4-11	< 10	10	6	6	7	58
				10-19	2				
4-6	21	M/F	3-10	< 10	21	7	8	11	52
7-9	18	M/F	3-17	< 10	10	10	10	10	55
				10-19	8				
10-12	21	M/F	0-21	< 10	15	8	10	15	71
				10-19	6				
13-15	7	M	3-11	< 10	6	7	15	7	100
				10-19	1				
13-15	12	F	1-19	< 10	4	11	13	9	75
				10-19	8				
16-20	7	M	0-12	< 10	6	7	17	7	100
				10-19	1				
16-20	12	F	4-15	< 10	9	8	12	10	83
				10-19	3				
21-60	75	M	1-41	< 10	33	12	15	54	72
				10-19	38				
				20-29	2				
				40-49	2				
61 and over	12	m	7-19	< 10	6	12	12	7	58
				10-19	6				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
21-60	56	F	0-22	< 10	27	11	12	30	53
				10-19	26				
				20-29	3				
61 and over	10	F	0-22	< 10	6	11	10	6	60
				10-19	3				
				20-29	1				
Lactating women	27	F	1-31	< 10	18	10	15	24	88
				10-19	7				
				30-39	2				
Ascorbic Acid (mg.)									
1-3	12	M/F	1-16	< 10	10	5	35	12	100
				10-29	2				
4-6	21	M/F	0-26	< 10	16	7	50	21	100
				10-29	5				
7-9	18	M/F	0-62	< 10	8	18	60	17	93
				10-29	7				
				40-49	1				
				50-59	1				
				60-69	1				
10-12	21	M/F	0-61	< 10	16	15	75	21	100
				40-49	3				
				50-59	1				
				60-69	1				
13-15	7	M	3-11	< 10	6	6	90	7	100
				10-29	1				
13-15	12	F	0-27	< 10	8	9	80	12	100
				10-29	4				
16-20	7	M	3-16	< 10	5	7	100	7	100
				10-29	2				
16-20	12	F	3-63	< 10	9	15	80	12	100
				10-29	1				
				30-39	1				
				60-69	1				

Age	Number of subjects	Sex	Range	Groups	Number of subjects in group	Average	NRC allowances	Number below allowances	Percent below allowances
21-60	75	M	0-58	< 10	52	10	70	75	100
				10-29	15				
				30-39	2				
				40-49	4				
				50-59	2				
61 and over	12	M	1-38	< 10	7	12	75	12	100
				10-29	4				
				30-39	1				
21-60	56	F	0-58	< 10	37	11	70	56	100
				10-29	12				
				30-39	1				
				40-49	4				
				50-59	2				
61 and over	10	F	0-43	< 10	5	20	70	10	100
				10-29	1				
				30-39	3				
				40-49	1				
Lactating women	27	F	0-42	< 10	16	12	150	27	100
				10-29	7				
				30-39	2				
				40-49	2				

2. Protein

All seven male subjects of the 16 to 20 years age group or 100% were below allowances. Lactating women and male subjects, 13 to 15 years of age, had a high percentage of subjects below allowances with 85% and 86%, respectively. Male subjects of the 21 to 60 years age group and female subjects of 21 to 60 years age group had a low percentage of subjects below allowances, 45% and 36%, respectively. Deviations of the other groupswere between these two figures.

For the total group of 290 Trukese, 162 subjects or 56% were below allowances and 128 or 44% were above allowances.

3. Fat

In all age groups, 100% or all subjects were below allowances, except the 7 to 9 years age group where 89% were below allowances.

For the total group of 290 Trukese, 288 subjects or 99% were below allowances and two subjects or 1% were above allowances.

4. Calcium

Of all age groups, males 13 to 15 years of age had the highest percentage of subjects below NRC allowances with 56% below allowances. This group was followed by the 10 to 12 years age group, 1 to 3 years age group, and lactating women with 52%, 50%, and 48% of the subjects below NRC allowances, respectively. Males 61 and over group had a low percentage of subjects below NRC allowances with 8% below allowances. Females of the 61 years and over group, and females of the 21 to 60 years group had 20% and 25% of the subjects below allowances.

For the total group of 290 Trukese, 97 subjects or 33% were below allowances and 193 subjects or 67% were above allowances.

5. Phosphorus

91% of the 1 to 3 years age group were below NRC allowances. All other groups had 80% or more of the subjects below NRC allowances with the exception of females 16 to 20 years of age; males 16 to 20 years of age; and females, 61 years and over group; with 75%, 71% and 70%, respectively.

For the total group of 290 Trukese, 212 subjects or 73% were below allowances and 78 subjects or 27% were above allowances.

6. Iron

100% or all of the subjects of the following groups were below NRC allowances: 1 to 3 years old; 4 to 6 years; 10 to 12 years; 13 to 15 years; males, 16 to 20 years; females, 16 to 20 years; and lactating women, 85% of the subjects were below NRC allowances for males of the 13 to 15 years old group.

For the total group of 290 Trukese, 282 subjects or 97% were below NRC allowances and 8 subjects or 3% were above NRC allowances.

7. Vitamin A

100% of the subjects were below NRC allowances for all groups with the exception of the 4 to 6 years old group and males of the 21 to 60 years old group where 95% and 97% of the subjects were below NRC allowances, respectively.

For the total group of 290 Trukese, 287 subjects or 99% were below NRC allowances and 3 subjects or 1% were above NRC allowances.

8. Thiamine

100% of the subjects were below NRC allowances for males of the 13 to 15 years old group and males of the 16 to 20 years old group. The 1 to 3 years old group had 34% of the subjects below NRC allowances. The other groups varied from 41% to 80% of the subjects being below NRC allowances.

For the total group of 290 Trukese, 170 subjects or 58% were below allowances and 120 subjects or 42% were above allowances.

9. Riboflavin

100% of the subjects of every group were below NRC allowances, except the 1 to 3 years old group and females, 21 to 60 years with 92% and 94% of the subjects below NRC allowances, respectively.

For the total group of 290 Trukese, 288 subjects or 99% were below NRC allowances and 2 subjects or 1% were above NRC allowances.

10. Niacin

100% of the males of the 13 to 15 years age group and 16 to 20 years group were below NRC allowances. 52% of the subjects of the 4 to 6 years old group were below NRC allowances. Other groups ranged from 53% to 88% of the subjects being below NRC allowances.

For the total group of 290 Trukese, 197 subjects or 68% were below NRC allowances and 93 subjects or 32% were above allowances.

11. Ascorbic Acid

100% of the subjects of each group were below NRC allowances except for the 7 to 9 years old group, where 93% of the subjects were below NRC allowances.

For the total group of 290 Trukese, 289 subjects or 99% were below NRC allowances and one subject or 1% was above NRC allowances.

Children 1 to 3 years of age

Intake records for children one to three years of age were collected for thirty-two subjects. Out of thirty-two subjects, twelve were weaned and twenty subjects were still breast fed although other foods were included in their dietary. Diets of non-breast fed subjects were calculated and tabulated in Table 16. For breast fed subjects, calories and nutrient values were calculated, however, intakes of breast feeding were not recorded. Therefore, all calculations exclude breast milk intakes.

