

THE NAGA EXPEDITION TO SOUTH CHINA AND AUSTRALASIAN SEAS 1959-1961

With Special Reference to the Participation of Claude and Jean ZoBell
Who Prepared this Report in February 1986

Scripps Institution of Oceanography
University of California, San Diego 92093

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Introduction.-- The Naga Expedition was a cooperative tripartite undertaking of U.S.A., Thailand, and Viet Nam to survey the hydrography and natural resources of the Gulf of Thailand and portions of the South China Sea adjacent to South Viet Nam. An important part of the project was to train native scientists and technicians in that area. The well-equipped 124-foot research vessel, the R/V *Stranger* as well as several smaller craft and land-based laboratories were used during the Expedition. James M. Faughn, a professional marine engineer, was a Project Officer, Captain of the ship, and Leader of the Expedition. The famous Danish oceanographer, Dr. Anton F. Bruun, was appointed Scientific Leader. More than a hundred scientists, seamen, officers, and trainees participated in the Expedition.

Although primarily a South China Sea and Gulf of Thailand expedition, a few participants traveled south to Thursday Island, Cape York, Queensland, Australia, for observations in and around Torres Strait and the Great Barrier Reef. They were members of the "Public Health" group, so-called because it was subsidized largely by the U.S. Public Health Service through the National Institute of Health. Jean and I were members of the "Public Health" group.

The R/V *Stranger* sailed from San Diego, California, 15 June 1959 and returned there 24 June 1961. The Expedition lasted much longer.

Birth of the Expedition.-- The Expedition was implemented early in 1958 by Dr. Roger R. Revelle, director of the Scripps Institution of Oceanography (SIO), University of California. He was also a member of the UNESCO International Advisory Committee on Marine Science. Revelle collaborated with Dr. Harold J. Coolidge who was executive director of the Pacific Science Board of the National Academy of Sciences. After conferring with government officials in Thailand and South Viet Nam, Dr. Revelle proposed sending an SIO ship to the South China Sea for three years for the dual purpose of collecting oceanographic information and to train Thai and Vietnamese technologists and scientists in hydrography, marine biology, and marine geology. All parties concerned, including the Regents of the University of California, agreed to a two-year tripartite expedition. It was named NAGA for the mythological sea serpent of Vishnu, worshipped as sacred by many Indo-Chinese tribes.

Through the International Cooperation Administration (ICA), the U.S.A. contracted for its part in the Expedition to be managed mainly by the SIO, University of California. The U.S.A. subsidized most of the cost (about \$500,000) via the Office of Naval Research (ONR), the National Science Foundation (NSF), and the U.S. Public Health Service (USPHS). Considerably less financial support was provided by general funds from the University of California and the George Vanderbilt Foundation (GVF) of Stanford University. The corporate GVF had facilities in Hawaii and also in the Bangkok district of Bangkok, Thailand. Laboratory accommodations, office space, and other shore facilities, including small boats, were provided by the Nhatrang Oceanographic Institute in South Viet Nam and by the Chulalongkorn University in Bangkok, Thailand. Other cooperating agencies included The Royal Thai Navy (hydrographic technicians, officers and petty officers to act as crew as well as scientific assistants and trainees), the Thailand Department of Fisheries (office and laboratory space), and the Australian CSIRO marine station on Thursday Island, Cape York, Queensland (for the "Public Health" group).

Personnel.-- Besides the masterminders mentioned above, others who had important decision-making responsibilities included:

Captain Amporn Penypol, Royal Thai Navy, Bangkok, Thailand
Mr. Boon Indrambarya, Department of Fisheries, Bangkok, Thailand
Rector Nguyen Quant Trinh, University of Saigon, Viet Nam
Dr. Le Van Thoi, University of Saigon, Viet Nam

Listed in alphabetical order on page 3a are most of those who participated for various periods of time in the Naga Expedition on the R/V *Stranger*. The following were aboard during Cruise S-6 from June 19-28, 1960:

James M. Faughn	Captain, Senior Engineer, and Chief Project Officer
Charles H. Smith	First Mate and Engineer
Louis J. Gonyea	Chief Engineer
Raymond M. Blei	Senior Laboratory Mechanician
John Van Landingham	Marine Chemist
Richard H. Greenbaum	Marine Technician
Tetsui Matsui	Marine Biologist
Claude E. ZoBell	Marine Microbiologist
Jean S. ZoBell	Laboratory Technician
Satcha Yongyuen	Thai Navy Officer
Lt. j.g. Cha-Erb	Thai Navy Officer
Thai cook and a steward	Names not available
Nguyen Dinh Bas	Vietnamese Trainee
Nguyen Van Luomi	Vietnamese Trainee
Tram Viet Quang	Vietnamese Trainee

Most of the crew members were rotated from cruise to cruise and served for different periods of time. With few exceptions, the membership of the crew that took the ship from San Diego to Bangkok (Thailand) via Honolulu, Guam, and Manila (a distance of 11,079 nautical miles) was quite different from the crew that brought the *Stranger* back to San Diego two years later. The return voyage of about 16,337 miles with stops in Darwin (Australia), Manila, Guam, and Hawaii required about three months.

According to Faughn (Naga Report, Vol. 1, p. 9, 1974), 58 of the 69 participants on the Expedition were from Thailand and Viet Nam. Of these, 16 made four or more cruises and were selected for four additional months of experience. They filled staff billets on board the *Stranger* during her return voyage to San Diego and spent two to four weeks at SIO before returning home. Thus, these 16 were gaining experience in the marine sciences for periods of 12 to 24 months.

The following participants on the Naga Expedition were members of the "Public Health" group:

Mr. Walter Gary,	Science Teacher, La Jolla High School
Dr. Malcolm Gordon	Instructor in Zoology, UCLA
Mrs. Diane Gordon	Musicologist, Los Angeles
Dr. Harold T. Hammel	Asst. Prof. Physiology, University of Pennsylvania
*Dr. Francis T. Haxo	Assoc. Prof. Biology, SIO
Mr. Edward Hemmingsen	Graduate Research Biologist, SIO
Mr. Hamilton Kelly	Research Assistant Zoology, UCLA
Mr. Roy E. King	Research Assistant Zoology, U.C. Berkeley
Dr. Knut Schmidt-Nielson	Prof. Zoology, Duke University
*Dr. Per F. Scholander	Prof. Physiology, SIO
Dr. Beatrice Sweeney	Asst. Research Biologist, SIO
*Dr. Claude E. ZoBell	Prof. Marine Microbiology, SIO
*Mrs. Jean S. ZoBell	Laboratory Technician, Microbiology, SIO

Those whose names are marked with an asterisk (*) did work on the *Stranger*.