Fischer (25) reported the following in her study: "Mothers of 33 children under six years of age were consulted as to the types of food eaten by their children. Only children under the age of eight months were reported as limited in their diets. In addition to the breast, these younger children were observed to eat sugar cane, sugar and coconut water. For the one bottle baby in this group, sugar was added to the baby's milk ..... Babies of eight months and older were eating the regular adult diet, pounded breadfruit, roasted fish, etc., in addition to the milk obtained from the mother. Only two babies as old as two years were found who had not been weaned and were not being fed entirely on adult foods. In regard to the unweaned baby, mothers were asked when they expected to wean them. These estimates ran from one to three years."

A few records are given as examples of quantities and kinds of food given to breast fed children of this age group.

One female child of one year had boiled white rice and drinking fluid of the immature coconuts in her diet. The daily intake was estimated at 220 gms. of coconut fluid, and 100 gms. of boiled white rice. Calculated daily caloric and nutrient values were as follows: calories, 390; protein, 8 gms.; fat, 0.43 gms.; carbohydrate, 88 gms.; calcium, 50 mgs.; phosphorus, 99mgs.; iron, 0.20 mgs.; vitamin A, none; thiamine, 39 mcgs.; riboflavin, 21 mcgs.; niacin, 1.6 mgs.; and ascorbic acid, 2 mgs.

One female child of one year had the following foods in her diet: soda crackers, drinking fluid of immature coconuts, and boiled white rice. The daily intake was estimated at 60 gms. of soda crackers, 342 gms. of coconut fluid, and 50 gms. of boiled white rice. Calculated daily caloric and nutrient values were as follows: calories, 736; protein, 7 gms.; fat, 3 gms.; carbohydrate, 72 gms.; calcium, 82 mgs.; phosphorus, 74 mgs.; iron, 0.8 mgs.; vitamin A, none; thiamine, 37 mcgs.; riboflavin, 34 mcgs.; niacin, 0.9 mgs.; and ascorbic acid, 3 mgs.

One female child of one year had the following foods in her diet: boiled white rice and white bread. The daily intake was estimated at 58 gms. of boiled white rice and 96 gms. of white bread. Calculated daily caloric and nutrient values were as follows: calories, 548; protein, 15 gms.; fat, 2 gms.; carbohydrate, 116 gms.; calcium, 40 mgs.; phosphorus, 145 mgs.; iron, 3 mgs.; vitamin A, 35 I. U.; thiamine, 535 mcgs.; riboflavin, 306 mcgs.; niacin, 4 mgs.; and ascorbic acid, none.

One female child of two years had the following foods in her diet; boiled white rice, boiled mackerel, baked breadfruit and drinking fluid of immature coconuts. The daily intake was estimated at 58 gms. of boiled white rice, 128 gms. of boiled mackerel, 107 gms. of baked breadfruit, and 223 gms. of coconut fluid. Calculated daily caloric and nutrient values were as follows: calories, 553; protein, 34 gms.; fat, 10 gms.; carbohydrate, 90 gms.; calcium, 74 mgs.; phosphorus, 451 mgs.; iron, 3 mgs.; vitamin A, 197 I. U.; thiamine, 105 mcgs.; riboflavin, 65 mcgs.; niacin, 2 mgs.; and ascorbic acid, 4 mgs.

One male child of two years had the following foods in his diet; sugar cane (pounded and juice extracted), boiled white rice, roasted breadfruit, soda crackers, and fluid of immature coconuts. The daily intake was estimated at 389 gms. of sugar cane, 10 gms. of boiled white rice, 270 gms. of roasted breadfruit, 137 gms. of coconut fluid, and 3 gms. of soda crackers. Calculated daily caloric and nutrient values were as follows: calories, 566; protein, 4 gms.; fat, 1 gm.; carbohydrate, 187 gms.; calcium, 146 mgs.; phosphorus, 158 mgs.; iron, 5 mgs.; vitamin A, 186 I. U.; thiamine, 376 mcgs.; riboflavin, 200 mcgs.; niacin, 3 mgs.; and ascorbic acid, 3 mgs.

One male child of three years had the following foods in his diet; roasted breadfruit, bananas, and drinking fluid of immature coconuts. The daily intake was estimated at 240 gms. of coconut fluid, 300 gms. of roasted breadfruit, and 100 gms. of bananas. Calculated daily caloric and nutrient values were as follows: calories, 556; protein, 5 gms.; fat, 1 gm.; carbohydrate, 131 gms.; calcium, 126 mgs.; phosphorus, 166 mgs.; iron, 2 mgs.; vitamin A, 1046 I. U.; thiamine, 281 mcgs.; riboflavin, 205 mcgs.; niacin, 3 mgs.; and ascorbic acid, 30 mgs.

Children and adult male subjects

Table 17 summarizes the daily quantities of various nutrients per person and comparison with National Research Council Allowances of children and adult male subjects of Udot, Truk District, Caroline Islands.

There were 173 subjects as follows: 12 males and females between the ages of 1 through 3 years of age; 21 males and females between the ages of 4 through 6 years of age; 18 males and females between the ages of 7 through 9 years of age; and 21 males and females between the ages of 10 through 12 years of age; 7 males between the ages of 13 through 15 years of age; 7 males between the ages of 16 through 20 years of age; 75 males between the ages of 21 to 60 years of age; and 12 males, 61 years of age and over.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given in Table 17.

Table 17.

Dietary Study - Udot, Truk District, Caroline Islands.

Summary of Daily Quantities of Various Nutrients
per Person and Comparison with National Research Council Allowances

by Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Children (Male and Female)		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
1 to 3 years (12)*											
Average intake	1303	38	8	1892	741	3	660	595	444	6	5
NRC Allowances	1200	40	33	1000	1000	7	2000	600	900	6	35
% of allowances	109	95	24	189	74	43	33	99	49	100	14
% of subjects below allowances	42	58	100	50	91	100	100	34	92	58	100
4 to 6 years (21)											
Average intake	1451	49	13	1810	740	4	794	809	501	7	7
NRC allowances	1600	50	44	1000	1000	8	2500	800	1200	8	50
% of allowances	91	98	29	181	74	50	32	101	42	87	14
% of subjects below allowances	57	67	100	43	86	100	95	43	100	52	100
7 to 9 years (18)											
Average intake	1913	60	21	2256	938	6	978	924	575	10	18
NRC allowances	2000	60	56	1000	1200	10	3500	1000	1500	10	60
% of allowances	96	100	37	226	78	60	28	92	38	100	30
% of subjects below allowances	61	61	89	33	85	88	100	66	100	55	93
10 to 12 years (21)											
Average intake	1948	61	17	1463	914	5	972	952	611	8	15
NRC allowances	2500	70	69	1200	1200	12	4500	1200	1800	10	75
% of allowances	77	87	25	121	76	42	22	79	34	80	20
% of subjects below allowances	76	67	100	52	80	100	100	80	100	71	100