Participants in the Naga Expedition on the RV *Stranger* were:

Ba, Nguyen Van	King, M.	Scholander, Dr. Per F.
Banasopit, Thien	Knudsen, Dr. Jorgen	Sdubbundhit, Lt., j.g. Cha-Erb
Banner, Christopher	Llarco, M	Serene, Dr. Raoul
Blei, Raymond M.	Loi, Tran Ngoc	Shipek, Carl J.
Bolin, Dr. Rolf	Luom, Nguyen Van	Smith, Charles H.
Boonlapo, Bhaisai	Matsui, Tetsui	Smelser, Clifford E.
Boonma, Bunya	Mero, Dr. John	Songnark, Jumngong
Boonyuen, Vicharn	Miller, Capt. Frank	Sripajumpiya, Bhaisai
Brinton, Dr. Edward	Mingmitra, Chamnarn	Srivirojna, Lt., j.g. Amnuay
Bruun, Dr. Anton Fr.	Moodharasint, Kosol	Subagjo
Buphavesa, Chaiyos	Muus, D.	Suboon, Lt., j.g. Anan
Calvert, Stephen	Nam, Sompong Mim	Sunpanich, Thumnoon
Chaitiamwong, Supachai	Nam, Tran Dinh	Suwanarit, Prachuab
Chalernpol, Lt. Cmndr. Sawang	Na-Nagara, Yong Yudh	Tanthikul, Soontorn
Chamsuksai, Bundith	Nhon, Tran Dai	Thien Tu Trinh
Chomsukprakit, Bhinyo	Nugulrak, Likit	Thompson, Robert W.
Clampitt, Clanton W.	Onnom, Songsukdi	Trac, Cao Xuan
Curray, Dr. Joseph R.	Pankasem, Narong	Tu, Tran Van
Debananda, Lt. Sg. Chuta	Penyapol, Capt. Amporn	Ucharatana, Chavalit
Faughn, Capt. James L.	Phoonsavad, Sompong	Vajrasthira, Chai
Gallardo, Ariel	Pinyoying, Sujet	van Andel, Dr. Tj. H.
Gonyea, Louis J.	Pirmoi, Sathuen	Van LANDINGHAM, John W.
Greenbaum, Richard H.	Piyakarnchana, Twesukdi	Varothai, Siri
Hai, Nguyen	Potibutra, Wong	Veevers, J.J.
Haxo, Dr. Francis T.	Prakitsri, Rangsarit	Villarta, R.
Hongkolohandha, Ens. Suchat	Quang, Tran Viet	Wooster, Dr. Warren S.
Hoodharasint, Kosol	Sach, Nguyen Van	Worawoothi, Pasok
Indrambarya, Kanok	Saichua, Pairat	Yamsri, Chala
Jacobs, William S.	Sainampuurg, Boonsong	Yuenyong, Satcha
Kasijan	Saisithi, Prasert	ZoBell, Dr. Claude E.
Khang, Nguyen Duc	Saomain, Asani	ZoBell, Mrs. Jean S.

In addition to cruise participants were those specialists who came to Southeast Asia to give instruction in their respective fields or to give special laboratory or cruise-planning assistance: Dr. Theodore Chamberlain, Professor Eugene La Fond, Mrs. Margaret K. Robinson, Dr. Douglas L. Inman, Dr. Robert Parker, jr., Mrs. Marcia Rottman, Dr. Garth Murphy.

Members of the George Vanderbilt Foundation in Bangkok were: Dr. Adair Fehlmann, Mr. Herbert Frey and Dr. R. R. Rofen.

The R/V *Stranger*.-- This 325-ton 123-foot long yacht had a beam of 24 feet, a draft of 15 feet, a speed of 12 knots, and a cruising range of 6,000 miles. She was powered by two 400-horsepower (each) Washington diesels. She was built in 1938 in Seattle for a wealthy Wyoming rancher, Fred Lewis, who owned a small island off the coast of British Columbia. Despite her having 60 tons of lead ingots on her keel, the *Stranger* had a reputation for rolling in rough seas.

After being obtained in 1955 by the University of California for use as a research vessel for the Scripps Institution of Oceanography, she was refitted as such and called the R/V *Stranger*. Her trawl winch was outfitted with 7,000 meters of new 3/8-inch braided wire rope. Two reels of 3/16-inch hydrographic wire were aboard for Nansen bottles, small plankton nets, J-Z bacteriological samplers, gravity corers, bathythermographs (BTs), and other small gear. Her rather crowded laboratories were conveniently located amidship immediately behind the bridge. The *Stranger* could accommodate a crew of 14 and 10 scientists.

Having carried aboard our portable laboratory for field work, Jean and I were able to collect and analyze water and bottom sediment samples during most kinds of weather. We had a cabin located forward with one bunk beneath the other and both below sea level. It was comfortable enough except during rough seas such as we experienced sometimes on Cruise S-6 (see p. 7a) during the monsoon season between 19 and 28 June 1960 when we were working at Hydrographic Stations 29 to 42 located up to 250 miles offshore between 5 and 10° N. Latitude. Much of the time the ship's inclinometer was indicating a roll angle of 10 to 45 degrees.

Despite much rolling during storms, none of the *Stranger's* crew members or scientists (see p. 3), including the ZoBells, were afflicted with mal de mer. None of us missed a meal or lost one. Excessive rolling tended to retard manual manipulations, including walking, but not enough to result in our skipping a scheduled station. At its worst, excessive rolling thwarted sound sleep. Side boards helped to keep one from rolling out of one's bunk, but the side boards abraded one's elbows. All of the Vietnamese trainees on Cruise S-6 (see p. 3) were confined to their bunks or otherwise suffered seasickness during foul weather.

Track of the *Stranger*. -- The westward voyage of the *Stranger* from San Diego, California, to Bangkok, Thailand, was not part of the routine survey. The distances traveled on each westward leg of the voyage are given below in nautical miles:

<u>Dates (1959)</u>	<u>Leg of voyage</u>	<u>Miles</u>
June 15-29	San Diego to Honolulu	2,427
July 3-21	Honolulu to Guam	3,526
July 24-Aug. 8	Guam to Manila, P.I.	2,810
Aug. 3-17	Manila to Nhatrang, Viet Nam	,718
Aug. 19-24	Nhatrang to Sattahip, Thailand	1,530
Aug. 28	Sattahip to Bangkok, Thailand	68
	Total nautical miles	11,079

Sattahip is a Thai Naval Base near Bangkok. Exploratory geological investigations, concerned mainly with deep-sea manganese nodules, were made only on the first leg from San Diego to Honolulu. Net tow, hydrographic, BT, and certain other observations were made only occasionally on the voyage from San Diego to Bangkok primarily to test the ship's equipment.

The first student training cruise was in the northern Gulf of Thailand, September 8-17, 1959. It was followed by the first scientific survey cruise (S-1). Odd-numbered cruises (S-1, S-3, S-5, S-7, S-9, and S-9A) designate Gulf of Thailand surveys. Even-numbered cruises (S-2, S-4, S-6, S-8, and S-10) designate South China Sea surveys. In the latter, the *Stranger* departed from Bangkok and put into port at either Nhatrang or Saigon. Hydrographic stations were

numbered consecutively by cruises, e.g., S-1-1 designates hydrographic station No. 1 on cruise S-1, and S-6-37 designates hydrographic station No. 37 on cruise S-6 (for examples see page 7a). Stations made enroute to pattern area are designated U to indicate underway.

The cruise pattern for the South China Sea consisted of stations aligned along six lines almost perpendicular to the eastern coast of South Viet Nam, extending from near-shore to approximately 250 miles off-shore. The northernmost line ran due east-west at latitude 15°40' N. The southernmost line veered south until it was almost parallel with the eastern shore of the Gulf of Thailand. The remaining lines were spaced at approximately 100-mile intervals. Along each line, hydrographic stations were spaced about 40 miles apart.

Sea miles as follows were traveled by the R/V *Stranger* on each of the Naga cruises in southeastern Asian waters and while homeward bound to San Diego. The first ten cruises started and terminated at Bangkok, Thailand. Cruises S-11A, B, C, D, and E were from Bangkok to San Diego via Darwin (Australia), Manila, (P. I.), Guam, and Hawaii.

<u>Cruise</u>	<u>Region or area</u>	<u>Dates</u>	<u>Distance</u>
S-1	Gulf of Thailand	October 19-31, 1959	1,885
S-2	South China Sea	November 16-30, 1959	3,200
S-3	Gulf of Thailand	January 9-31, 1960	2,000
S-4	South China Sea	February 15-March 21, 1960	3,500
S-5	Gulf of Thailand	April 21-May 3, 1960	2,063
S-6	South China Sea	May 23-June 28, 1960	3,697
S-7	Gulf of Thailand	August 2-15, 1960	2,021
S-8	South China Sea	September 5-October 8, 1960	3,586
S-9	Gulf of Thailand	November 9-25, 1960	2,024
S-9A	Gulf of Thailand	December 8-14, 1960	698
S-10	Gulf & S. China Sea	January 10-February 13, 1961	3,130
Total miles			27,804
S-11A	Bangkok to Darwin	March 15-April 21, 1961	6,331
S-11B	Darwin to Manila	April 13-May 3, 1961	1,870
S-11C	Manila to Guam	May 6-20, 1961	2,183
S-11D	Guam to Hawaii	May 23-June 10, 1961	3,671
S-11E	Hawaii to San Diego	June 13-26, 1961	2,282
Total miles from Bangkok to San Diego (eastbound)			16,337
San Diego to Bangkok (westbound)			11,079
Total miles traveled by the R/V <i>Stranger</i> on the Naga Expedition			55,220

Naga Cruise S-11. -- This was the last cruise of the *Stranger* on the Naga Expedition. The voyage consisted of five legs designated S-11A, B, C, D, and E. Naga Cruise S-11A departed from Bangkok on March 15, 1961. The ship sailed southeasterly out of the Gulf of Thailand and then through the South China Sea and the Sunda Strait into the Indian Ocean. There she proceeded eastward parallel to the south coast of Java (Indonesia) and the Lesser Sunda Islands into the Timor Sea to Port Darwin in northwestern Australia (see page 5a). The small marks on the track show where routine BT observations were made. The zig-zag tracks in the bottom right-hand corner of the chart on page 5b show a continuation of Cruise S-11A for a couple of weeks from and back to Darwin for observations in the Timor and Arafura Seas.

After two more days in port at Darwin, the *Stranger* started on Cruise S-11B. She sailed north by northeasterly to Manila, P.I., via the Timor Sea, Banda Sea, Malukka Sea, Celebes Sea, Sulu Sea, and the eastern side of the South China Sea. This was the last of the Naga Expedition cruises on which routine hydrographic, biological, chemical, and geological observations or collections were made. Only routine BT observations and infrequent stramin tows (indicated by small squares on page 5b) were made on Cruises S-11C, D, and E. between Manila and San Diego.

Fig. 5a.-- Naga Cruise S-11A and S-11B. Cruise S-11A was from Bangkok southward into the Indian Ocean through the Sunda Strait, then eastward to Darwin, Australia (Station V-165). S-11A continued for two weeks from Darwin into the Timor and Arafura Seas and back to Darwin before beginning S-11B from Darwin northward through the Sulu Sea to Manila, P.I.. Reprinted from James L. Faughn, "Naga Expedition: Station Index and Data," Naga Report Vol. 1, p. 118, Scripps Institution of Oceanography, University of California, San Diego, 1974.