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Males		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
13 to 15 years (7)											
Average intake	1793	56	12	1748	755	6	518	806	462	7	6
NRC allowances	3200	85	89	1400	1320	15	5000	1500	2000	15	90
% of allowances	56	66	13	124	57	40	10	54	23	47	7
% of subjects below allowances	86	86	100	56	85	85	100	100	100	100	100
16 to 20 years (7)											
Average intake	1833	63	13	3964	1235	4	1006	972	599	7	7
NRC allowances	3800	100	105	1400	1320	15	6000	1700	2500	17	100
% of allowances	48	63	12	283	94	27	17	56	24	41	7
% of subjects below allowances	100	100	100	28	71	100	100	100	100	100	100
21 to 60 years (75)											
Average intake	2471	76	17	2431	1237	6	1318	1310	825	12	10
NRC allowances	3000	70	83	1000	1320	12	5000	1500	1800	15	70
% of allowances	82	108	20	243	94	50	26	87	46	80	14
% of subjects below allowances	70	45	100	29	68	97	97	60	100	72	100
61 to 70 years (12)											
Average intake	2545	67	14	4491	1419	7	1351	1429	847	12	12
NRC allowances	2400	70	67	1000	1320	12	5000	1200	1800	12	75
% of allowances	106	96	21	449	107	58	27	119	47	100	16
% of subjects below allowances	50	58	100	8	58	88	100	50	100	58	100

* Figure in ( ) indicate number of subjects studied.

I. CHILDREN

1 to 3 years of age There were 12 male and female subjects. All of the subjects or 100% were below NRC allowances for fat, iron, vitamin A and ascorbic acid. 92% of the subjects were below allowances for riboflavin and 91% were below allowances for phosphorus. 34% of the subjects were below allowances for thiamine, and 42% were below allowances for calories. 58% of the subjects were below allowances for protein and niacin, and 50% were below allowances for calories.

4 to 6 years of age There were 21 males and female subjects. All of the subjects or 100% were below NRC allowances for fat, iron, riboflavin, and ascorbic acid. 95% of the subjects were below allowances for vitamin A. 86% of the subjects were below allowances for phosphorus. 57% of the subjects were below allowances for calories and 52% for niacin. 67% of the subjects were below allowances for protein. 43% of the subjects were below allowances for calcium and thiamine.

7 to 9 years of age There were 18 male and female subjects. All of the subjects or 100% were below allowances for vitamin A and riboflavin. 93% of the subjects were below allowances for ascorbic acid. 89% of the subjects were below allowances for fat; 88% were below allowances for iron and 85% were below allowances for phosphorus. 66% of the subjects were below allowances for thiamine and 61% for calories and protein. 55% were below allowances for niacin and 33% were below allowances for calcium.

10 to 12 years of age There were 21 male and female subjects. All of the subjects or 100% were below allowances for fat, iron, vitamin A, riboflavin, and ascorbic acid. 80% of the subjects were below allowances for phosphorus and riboflavin. 76% of the subjects were below allowances for calories and 71% were below allowances for niacin. 67% of the subjects were below allowances for protein and 52% of the subjects were below allowances for calcium.

III. MALES

13 to 15 years of age There were 7 subjects. 100% or all of the subjects were below allowances for fat, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. 86% of the subjects were below allowances for calories and protein; 85% were below allowances for phosphorus and iron. 56% were below allowances for calcium.

16 to 20 years of age There were 7 subjects. 100% or all of the subjects were below allowances for calories, protein, fat, iron, vitamin A, thiamine, riboflavin, niacin and ascorbic acid. 71% of the subjects were below allowances for phosphorus and 28% of the subjects were above allowances.

21 to 60 years of age There were 75 subjects. 100% or all of the subjects were below allowances for fat, riboflavin, and ascorbic acid. 97% of the subjects were below allowances for iron and vitamin A. 72% of the subjects were below allowances for niacin, and 70% for calories. 68% of the subjects were below allowances for phosphorus and 60% were below allowances for thiamine. 45% were below allowances for protein and 29% were below allowances for calcium.

<u>61 to 70 years of age</u> There were 12 subjects. 100% or all of the subjects were below NRC allowances for fat, vitamin A, riboflavin, and ascorbic acid. 88% of the subjects were below allowances for iron. 58% of the subjects were below NRC allowances for protein, phosphorus, and niacin. 50% of the subjects were below allowances for calories and thiamine. 8% of the subjects were below allowances for calcium.

<u>Female subjects</u>

Table 18 summarizes the daily quantities of various nutrients per person and comparison with National Research Council Allowances for female subjects of Udot, Truk District, Caroline Islands.

There were 117 female subjects as follows: 12 females between 13 and 15 years of age; 12 females between 16 through 20 years of age; 56 females between the ages of 21 through 60 years of age; 10 females, 61 years and over; and 27 lactating women.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given in Table 18.

III. FEMALES

<u>13 to 15 years of age</u> There were 12 subjects. 100% or all of the subjects were below allowances for fat, iron, vitamin A, riboflavin, and ascorbic acid. 75% of the subjects were below allowances for niacin. 67% of the subjects were below allowances for calories. 58% of the subjects were below allowances for phosphorus and 50% were below allowances for protein. 41% of the subjects were below allowances for thiamine and 33% were below allowances for calcium.

<u>16 to 20 years of age</u> There were 12 subjects. 100% or all of the subjects were below allowances for fat, iron, vitamin A, riboflavin and ascorbic acid. 83% of the subjects were below allowances for niacin. 75% of the subjects were below allowances for thiamine and phosphorus. 67% of the subjects were below allowances for protein. 58% of the subjects were below allowances for calories and 25% of the subjects were below allowances for calcium.

<u>21 to 60 years of age</u> There were six subjects. 100% or all of the subjects were below NRC allowances for fat, vitamin A, and ascorbic acid. 94% were below allowances for iron and riboflavin. 66% were below allowances for phosphorus, and 53% were below allowances for niacin. 46% were below allowances for niacin. 46% were below allowances for calories and 42% were below allowances for thiamine. 36% were below allowances for protein and 25% were below allowances for calcium.

<u>61 to 70 years of age</u> There were ten subjects. 100% or all of the subjects were below allowances for fat, vitamin A, riboflavin and ascorbic acid. 90% of the subjects were below allowances for iron. 70% of the subjects were below allowances for phosphorus and 60% were below allowances

Table 18.

Dietary Study - Udot, Truk District, Caroline Islands.