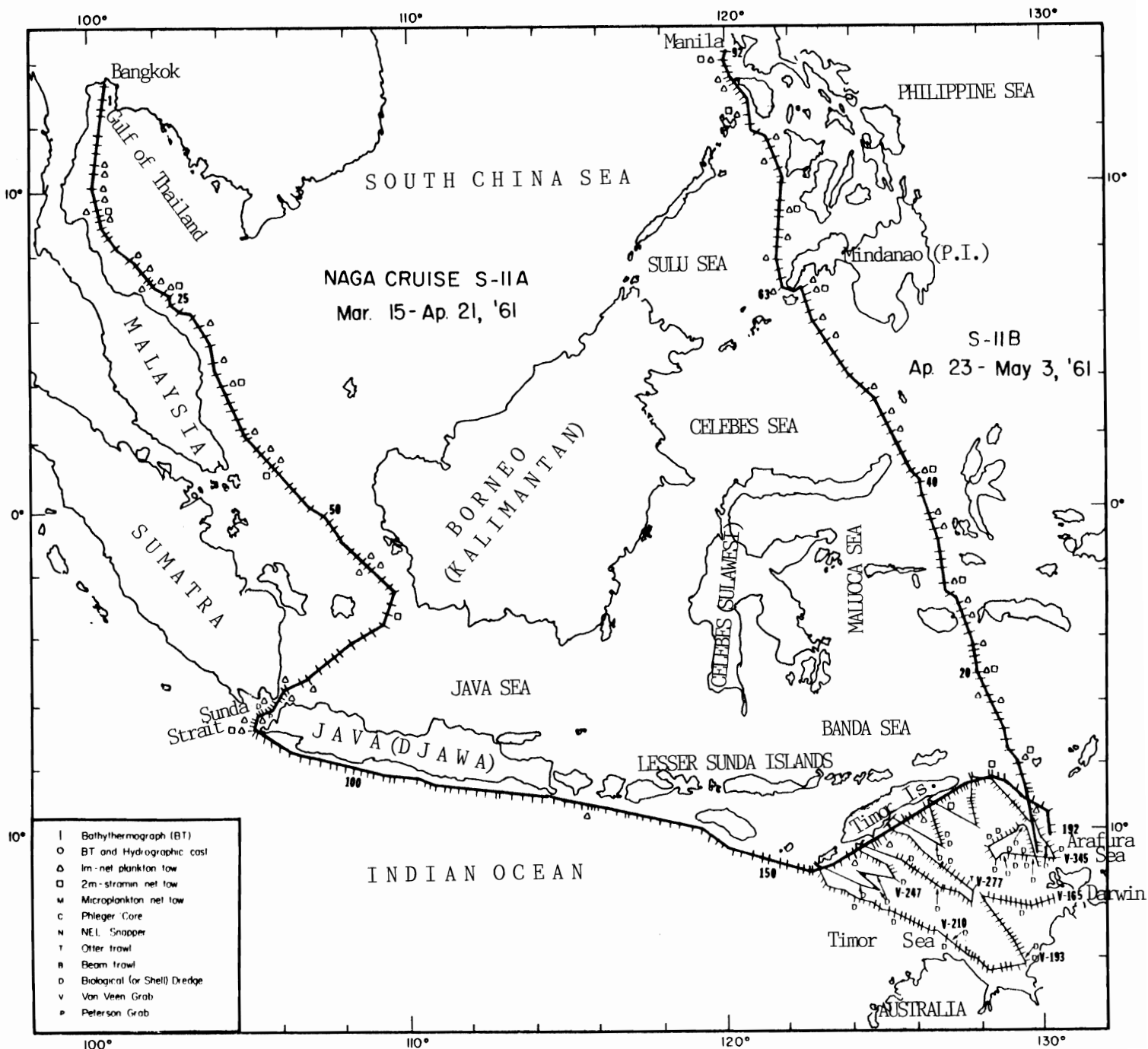
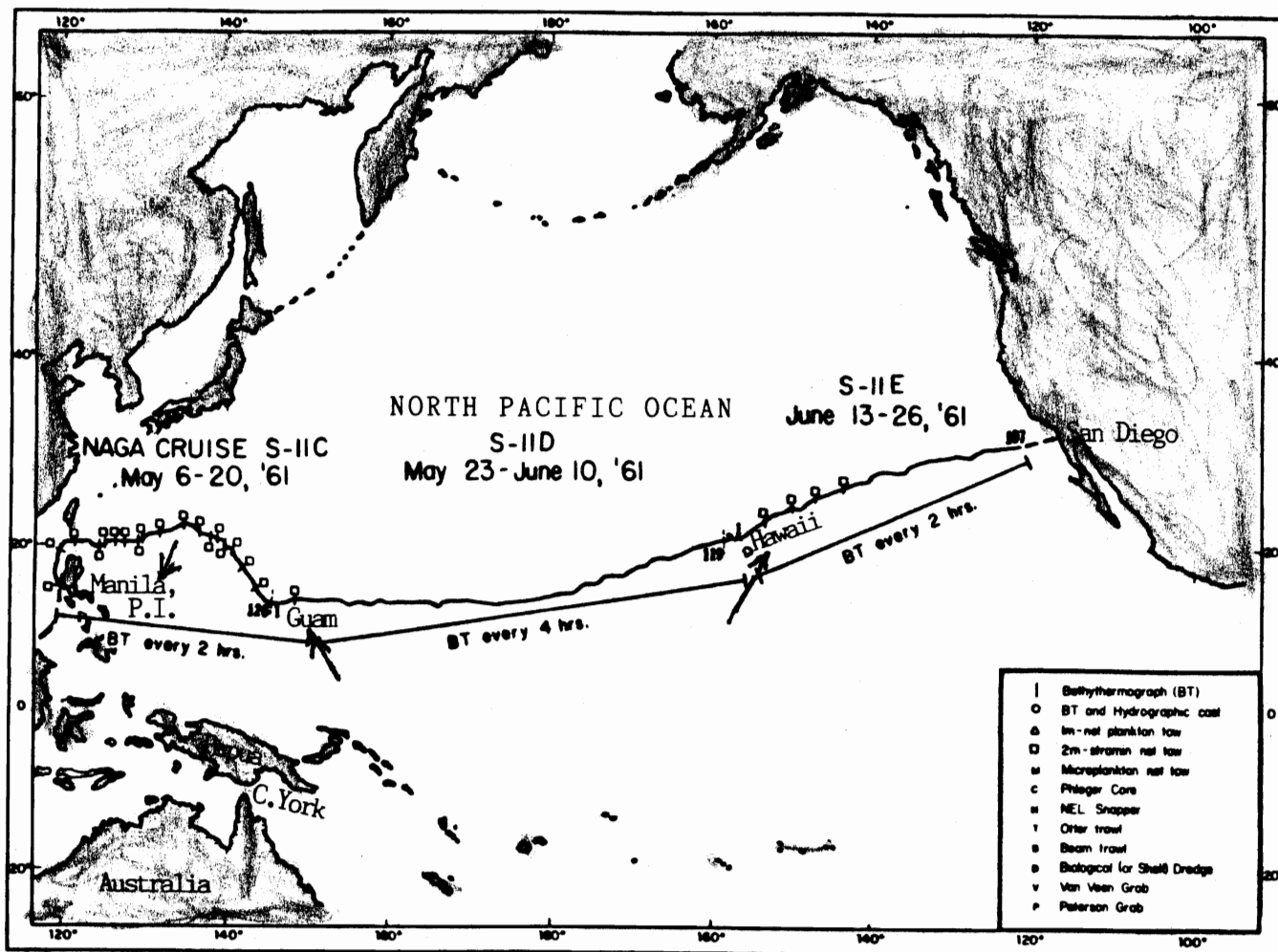


Fig. 5b.-- Naga Cruise S-11C, D, and E from Manila, P.I., to San Diego, Calif., via Guam and Honolulu, Hawaii. Reprinted from James L. Faughn, "Naga Expedition Station Index and Data," Naga Report, Vol. 1, p. 119, Scripps Institution of Oceanography, University of California, San Diego, 1974.



Ocean Hopping to Southeast Asia.-- Except for the few who traveled on the *Stranger*, Expedition participants were obliged to obtain other means of transportation to Southeast Asia. Jean and Claude Zobel traveled overseas by Pan American Airlines to Saigon, South Viet Nam. We departed from San Diego late in the day on May 26, 1960, enroute to Honolulu via Los Angeles. We stopped for six nights in Tokyo from which we made side trips by rail to Shizuoko, Yokohama, and Kamakura, primarily to visit former students and visiting investigators. We lost a day crossing the International Date Line between Honolulu and Tokyo. The plane schedule obliged us to stop overnight in Hong Kong where we had bed and board in the Peninsula Hotel on Kowloon. It was only a three-hour flight from Hong Kong to Saigon. There the Naga Expedition officers had made arrangements for our being accommodated in Hotel Majestic for four days, June 4-7, 1960.

Hotel Majestic was located beside the Saigon River not far from the port where the *Stranger* sometimes docked. It was within easy walking distance of the U.S.A. Officer's Club (called The Brink), the Railroad Station, the National Museum, the Saigon University campus, the Pasteur Institute, the South Viet Nam Division of Fisheries, and several other places of interest.

Our first rendezvous with other members of the Naga Expedition was in Hotel Majestic. Also stopping at the Majestic Hotel were Pete Scholander, Francis Haxo, and Roy King. The latter was a young Research Assistant Zoologist from the University of California, Berkeley. Professors Scholander and Haxo were SIO marine biology professors. These three, like Jean and I, were enroute to the Institut Océanographique in Nhatrang, one of the principal cooperating agencies for the Naga Expedition.

To Nhatrang and Back to Saigon.-- Drs. Haxo and Scholander, and Roy King departed from Saigon by train enroute to Nhatrang on June 7. This was about a 10-hour trip of some 250 miles along the east coast of South Viet Nam. The Zobel's elected to fly to Nhatrang in a Vietnamese Air Force plane. We had learned from a casual conversation with a U.S. Military Advisor at The Brink that such training planes made daily flights between Saigon and Nhatrang. The ONR card that Claude carried was accepted by the U.S. Military Advisor in charge of MATS (Military Air Transport) transportation and we were cleared for the training flight.