Summary of Daily Quantities of Various Nutrients
per Person and Comparison with National Research Council Allowances

by Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Females											
13 to 15 years (12)*											
Average intake	2141	78	20	2487	1167	6	1303	1297	801	11	9
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	82	97	28	191	97	40	26	99	40	85	11
% of subjects below allowances	67	50	100	33	58	100	100	41	100	75	100
16 to 20 years (12)											
Average intake	2125	76	13	2157	1035	5	1442	889	604	8	15
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	88	101	19	216	86	33	29	74	33	67	19
% of subjects below allowances	58	67	100	25	75	100	100	75	100	83	100
21 to 60 years (56)											
Average intake	2531	76	16	2690	1254	6	1296	1505	803	11	11
NRC allowances	2400	60	67	1000	1320	12	5000	1200	1500	12	70
% of allowances	105	126	24	269	95	50	26	125	54	92	16
% of subjects below allowances	46	36	100	25	66	94	100	42	94	53	100
61 to 70 years (10)	2466										
Average intake	2466	66	19	2886	1284	7	732	1151	797	11	20
NRC allowances	2000	60	56	1000	1320	12	5000	1000	1500	10	70
% of allowances	123	110	34	289	97	58	15	115	53	110	28
% of subjects below allowances.	50	50	100	20	70	90	100	50	100	60	100
Lactating women (27)											
Average intake	2200	74	16	2686	1206	6	986	1089	707	10	12
NRC allowances	3000	100	83	2000	1800	15	8000	1500	3000	15	150
% of allowances	73	74	19	134	67	40	12	73	24	67	8
% of subjects below allowances	89	85	100	48	81	100	100	77	100	88	100

* Figure in ( ) indicate number of subjects studied.

for niacin. 50% of the subjects were below allowances for calories, protein and thiamine. 20% were below allowances for calcium.

Lactating women There were 27 subjects. 100% or all of the subjects were below NRC allowances for fat, iron, vitamin A, riboflavin and ascorbic acid. 89% of the subjects were below allowances for calories and 88% were below allowances for niacin. 85% of the subjects were below allowances for protein and 81% were below allowances for phosphorus. 77% of the subjects were below allowances for thiamine and 48% were below allowances for calcium.

Classification of averages of nutrient intake in relation to NRC Recommended Dietary Allowances

Table 19 gives the classification of averages of nutrient intake of 290 Trukese of Udot, Caroline Islands, in relation to NRC Recommended Dietary Allowances. Classification of average intake is given as percentage of NRC Recommended Dietary Allowances.

For calories, protein, calcium, and thiamine the greatest number of average intakes were in the group which was 90 to 100% of the NRC Recommended Dietary Allowances.

Table 19.

Classification of Averages of Nutrient Intake of 290 Trukese of Udot, Caroline Islands in Relation to NRC Recommended Dietary Allowances.

Classification of Average Intake as Percentage of NRC Recommended Dietary Allowances

by Mary Murai

	90-100 Percent	70-89 Percent	Under 70 Percent
Calories	123	56	111
Protein	150	56	84
Fat	6	7	277
Calcium	198	21	71
Phosphorus	105	59	126
Iron	13	31	246
Vitamin A	3	11	276
Thiamine	133	50	107
Riboflavin	7	36	247
Niacin	100	60	130
Ascorbic Acid	2	9	279

For fat, phosphorus, iron, vitamin A, riboflavin, niacin, and ascorbic acid the greatest number of average intakes were in the group which was under 70% of NRC Recommended Dietary Allowances.

DISCUSSION

Little is known about the physiological requirements of the Trukese for various nutrients.

In order to have some data on body sizes of Trukese, 282 male and female Trukese, from the ages of 1 through 70 years, participants in this dietary survey, were weighed and measured by the author.

Table 20 shows the weights and heights of 282 male and female subjects from 1 year through 70 years of age. The weights are given in pounds showing the range and average; heights are given in inches showing the range and average.

The average weights of Trukese were compared with average weights of Americans of the same age group to obtain the difference between Trukese and Americans.

Table 21 shows the difference between average body weights of Trukese and American subjects of the same age group.

Trukese subjects had smaller body sizes when compared with American subjects of the same age group, with the exception of females 21 years and over, where the average weight for Trukese females was two pounds heavier than the average weight for American females.

CALORIES

Caloric requirements, using the FAO formula for calculating these requirements, would be similar to the calculated values for Marshallese as the body sizes of the Trukese are very much like the Marshallese and the mean temperature of Truk is the same as that of the Marshall Islands. For details see section under Discussion in the Nutrition Study of the Marshall Islands.

Table 20.

Weights and Heights of Trukese Subjects

Age (yrs.)	Sex	Number of subjects	Weight (pounds) Range	Weight (pounds) Average	Height (inches) Range	Height (inches) Average
1-3	M	17	20-30	25	22-30	27
	F	15	20-30	25	22-30	27
4-6	M	7	30-35	32	36-40	38
	F	14	20-33	28	36-40	38
7-9	M	13	42-60	50	40-55	45
	F	4	40-60	48	40-54	47
10-12	M	12	64-90	78	48-50	50
	F	9	65-88	76	50-58	52
13-15	M	7	70-120	98	55-63	60
	F	12	75-125	100	50-60	58
16-20	M	7	95-165	133	55-68	63
	F	12	80-140	121	55-65	61
21-60	M	75	110-200	138	59-69½	64
	F	56	90-170	125	55-68	61
61-70	M	12	98-160	123	59-69	63
	F	10	90-150	121	56-64	56

Table 21.

Comparison of Average Weights of Trukese with Weights of Americans Given for Each Age Group in the Table of Recommended Daily Allowances, National Research Council.

Weights of Americans Age group	Weights of Americans Weight in Pounds	Weights of Trukese Weight in Pounds	Difference in Pounds
1 to 3	27	25	-2
4 to 6	42	30	-12
7 to 9	58	49	-9
10 to 12	78	77	-1
13 to 15 (girls)	108	100	-8
16 to 20 (girls)	122	121	-1
13 to 15 (boys)	108	100	-8
16 to 20 (boys)	141	133	-8
21 and over (females)	123	125	/2
21 and over (males)	154	138	-16

FOOD ITEMS COMMONLY CONSUMED BY TRUKESE STUDIED IN THIS DIETARY SURVEY

	TRUKESE	ENGLISH
1. BREADS	Pinauwa	Bread, white
2. CEREAL AND CEREAL DISHES	Rais	Rice, boiled, white
3. CRACKERS		Crackers, soda

4. FISH, CRUSTACEA, AND SIMILAR FOODS

TRUKESE	ENGLISH	SCIENTIFIC
Ar	Parrot fish	Scarus
Boro	Wrasse	Family Labridae
Bula	Surgeon fish (Tang)	Naso Lituratus
Eni	Sea Bass	Cephalopholis Argus (Bloch)
Fide	Snapper	Family Lutjanidae (genus Lutjanus)
Ikechon	Wrasse	Family Labridae
Kinfou	Sea Bass	Epinephelus macro-spilos (?)
Kuo		Siganus (punctatus?)
Meigyogyo	Trigger Fish	Family Balistidae or Monacanthidae
Meich		Siganus Rostratus
Musum	Damsel Fish, Sergeant Major, Squirrel Fish or Soldier Fish	Contains several species belonging at least to the familiar Pomacentridae and Holocentridae
Nippach	Octopus	Octopus (Octopus) sp. (probably O. o. cyanea)
Onon	Bivalves found in mangrove swamps	Lucina edentula (Linné)
Petu	Mackerel	
Puna	Surgeon Fish (Tang)	Family Acanthuridae