Before dawn on June 8, we were picked up at the Majestic Hotel by a military Jeep and driven through the dark streets of Saigon to the Tan San Nhut airport, passing through its heavily guarded gates in dawn's earliest light. We were escorted to our bucket seats aboard the plane. As the crew came on board, we were somewhat surprised to see that the pilot, co-pilot, and navigator were all Vietnamese. The U.S. Military Advisor, a sergeant, remained in the middle of the plane with us. After a short hop, the plane landed at an airstrip. We climbed out of the plane hoping to find some sanitary facilities, but discovered that the airstrip was little more than an open field surrounded by armed guards posted about a hundred meters apart. The flight soon continued on to Nhatrang.

Pete Scholander and Francis Haxo met us at the Nhatrang airport. In the Expedition Jeep, they drove us to the Institut Océanographique, where our party was housed in the Institute dormitory. We were welcomed by Mr. Nguyen Dinh Hung. We also met and later worked with Mr. Nguyen Hai and Mr. Ngoc Loi (jokingly referred to as Mr. High and Mr. Low). They showed us through the laboratory and library. The library shelved about a thousand volumes, most of which were textbooks and reports from other biological stations. Conspicuous were several paper-bound volumes of the SIO Contributions. I was pleased to see two copies of my "Marine Microbiology" shelved beside a well-worn copy of "The Oceans" by Sverdrup, Johnson, and Fleming.

Across the road from the Institute was a French restaurant, Chez François. François was a Frenchman who remained in South Viet Nam after the withdrawal of the French military forces in 1956. He was married to a North Vietnamese woman. The restaurant was clean and the food so good that we ate our meals there during our stay in Nhatrang. It specialized in fresh fish, crab, lobsters, and shrimp, and French cheeses and wines. François made delicious omelets.

On June 9, Capt. Jim Faughn escorted Pete Scholander, Francis Haxo, Roy King, and the Zobel's on an all-day reconnaissance cruise aboard the *Stranger*. We sailed around Hon Ngoai, Hon Lon, and Hon Mung Islands and fishing banks in Nhatrang Bay.

Not until June 13 was our "portable water laboratory" delivered to us by a South Viet Nam customs officer. It had been shipped to us a couple of weeks earlier from La Jolla by military air express. It was a 26 x 12 x 16-inch acrylic-coated fiber-glass box that weighed about 27 kg (60 lb) when loaded with Isopor membrane apparatus, six dozen Isopor filters, two dozen pipettes, six dozen small test tubes, sterilizing equipment, vacuum pump, a hundred small plastic Petri dishes and receptacles for their sterile storage and incubation. The portable laboratory could be assembled in a field or research laboratory in about 20 minutes and packed for transportation almost as rapidly. We used it on the *Stranger*, in hotel rooms, on an outboard motorboat, and elsewhere in the field.

The first entry made in my field notebook records on June 13, "Portable lab received at 3:00 p.m. from Viet Nam customs officer. Made tests on filtered dormitory drinking water." After 24 hours' incubation at 37°C, presumptive tests for enteric bacteria were positive, four-plus for *E. coli*.

During our two remaining days in Nhatrang (June 14 and 15), we examined 38 water samples for the presence of enteric bacteria of sanitary significance. Included in this quick survey were samples of drinking water from various places, melted ice water, "filtered" water, iodized water, and seawater collected from the beach and bay in the vicinity of the Institut, Chez François, and residences along the coast where raw untreated sewage flowed along the beach and into the bay. Demonstrating and employing such methods was one of my assignments from the U.S. National Institutes of Health (NIH).

On June 16, we returned from Nhatrang by commercial plane to Saigon. There we were lodged again in Hotel Majestic. That evening, Dr. Per Scholander treated the Public Health group and Jim Faughn to an escargot (snail) dinner in a fancy French restaurant. As is customary, the snails were served in the shell with a delicious sauce.

The following afternoon (June 17), we had a conference at Saigon University. The conference was arranged by Mr. Nguyen Dinh Hung and Rector Nguyen Quang Trinh. Besides these two, our Public Health Group, Capt. Faughn, and officers of the Pasteur Institute and the Thai Department of Fisheries participated in the conference along with Capt. Amporn Penypol, Royal Thai Navy Hydrographic Office, Bangkok. All seemed to be going well as the Naga Expedition approached its midway point.

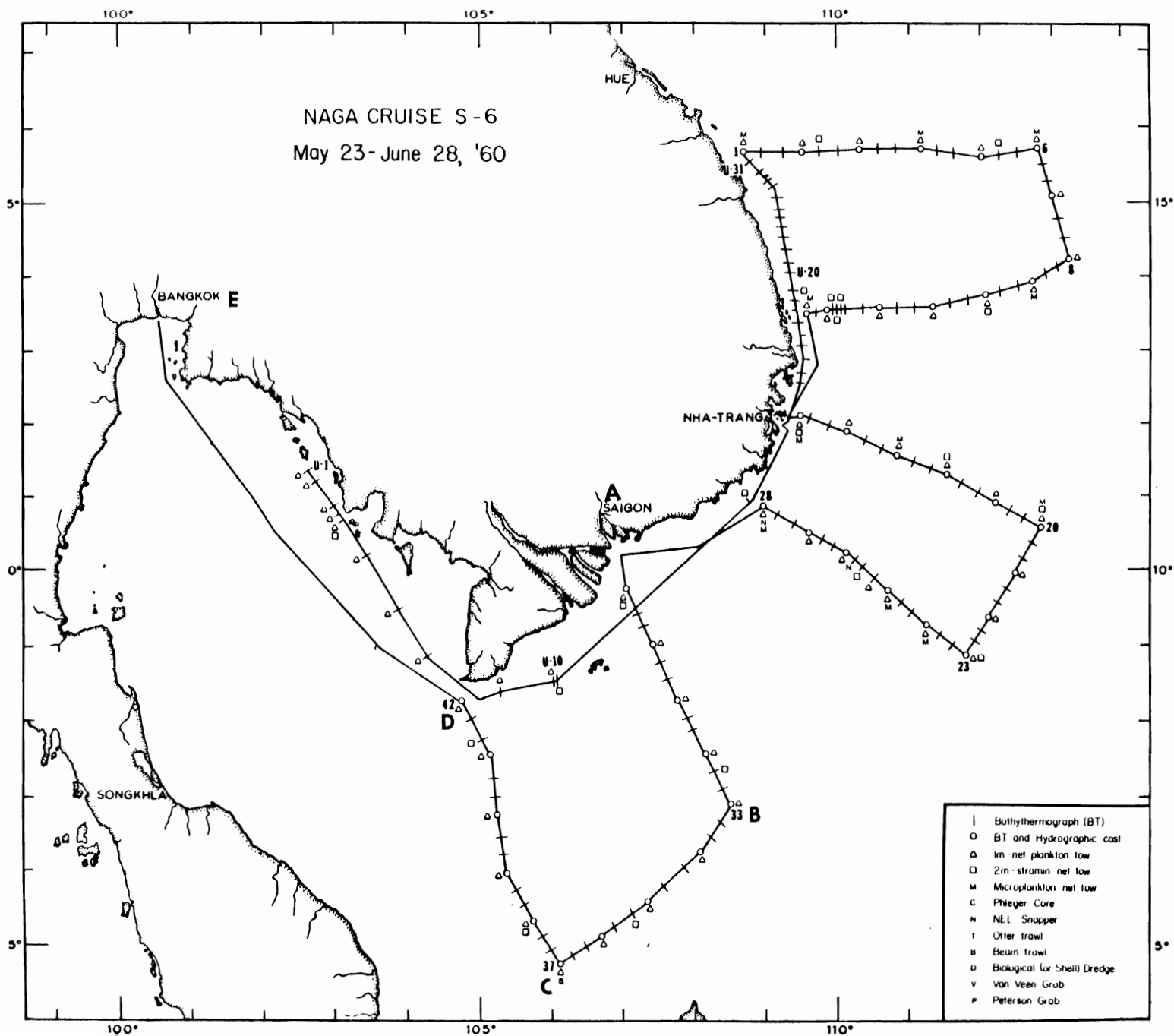
After having retrieved our passports the day before, we were cleared to exit Viet Nam on Sunday, June 19. We boarded the *Stranger* at 8:30 a.m. and began the trip down the Saigon River shortly afterwards. This was the beginning of Cruise S-6 for us.

Our Participation on Naga Cruise S-6. -- The return leg of Cruise S-6 is charted on page 7a. The R/V *Stranger* and her performance at sea have been discussed on page 4 and her personnel on Cruise S-6 on page 3. The ZoBells boarded the *Stranger* on June 19 in Saigon. She sailed down the Saigon River and out about 248 miles southwesterly in the South China Sea to station No. 33 (see page 7a). There the ship turned southeast for about 230 miles to Station No. 37, where she turned 90 degrees northward and continued 278 miles north northeast to station No. 42.

Hydrographic stations were occupied every four hours day and night on our 660-mile cruise from Saigon to station No. 42. The details are recorded in the Log of the *Stranger* (shelved behind locked doors in the SIO Library) and in the "Naga Expedition: Station Index and Data" by James M. Faughn, Vol. 1, p. 177, 1974 (SIO call number GC 5 N 147).

The ZoBells aseptically collected and examined by cultural methods 156 samples of water from 24 stations in the South China Sea. They collected these samples from near the surface, at depths of 10 to 20 meters, and from about one meter off the bottom (depth 30 to 90 meters). The water samples were examined for the abundance of bacteria and yeasts. Some of the data and their oceanographic significance were summarized by ZoBell in a lecture at a joint meeting of the Microbiological Society of Thailand and the Pasteur Institute in Bangkok, July 1, 1960. (See his paper, "Marine Microbiology with Notes on Bacteria in the South China Sea," Jour. Microbiol. Soc. Thailand, Vol 5:361-368, 1961.)

Fig. 7a.-- Claude and Jean ZoBell boarded the R/V Stranger at Saigon (A) and sailed 248 miles southeast to Station 33 (B), then 230 miles southwest to Station 37 (C), 278 miles northwest to Station 42 (D), and finally about 500 miles northwesterly to Bangkok (E), a total of 1255 miles. Reprinted from Naga Report, Vol. 1, page 112, 1974.



laboratory shared with Tets made it necessary for me to have some friendly conversation with him concerning the incompatibility of formaldehyde (commonly used to preserve fish and certain other marine animals) with marine microbes that microbiologists strive to keep alive.

Our Activities in Bangkok, Thailand. -- After completing Cruise S-6 at Station No. 42, we headed for Bangkok, a voyage of nearly 420 miles through the Gulf of Thailand and into the Chao Phraya River. The *Stranger* docked at the Police Dock in Bangkok on Tuesday, June 28. Jean and I simply walked off the ship and took a taxi to Hotel Playa. That proved to be a mistake inasmuch as by doing so, we had not legally entered Thailand. To correct this mistake, we had to appear before Thai immigration authorities. After several anxious hours, through the good offices of Capt. Jim Faughn, our passports were stamped to show that we had legally entered Thailand.

We were warmly welcomed by several faculty members at Chulalongkorn University and the Queen Saovabha Institute. Among those with whom we conversed were Choelon Purananda, Kloom Vejarabala, Twesukdi Peyakarnchans, and Jinda Thiemmedk. All of these were teaching microbiology, mainly medical and sanitary microbiology, with not much original research. They invited me to give a lecture on marine microbiology. I also gave a talk at the Pasteur Institute of Thailand and the Thailand Society for Microbiology. The latter elected me to honorary life membership. Most of the members seemed to be strongly oriented towards problems of public health and infectious diseases.

We were then taken to the Thailand Venomous Snake Farm and Research Institute located on the outskirts of Bangkok. For our benefit, attendants demonstrated the "milking" of four different kinds of venomous snakes said to be common in Thailand. The venom is used to produce anti-venom for the treatment of snake bites.

On several occasions, Dr. Edward Brinton was our host. Ed specializes on euphausiid crustaceans at SIO. He was spending a year with his family in Bangkok where he was serving as a liaison officer for the Naga Expedition. In close collaboration with the Rector of Chulalongkorn University, Ed directed expedition work in the University laboratory dealing with the biological field collections after each cruise of the *Stranger*. As a staff scientist, Ed also accepted teaching assignments, attended seminars, and participated in the final field cruises. He escorted Jean and me on a half-day boat ride on the Chao Phraya River and some of the adjoining klongs (canals) and to the Wat Trimitra in which the Golden Buddha is housed. It is said to contain eight tons of solid gold.

As permitted by our schedule, on our own we visited the Royal Palace Gardens, the famous Emerald Buddha at Wat Pra Kaew, the Reclining Buddha at Wat Po, and the Gallery of 1000 Buddhas. We were also intrigued by the numerous water markets, Thai handicraft factories, klongs, and city parks.

Bangkok to Cairns via Singapore and Brisbane. -- Our carefully planned itinerary called for our departing from Bangkok at 5:00 p.m. on July 3 with dinner to be served enroute to Singapore. However, owing to the delayed arrival of our flight, on-going passengers had dined before the plane arrived in Bangkok. Passengers like Jean and me who boarded the plane in Bangkok were informed that there would be no food served enroute to Singapore. The flight from Bangkok to Singapore, located nearly a hundred miles north of the Equator, was about 900 miles. It was nearly midnight when we arrived at the Cockpit Hotel in Singapore, too late for dinner.

We celebrated the 4th of July exploring Singapore. We were amazed by the polyglot population and by the seemingly endless packs of Chinese junks occupying so much space in the waterways. Tempting were the omnipresent open-air food stands lining the streets in midtown Singapore.

We spent most of July 5 walking around the famous Singapore Botanical Gardens, best known for the great variety of plants, attractive landscape architecture, and numerous unrestrained monkeys frolic about through the trees and on the ground. We checked out of the Cockpit Hotel and spent the remainder of the day at the Raffles Hotel, waiting for our 8:30 p.m. departure for Sydney, Australia, a distance of 4300 miles. There was snow on the ground in Sydney, it being midwinter there. We were grateful that our stop was brief, inasmuch as we arrived there dressed for the tropics. From Sydney we flew to Brisbane, some 450 miles to the north, where it was much warmer.