TRUKESE	ENGLISH	SCIENTIFIC
Senif	Sardines, small	A clupeid fish, probably of the genus Harengula
Sewit	Scorpion Fish	Family Scorpaenidae
Sim	Clam	Hippopus hippopus
To	Clam	Tridacna sp. (probably T. crocea)
Tsufu	Parrot Fish	Family Scaridae

	TRUKESE	ENGLISH
5. FRUITS		
	Utsu	Bananas, raw and cooked
	Naimis	Limes
	Painaper	Pineapple
	Sasaf	Soursop
	Mangko	Mangoes
	Sennia	Watermelon
	Kurukur	Orange
	Kippwau	Papaya
6. MEATS, FRESH		
	Pik	Pig
	Chuko	Chicken Chicken soup
7. MEAT, SAUSAGE AND SIMILAR PRODUCTS		
		Frankfurters
8. MILK		Evaporated milk for infants
9. NUTS	Nu	Coconut fluid from the immature nut
	Taka	Meat from mature coconut
	Apun	Meat often called spoon meat from immature coconuts

	TRUKESE	ENGLISH
9. NUTS (CONT'D)		
	Ot or chofar	Embryo of the sprouting coconut
10. SUGAR		
	Wo	Sugar cane
	Suke	Sugar, white, refined
11. VEGETABLES		
	Kon	Breadfruit, steamed and pounded into a loaf
	Ainbat mei	Breadfruit, boiled
	Aponau	Breadfruit, baked
	Matun	Breadfruit, steamed, pounded and coconut milk added
	Ror or opou	Breadfruit, roasted, charred, skin scraped off and baked in coconut milk
	Emesifich	Breadfruit, steamed, pounded and coconut oil added
	Kamuti	Potato, sweet
	Pwoteiton	Potato, white
12. MISCELLANEOUS		
	Kofi	Coffee
	Ti	Tea
		Miso soup

BREADFRUIT AND TARO SEASON

Bulk of the breadfruit crop is obtained during the main harvest season from July to September. During this season, the surplus is stored as fermented breadfruit, "apot".

Meikoch, a variety of breadfruit, is harvested in October. Meikoch, sawan, and Meiyon are in season from the middle of December until the middle of January and in good years until middle of February.

Root crops such as puna (Cyrtosperma chamissonis), taro or oni (Colocasia esculenta) and dryland taro or ka (Colocasia macrorrhiza) and tapioca are cultivated all year round.

RECOMMENDATIONS

See section under Recommendations Based on Dietary Studies in the Nutrition Study of the Marshall Islands.

SUMMARY

Seven-day dietary records of 290 Trukese of Udot, Truk District, Caroline Islands, from the ages of one to 70 years of age were studied for daily quantities of calories, protein, fat, calcium, phosphorus, iron, Vitamin A, thiamine, riboflavin, niacin and ascorbic acid. These figures were then compared with National Research Council allowances.

Taking the total group of 290 subjects, the following results were obtained when daily intakes were compared with NRC allowances:

1. Calories: 186 subjects or 64% were below NRC allowances and 104 subjects or 36% were above NRC allowances.

2. Protein: 162 subjects or 56% were below allowances and 128 or 44% were above NRC allowances.

3. Fat: 188 subjects or 99% were below NRC allowances and two subjects or 1% were above allowances.

4. Calcium: 97 subjects or 33% were below allowances and 193 subjects or 67% were above NRC allowances.

5. Phosphorus: 212 subjects or 73% were below NRC allowances and 78 subjects or 27% were above NRC allowances.

6. Iron: 282 subjects or 97% were below NRC allowances and eight subjects or 3% were above NRC allowances.

7. Vitamin A: 287 subjects or 99% were below NRC allowances and three subjects or 1% were above NRC allowances.

8. Thiamine: 170 subjects or 58% were below allowances and 120 subjects or 42% were above NRC allowances.

9. Riboflavin: 288 subjects or 99% were below NRC allowances and two subjects or 1% were above NRC allowances.

10. Niacin: 197 subjects or 68% were below NRC allowances and 93 subjects or 32% were above NRC allowances.

11. Ascorbic Acid: 289 subjects or 99% were below NRC allowances and one subject or 1% was above NRC allowances.

PART III

A COMPARATIVE STUDY OF THE NUTRIENT INTAKES OF THE MARSHALLESE OF MAJURO VILLAGE, MARSHALL ISLANDS, AND THE TRUKESE OF UDOT, TRUK DISTRICT, CAROLINE ISLANDS

PURPOSE: To compare the nutrient intakes of the Marshallese of Majuro Village, Marshall Islands, a "low" island; and the nutrient intakes of the Trukese of Udot, Truk District, Caroline Islands, a "high" island.

PROCEDURE: As given in section for the Marshall Islands and the Caroline Islands.

RESULTS

Table 22 summarizes the daily quantities of various nutrients per person and comparison with National Research Council allowances of the Marshallese children of Majuro Village, Marshall Islands and the Trukese children of Udot, Caroline Islands.

There were 120 children. Ages 1 to 3 years: Marshallese, 24; Trukese, 12. Ages 4 to 6 years: Marshallese, 12; Trukese, 21. Ages 7 to 9 years: Marshallese, 6; Trukese, 18. Ages 10 to 12 years: Marshallese 6; Trukese, 21.

The average intakes, NRC allowances, percent of allowance, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given in Table 22.

I. CHILDREN

1 to 3 years of age In comparing the Marshallese and the Trukese of this age group, for the Marshallese, a greater percentage of subjects were below allowances for all nutrients except niacin. For the Trukese, a greater percentage were below allowances for fat, phosphorus, iron, vitamin A, riboflavin and ascorbic acid. For protein and niacin almost half of the subjects were above and half below NRC allowances. For calcium, it was evenly divided between those above and those below allowances.

4 to 6 years of age For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients except iron and niacin. For the Trukese, a greater percentage of the subjects were below allowances for all nutrients except calcium and thiamine. Caloric and niacin intakes were divided with almost half of the subjects above and half below allowances.

7 to 9 years of age For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients except niacin. The percentage for protein and for iron were divided with half of the subjects above and half below allowances. For the Trukese, a greater percentage of the subjects were below allowances for all nutrients except calcium and niacin.

Table 22.

Summary of Daily Quantities of Various Nutrients per Person of the Marshallese, Majuro Village, Marshall Islands and the Trukese, Udot, Caroline Islands and Comparisons with National Research Council Allowances.

by Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Children (male and female)											
1 to 3 years											
Marshall Islands (21)*											
Average intake	823	26	13	229	404	6	1404	503	409	11	20
NRC allowances	1200	40	33	1000	1000	7	2000	600	900	6	35
% of allowances	68	65	39	23	40	86	70	84	45	180	57
% of subjects below allowances	92	88	96	100	100	62	83	75	96	33	83
Caroline Islands (12)											
Average intake	1303	38	8	1892	741	3	660	595	444	6	5
NRC allowances	1200	40	33	1000	1000	7	2000	600	900	6	35
% of allowances	109	95	24	189	74	43	33	99	49	100	14
% of subjects below allowances	42	58	100	50	91	100	100	34	92	58	100
4 to 6 years											
Marshall Islands (12)											
Average intake	1096	42	21	303	572	8	2019	642	439	9	30
NRC allowances	1600	50	44	1000	1000	8	2500	800	1200	8	50
% of allowances	68	84	48	30	57	100	81	80	36	112	60
% of subjects below allowances	92	67	92	100	100	33	83	75	100	42	67
Caroline Islands (21)											
Average intake	1451	49	13	1810	740	4	794	809	501	7	7
NRC allowances	1600	50	44	1000	1000	8	2500	800	1200	8	50
% of allowances	91	98	29	181	74	50	32	101	42	87	14
% of subjects below allowances	57	67	100	43	86	100	95	43	100	52	100

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
7 to 9 years		gm.	gm.	mg.	mg.	mg.	I.U.	mcg	mcg.	mg.	mg.
Marshall Islands (6)											
Average intake	1269	52	21	534	732	10	3508	631	563	12	19
NRC allowances	2000	60	56	1000	1200	10	3500	1000	1500	10	60
% of allowances	63	87	37	53	61	100	100	63	37	120	32
% of subjects below allowances	100	50	100	67	100	50	67	83	100	0	100
Caroline Islands (18)											
Average intake	1913	60	21	2256	938	6	978	924	575	10	18
NRC allowances	2000	60	56	1000	1200	10	3500	1000	1500	10	60
% of allowances	96	100	37	226	78	60	28	92	38	100	30
% of subjects below allowances	61	61	89	33	85	88	100	66	100	55	93
10 to 12 years											
Marshall Islands (6)											
Average intake	1577	62	30	486	925	11	2550	801	621	12	26
NRC allowances	2500	70	69	1200	1200	12	4500	1200	1800	10	75
% of allowances	63	88	43	40	77	92	57	67	34	120	35
% of subjects below allowances	100	83	100	100	83	67	83	83	100	33	100
Caroline Islands (21)											
Average intake	1948	61	17	1463	914	5	972	952	611	8	15
NRC allowances	2500	70	69	1200	1200	12	4500	1200	1800	10	75
% of allowances	77	87	25	121	76	42	22	79	34	80	20
% of subjects below allowances	76	67	100	52	80	100	100	80	100	71	100

* Figures in ( ) indicate number of subjects studied.

10 to 12 years of age For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients except niacin. For the Trukese, a greater percentage of subjects were below allowances for all nutrients except calcium. For calcium almost half of the subjects were below allowances and half were above allowances.

Table 23 summarizes the daily quantities of various nutrients per person and comparison with National Research Council allowances of the Marshallese males of Majuro Village, Marshall Islands and the Trukese males of Udot, Caroline Islands.

There were 147 males. Ages 13 to 15 years: Marshallese, 3; Trukese, 7. Ages 16 to 20 years: Marshallese, 2; Trukese, 7. Ages 21 to 60 years: Marshallese, 33; Trukese, 75. Ages 61 to 70 years: Marshallese, 8; Trukese, 12.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin and ascorbic acid are given in Table 23.

II. MALES

13 to 15 years of age For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients. For the Trukese, a greater percentage of subjects were below allowances for all nutrients except calcium. Almost one half of the subjects were below allowances and one half were above allowances for calcium.

16 to 20 years For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients except protein, phosphorus, iron, vitamin A, thiamine and niacin. For all these nutrients, one half of the subjects were below allowances and one half were above allowances. For the Trukese, a greater percentage of the subjects were below allowances for all nutrients except calcium.

21 to 60 years of age For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients. For the Trukese, a greater percentage of the subjects were below allowances for all nutrients except protein and calcium.

61 to 70 years of age For the Marshallese, a greater percentage of the subjects were below allowances for all nutrients except niacin. For the Trukese, a greater percentage of the subjects were below allowances for fat, iron, vitamin A, riboflavin, and ascorbic acid. Almost one half of the subjects were below allowances and one half were above allowances for protein, phosphorus, thiamine, and niacin. For calories, one half were below and one half above NRC allowances.

Table 24 summarizes the daily quantities of various nutrients per person and comparison with National Research Council allowances of the Marshallese females of Majuro Village, Marshall Islands, and the Trukese females of Udot, Caroline Islands.

Table 23.

Summary of Daily Quantities of Various Nutrients per Person of the Marshallese, Majuro Village, Marshall Islands and the Trukese, Udot, Caroline Islands and Comparisons with National Research Council Allowances.

by Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Males											
13 to 15 years											
Marshall Islands (3)*											
Average intake	1385	49	28	313	552	8	901	939	622	13	33
NRC allowances	3200	85	89	1400	1320	15	5000	1500	2000	15	90
% of allowances	43	58	31	22	42	53	18	63	31	87	37
% of subjects below allowances	100	100	100	100	100	100	100	100	100	67	100
Caroline Islands (7)											
Average intake	1793	56	12	1748	755	6	518	806	462	7	6
NRC allowances	3200	85	89	1400	1320	15	5000	1500	2000	15	90
% of allowances	56	66	13	124	57	40	10	54	23	47	7
% of subjects below allowances	86	86	100	56	85	85	100	100	100	100	100
16 to 20 years											
Marshall Islands (33)											
Average intake	2240	92	32	489	1547	17	1799	1415	1133	17	20
NRC allowances	3800	100	105	1400	1320	15	6000	1700	2500	17	100
% of allowances	59	92	30	35	117	113	30	83	45	100	20
% of subjects below allowances	100	50	100	100	50	50	50	50	100	50	100
Caroline Islands (7)											
Average intake	1833	63	13	3964	1235	4	1006	972	599	7	7
NRC allowances	3800	100	105	1400	1320	15	6000	1700	2500	17	100
% of allowances	48	63	12	283	94	27	17	56	24	41	7
% of subjects below allowances	100	100	100	28	71	100	100	100	100	100	100

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
21 to 60 years		gm.	gm.	mg.	mg	mg.	I.U.	mcg.	mcg.	mg.	mg.
Marshall Islands (33)											
Average intake	1469	54	24	390	744	10	1307	944	726	13	14
NRC allowances	3000	70	83	1000	1320	12	5000	1500	1800	15	75
% of allowances	49	77	29	39	56	83	26	63	40	87	19
% of subjects below allowances	100	82	97	97	91	64	91	85	100	70	97
Caroline Islands (75)											
Average intake	2471	76	17	2431	1237	6	1318	1310	825	12	10
NRC allowances	3000	70	83	1000	1320	12	5000	1500	1800	15	70
% of allowances	82	108	20	243	94	50	26	87	46	80	14
% of subjects below allowances	70	45	100	29	68	97	97	60	100	72	100
61 to 70 years											
Marshall Islands (8)											
Average intake	1302	42	16	308	601	8	436	839	619	12	11
NRC allowances	2400	70	67	1000	1320	12	5000	1200	1800	12	75
% of allowances	54	60	24	31	45	67	9	70	34	100	15
% of subjects below allowances	100	100	100	100	100	75	100	88	100	38	100
Caroline Islands (12)											
Average intake	2545	67	14	4491	1419	7	1351	1429	847	12	12
NRC allowances	2400	70	67	1000	1320	12	5000	1200	1800	12	75
% of allowances	106	96	21	449	107	58	27	119	47	100	16
% of subjects below allowances	50	58	100	8	58	88	100	50	100	58	100

* Figures in ( ) indicate number of subjects studied.