While in Brisbane, we visited several scientists, some of whom I had met in October 1951 while on the *Galathea* Round-the-World Deep-Sea Expedition. These friends included Dr. I. M. Mackerras, director of the Queensland Institute of Medical Research, and the following staff members of the University of Queensland: Dr. Edward Derrick, who discovered Q (for query) fever, Dr. V. B. Skerman, Dr. George T. Stevenson, and Dr. Dorthea Sanders. The latter took us for a long trip in the country on Sunday, July 10.

Early Monday morning, Ansett flight No. 104 took us to Cairns (see page 9a), a small coastal town on the northeast side of Queensland about 500 miles southeast of Thursday Island and 900 miles northwest of Brisbane. We were lodged for three nights in Cairns at the Palace Hotel.

While at Cairns, we took a four-hour tour of the Atherton Tablelands, a scenic volcanic plateau rising two to three thousand feet above sea level a few miles west of Cairns. Its chief attractions are its rain forest, fertile fields, two crater lakes, and other geological features.

The Green Island tour, taken the next day, is popular with tourists, particularly marine biologists. It is a coral cay near Cairns on the inner (western) edge of the Great Barrier Reef. It is one of the closest and most accessible of the true coral cays. Its special attraction is an underwater clear glass observatory about 3 meters high, 3 meters wide, and 20 meters long. A walk through the passageway provides a spectacular view of corals, fish, and many other kinds of organisms in their natural habitat (see page 9b).

Cairns to Thursday Island, Australia. -- Appropriately enough, the ZoBells took an Ansett plane from Cairns to Horn Island and there a water taxi to Thursday Island on Thursday, July 14. These two Torres Strait islands are located about 500 miles north by northwest from Cairns at 10°34' S. Lat. In 1960 the taxi fare from Horn Island to Thursday Island (T.I.) was five shillings per person or about 60 cents. As shown on page 9c, T. I. is closely surrounded by Prince of Wales I., Friday I., Hammond I., and Wednesday I. The latter is 3 3/4 miles northeast of T.I.; the other three islands are only about a mile from T.I. At the narrowest point, T.I. is only two-thirds of a mile from the 12 square mile Horn Island, which had the only airfield in the area.

The other members of the Public Health group arrived in Cairns from Brisbane July 8, three days before the ZoBells. At that time this group consisted of Pete Scholander, Francis Haxo, Edvard Hemmingsen, Harold Hammel, Walter Gary, Beatrice Sweeney, and H. G. Le Messurier, Professor of Aeromedical Biology from the University of Adelaide, Australia. With the approval of all concerned, a 50-foot long motor vessel, the *Tropic Seas*, was chartered for a few weeks from Vince Vlasoff. He served as Captain and pilot. The ship had a beam of 13 feet, a draft of 6 feet, a speed of 7 knots, and a cruising range of 1500 miles. She carried a motor boat, a dinghy, a 2-way radio, and a 60 cubic-foot refrigerator. Her charter charge in 1960 was £24 (\$52.80) per day plus 16 shillings (\$1.75) per person for food.

The plan to have all of the Public Health group live aboard the *Tropic Seas* proved to be impractical, partly because of insufficient space to accommodate nine scientists and their gear, and also because the *Tropic Seas* made frequent overnight or longer trips to the pearl diving areas and to the Jardine River to study mangroves at the northern end of Cape York.

Drs. Haxo and Sweeney and the ZoBells resided in the Federal Hotel. It was somewhat less than first class, but it was the only hotel of the four on T.I. that had indoor plumbing. The other three had outhouses or "Chick Sales." The best double room, with full board, was only £12 or \$27 per week at the Federal Hotel.

Dr. Stan Hynd, the chief scientist at the CSIRO Department of Fisheries on T.I, provided acceptable laboratory and office space for Drs. Haxo and Sweeney in the main CSIRO laboratory located only a short distance southwest of the Federal Hotel. The ZoBells were given the use of a very well equipped 14 x 20-ft laboratory located at the end of the 600-ft Navy Wharf, about two-thirds of a mile from the Federal Hotel. The laboratory was available because the Japanese scientist who worked there on culturing pearls was away on extended leave. Thanks to our portable water laboratory, we were prepared to commence our microbial culture work almost immediately with very few innovations or acquisitions.

Fig. 9a.-- Principal islands in the Coral Sea off the east coast of Queensland, Australia, from Cooktown to Rockhampton near the Tropic of Capricorn. The black arrow points to the location of Cairns and Green Island. Brisbane is about 500 km (about 300 miles) south southeast of Rockhampton. (One inch = 100 miles). Reprinted from Douglass Baglin and Barbara Mullins, "Islands of Australia," Ure Smith, North Sydney, Australia, 1972.