There were 180 females. Ages 13 to 15 years: Marshallese, 3; Trukese, 12. Ages 16 to 20 years: Marshallese, 4; Trukese, 12. Ages 21 to 60 years: Marshallese, 36; Trukese, 56. Ages 61 to 70 years: Marshallese, 9: Trukese, 10. Lactating women: Marshallese, 11; Trukese, 27.

The average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid are given in Table 24.

III. FEMALES

13 to 15 years of age For the Marshallese, a greater percentage of subjects were below allowances for all nutrients. For the Trukese, a greater percentage of subjects were below allowances for all nutrients except calcium and thiamine. For phosphorus, almost one half of the subjects were above and one half below allowances. For protein, one half were below and one half above NRC allowances.

16 to 20 years of age For the Marshallese, a greater percentage of subjects were below allowances for all nutrients except phosphorus and iron where one half of the subjects were above and one half below allowances. For the Trukese, a greater percentage of subjects were below allowances for all nutrients except calcium. For calories, about one half of the subjects were below allowances and one half were above allowances.

21 to 60 years of age For the Marshallese, a greater percentage of subjects were below allowances for all nutrients except niacin. For the Trukese, a greater percentage of subjects were below allowances for all nutrients except calories, protein, calcium and thiamine. Almost a half of the subjects were below allowances and one half were above allowances for niacin.

61 to 70 years of age For the Marshallese, a greater percentage of subjects were below allowances for all nutrients except niacin. For the Trukese, a greater percentage of subjects were below allowances for fat, phosphorus, iron, vitamin A, riboflavin, niacin and ascorbic acid. One half of the subjects were below and one half above allowances for calories, protein, and thiamine.

Lactating women For the Marshallese, a greater percentage of subjects were below allowances for all nutrients except niacin. For the Trukese, a greater percentage of the subjects were below allowances for all nutrients except calcium.

Tablo 24.

Summary of Daily Quantities of Various Nutrients per Person of the Marshallese, Majuro Village, Marshall Islands and the Trukese, Udot, Caroline Islands and Comparisons with National Research Council Allowances.

By Mary Murai

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
Females		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
13 to 15 years											
Marshall Islands (3)*											
Average intake	1487	59	25	442	655	9	352	745	568	12	6
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	57	74	35	34	54	60	7	57	28	92	7
% of subjects below allowances	100	100	100	100	100	100	100	100	100	67	100
Caroline Islands (12)											
Average intake	2141	78	20	2487	1167	6	1303	1297	801	11	9
NRC allowances	2600	80	72	1300	1200	15	5000	1300	2000	13	80
% of allowances	82	97	28	191	97	40	26	99	40	85	11
% of subjects below allowances	67	50	100	33	58	100	100	41	100	75	100
16 to 20 years											
Marshall Islands (4)											
Average intake	1323	52	15	277	867	6	1119	801	637	10	10
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	55	69	22	28	72	40	22	67	35	83	12
% of subjects below allowances	100	75	100	100	50	50	100	100	100	75	100
Caroline Islands (12)											
Average intake	2125	76	13	2157	1035	5	1442	889	604	8	15
NRC allowances	2400	75	67	1000	1200	15	5000	1200	1800	12	80
% of allowances	88	101	19	216	86	33	29	74	33	67	19
% of subjects below allowances	58	67	100	25	75	100	100	75	100	83	100

	Calories	Protein	Fat	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Ascorbic Acid
<u>21 to 60 years</u>		gm.	gm.	mg.	mg.	mg.	I.U.	mcg.	mcg.	mg.	mg.
Marshall Islands (36)											
Average intake	1365	47	23	363	661	10	1524	809	648	12	13
NRC allowances	2400	60	67	1000	1320	12	5000	1200	1500	12	70
% of allowances	57	78	34	36	50	83	30	67	43	100	18
% of subj. below allow.	97	72	97	100	97	67	89	86	100	47	97
Caroline Islands (56)											
Average intake	2531	76	16	2690	1254	6	1296	1505	803	11	11
NRC allowances	2400	60	67	1000	1320	12	5000	1200	1500	12	70
% of allowances	105	126	24	269	95	50	26	125	54	92	16
% of subj. below allow.	46	36	100	25	66	94	100	42	94	53	100
<u>61 to 70 years</u>											
Marshall Islands (9)											
Average intake	1197	38	19	375	582	11	1375	683	550	10	43
NRC allowances	2000	60	56	1000	1320	12	5000	1000	1500	10	70
% of allowances	60	63	34	37	44	92	27	68	37	100	18
% of subj. below allow.	100	78	100	100	100	78	89	89	100	44	100
Caroline Islands (10)											
Average intake	2466	66	19	2886	1284	7	732	1151	797	11	20
NRC allowances	2000	60	56	1000	1320	12	5000	1000	1500	10	70
% of allowances	123	110	34	289	97	58	15	115	53	110	28
% of subj. below allow.	50	50	100	20	70	90	100	50	100	60	100
<u>Lactating Women</u>											
Marshall Islands (11)											
Average intake	1695	62	27	466	840	12	2499	876	786	16	17
NRC allowances	3000	100	83	2000	1800	15	8000	1500	3000	15	150
% of allowances	56	62	32	23	47	80	31	58	26	107	11
% of subj. below allow.	100	100	100	100	100	73	91	91	100	45	100
Caroline Islands (27)											
Average intake	2200	74	16	2686	1206	6	986	1089	707	10	12
NRC allowances	3000	100	83	2000	1800	15	8000	1500	3000	15	150
% of allowances	73	74	19	134	67	40	12	73	24	67	8
% of subj. below allow.	89	85	100	48	81	100	100	77	100	88	100

* Figures in ( ) indicate number of subjects studied.

Classification of Averages of Nutrient Intake of Marshallese and Trukese Subjects in Relation to NRC Recommended Dietary Allowances

Table 25 gives the classification of averages of nutrient intake of 161 Marshallese subjects and 290 Trukese subjects in relation to NRC Recommended Dietary Allowances. Classification of average intake is given as percentage of NRC dietary allowances. The number of individuals in each group is given as percentage of subjects studied.

1. Calories: 4% of the Marshallese and 43% of the Trukese were in the 90 to 100% group. 18% of the Marshallese and 19% of the Trukese were in the 70 to 89% group in relation to NRC recommended allowances. 78% of the Marshallese and 38% of the Trukese were in the under 70% group.

2. Protein: 29% of the Marshallese and 52% of the Trukese were in the 90 to 100% group, and 27% of the Marshallese and 19% of the Trukese were in the 70 to 89% group. 44% of the Marshallese and 29% of the Trukese were in the under 70% group.