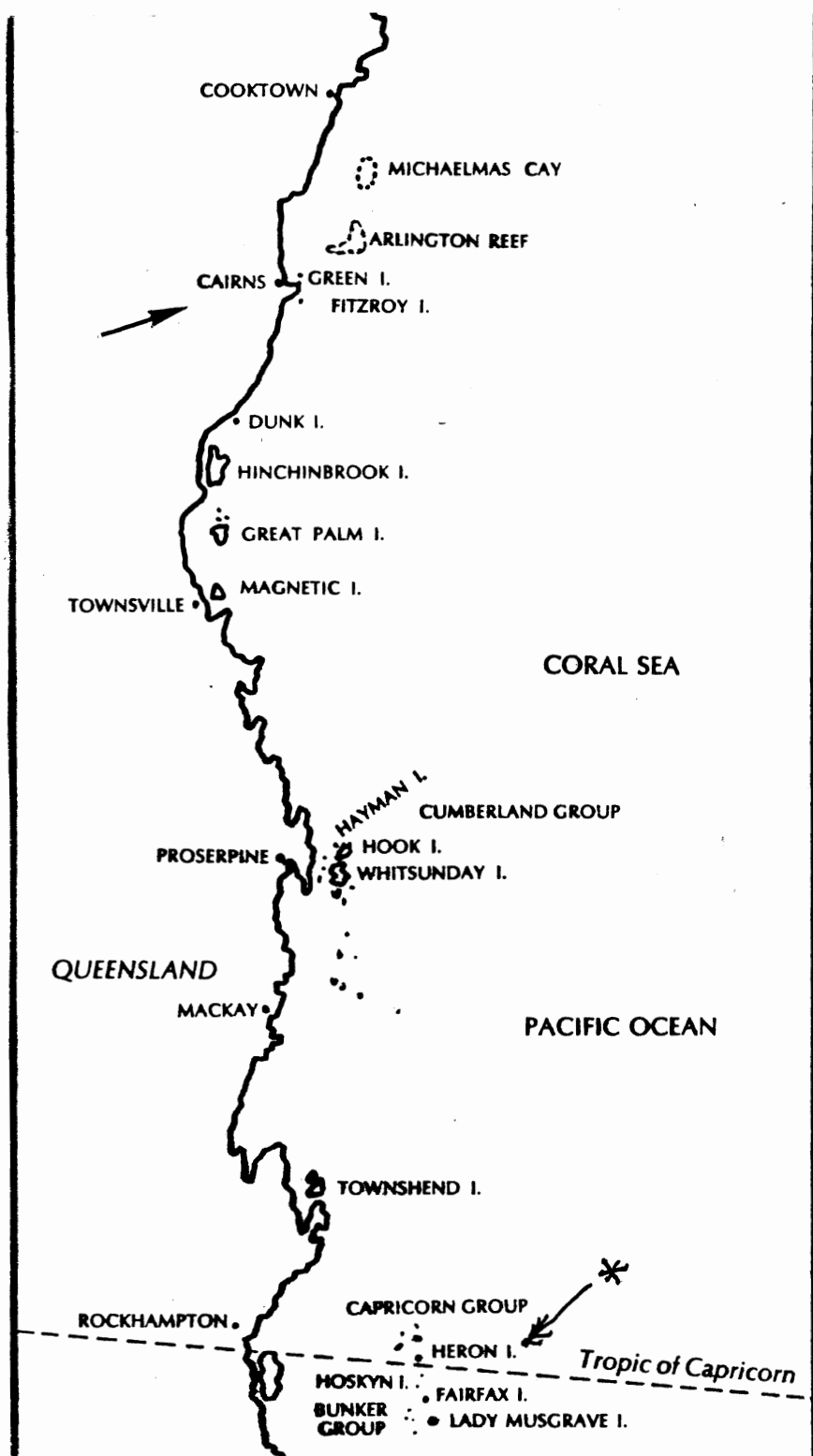
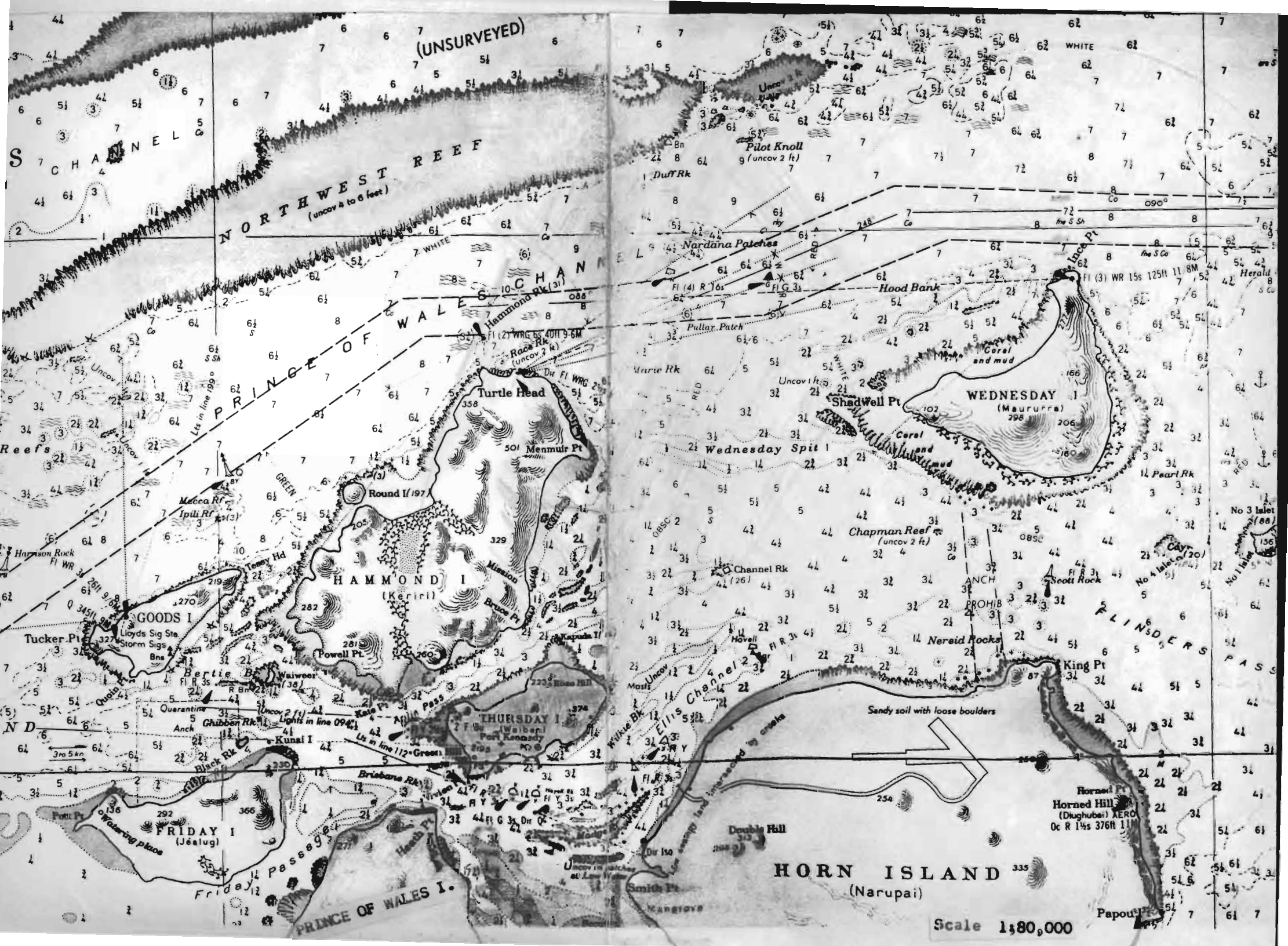


Fig. 9b.-- Green Island is a wooded islet located near Cairns within sight of land off the northeast coast of Cape York about 160 miles north of Townsville (Queensland, Australia) and some 600 miles south southeast of Thursday Island (in the Torres Strait). The underwater observatory is near the outer end of the approximately 900-ft long pier. Reprinted from Douglass Baglin and Barbara Mullins, "Islands of Australia," Ure Smith, North Sydney, Australia, 1972.





(UNSURVEYED)

NORTHWEST REEF
(uncov 4 to 6 feet)

CHANNEL OF WALE

PRINCE OF WALE I.

HAMMOND I
(Keriri)

THURSDAY I
(Wabapi)

FRIDAY I
(Jéalug)

HORN ISLAND
(Narupai)

Scale 1:80,000

Papou



Federal Hotel, Port Kennedy, Thursday Island, Australia, 1960

We came to love our Navy Wharf laboratory, where we had freedom from dust, mosquitoes, flies, and all except authorized visitors. Each day we lunched on fresh bread, bought at the local bakery on our morning walk to the lab, peanut paste (butter) and strawberry jam from the local general store, and fresh fish. Each morning as Claude sat on the deck recording data, he would throw a hook and line over the edge, wrapping the upper end of the line around his big toe. Within minutes there would be a tug on his toe and lunch would be on the line.



Claude ZoBell overlooking the Navy Wharf and our laboratory, T.I., Australia

Fig. 10a.-- Thursday Island (T.I.) is separated from Hammond Island by the Aplin Pass and from Horn Island by the Ellis Channel. Except for the harbor area where there are three piers; (E) 500-ft long Engineers Jetty, (T) 800-ft Main Pier, and (N) 600-ft Navy Wharf, T.I. is reef-fringed (R). Criss-cross lines (M) demark mangroves. (S) shows sandy beaches at low tide. (H) shows the location of the Federal Hotel where some of us resided. The hospital and CSIRO Fisheries Laboratory were located on the "Reserve" in the southwest corner of T.I. (From U.S. Hydrographic Chart No. 3471).