3. Fat: 3% of the Marshallese and 2% of the Trukese were in the 90 to 100% group; while 2% of the Marshallese and 3% of the Trukese were in the 70 to 89% group. 95% of both Marshallese and Trukese were in the under 70% group in relation to NRC recommended allowances.

4. Calcium: 2% of the Marshallese and 68% of the Trukese were in the 90 to 100% group; while 3% of the Marshallese and 7% of the Trukese were in the 70 to 89% group; and 95% of the Marshallese and 25% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

5. Phosphorus: 8% of the Marshallese and 36% of the Trukese were in the 90 to 100% group; 9% of the Marshallese and 20% of the Trukese were in the 70 to 89% group; while 83% of the Marshallese and 44% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

6. Iron: 42% of the Marshallese and 4% of the Trukese were in the 90 to 100% group; 20% of the Marshallese and 11% of the Trukese were in the 70 to 89% group; while 38% of the Marshallese and 85% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

7. Vitamin A: 13% of the Marshallese and 1% of the Trukese were in the 90 to 100% group; 3% of the Marshallese and 4% of the Trukese were in the 70 to 89% group; while 84% of the Marshallese and 95% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

8. Thiamine: 20% of the Marshallese and 46% of the Trukese were in the 90 to 100% group; 19% of the Marshallese and 17% of the Trukese were in the 70 to 89% group; while 61% of the Marshallese and 37% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

Table 25.

Classification of Averages of Nutrient Intake of Marshallese and Trukese in Relation to NRC Recommended Dietary Allowances.

Classification of Average Intake as Percentage of NRC Recommended Dietary Allowances. Number of Individuals in Each Group Given as Percentage of Subjects Studied.

	90 to 100 Percent		70 to 89 Percent		Under 70 Percent	
	Marshallese Percent	Trukese Percent	Marshallese Percent	Trukese Percent	Marshallese Percent	Trukese Percent
Calories	4	43	18	19	78	38
Protein	29	52	27	19	44	29
Fat	3	2	2	3	95	95
Calcium	2	68	3	7	95	25
Phosphorus	8	36	9	20	83	44
Iron	42	4	20	11	38	85
Vitamin A	13	1	3	4	84	95
Thiamine	20	46	19	17	61	37
Riboflavin	1	3	4	12	95	85
Niacin	58	34	20	21	22	45
Ascorbic Acid	7	1	3	3	90	96

9. Riboflavin: 1% of the Marshallese and 3% of the Trukese were in the 90 to 100% group; 4% of the Marshallese and 12% of the Trukese were in the 70 to 89% group; and 95% of the Marshallese and 85% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

10. Niacin: 58% of the Marshallese and 34% of the Trukese were in the 90 to 100% group; 20% of the Marshallese and 21% of the Trukese were in the 70 to 89% group; and 22% of the Marshallese and 45% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

11. Ascorbic acid: 7% of the Marshallese and 1% of the Trukese were in the 90 to 100% group; 3% of the Marshallese and Trukese were in the 70 to 89% group; and 90% of the Marshallese and 96% of the Trukese were in the under 70% group in relation to NRC recommended allowances.

DISCUSSION

Data for the Marshall Islands dietary study were collected during the period from January 18th through May 29th, 1951, while the data for the Caroline Islands study covered the period from June 27th through October 8th, 1951.

The diets of the people are influenced by the seasonal fruits and vegetables available, so this comparative study does not indicate the differences that exist between the dietaries for the whole twelve months period but shows only the differences or similarities during the seasons when these studies were undertaken. For a true comparison, the studies should be undertaken for a year period.

Marshall Islands is representative of a "low" island and the Caroline Islands, of a "high" island. "Low" islands are coral atolls and "high" islands are of volcanic origin. The supply and variety of vegetables and fruits differ on each of these islands.

The Marshallese of Majuro Village depended more on store goods for their source of food supplies. For example, rice, sugar, flour and canned goods were predominant in their dietary. Trukese of Udot depended on the sea and their vegetable crops for their existence. Fish, octopus, shellfish, breadfruit, bananas and coconuts were used in greater quantities.

Fish heads and fish bones were not as commonly used in the Marshallese diets while the Trukese took small fish (Musum), boiled them and ate the whole fish including heads, bones, and entrails. The bony structure of fish is high in calcium values and this is one of the reasons why the calcium intake was higher among the Trukese than the Marshallese. 68% of the Trukese were in the group which was 90 or 100% of the NRC recommended allowances, while only 2% of the Marshallese were in this group. 95% of the Marshallese were in the under 70% of NRC recommended allowances group.

For other differences in the diets, 43% of the Trukese were in the upper group for calories and only 4% of the Marshallese were in this group. 76% of the Marshallese were in the lowest group for caloric intake. It was breadfruit season in Udot and everyone had large quantities of "kon" to eat, while in the Marshall Islands the breadfruit season had not started.

For protein intakes, 52% of the Trukese were in the upper group for protein intake, while only 29% of the Marshallese were in this group. On Udot, the women of the village were responsible for fishing while the men of the village were responsible for "kon" making. Each day the women were out in the reef looking for shellfish or octopus. At least once a week, they fished in groups with their hand nets in the lagoon. About once in two weeks, the Chief's wife took all the available women of the village on the Chief's boat and they went out in the ocean to fish leaving their homes very early in the morning and returning very late at night. They came back with large amounts of fish, which they divided among the people of the village. Men did the fishing on Majuro, usually on Saturdays.

For phosphorus intakes, 36% of the Trukese were in the upper group and only 8% of the Marshallese were in this group. Usually foods that have calcium have phosphorus also, so that it often follows that when calcium intakes are low phosphorus intakes are also low.

For thiamine intakes, 46% of the Trukese were in the upper group, and only 20% of the Marshallese were in this group. For the Trukese, the large amounts of breadfruit eaten may account for the thiamine intake.

For iron and niacin intakes, Marshallese were in the upper groups.

Both the Trukese and Marshallese diets were low in fat, riboflavin, Vitamin A, and ascorbic acid.

Trukese did not include coconut sap in their diets as it was unlawful to tap coconut trees. This law was put in effect to curtail the making of fermented coconut sap liquor. Large quantities of coconut sap were used by the Marshallese.

The reasons for the existence of these deficiencies and how they may be remedied is discussed in the section under Recommendations Based on Dietary Studies in the Nutrition Study of the Marshall Islands.

SUMMARY

Seven-day dietary records of 157 Marshallese of Majuro Village, Marshall Islands and 290 Trukese of Udot, Truk District, Caroline Islands, from the age of one to 70 years of age were studied for daily quantities of calories, protein, fat, calcium, phosphorus, iron, Vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. These figures were then compared with National Research Council allowances. Tables are given with figures for average intakes, NRC allowances, percent of allowances, percent of subjects below allowances, for calories, protein, fat, calcium, phosphorus, vitamin A, thiamine, riboflavin, niacin, and ascorbic acid. Differences and similarities in the nutrient intakes of the Marshallese and Trukese

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