WORKING IN THE PACIFIC

BY

JOSHUA I. TRACEY, JR.

INTRODUCTION

My education and training leading to my becoming a "coral reef specialist" did not proceed in any logical manner through courses in biology and the expected specialties. In fact, I graduated from Yale with a degree in physics and mathematics and I spent my first year in graduate school staggering through Leigh Page's five-days per week, one-and-a-half hours per day course "Physics 100" in mathematical physics, which students claimed required 100 hours of study per week. This convinced me that I had no future in physics and I decided to turn to geology, although my background there was not promising. I had taken a first-year geology course in my junior year! So in my second year in graduate school I started with courses in geology that I should have taken as an undergraduate.

By the time the war erupted, I was on my way to becoming a geologist. I joined the U.S. Geological Survey in early March, 1941 in Eufaula, Alabama and was shortly sent to Richland, Georgia to prospect for bauxite — the ore of aluminum. For two months I walked the Wilcox- Midway contact, wherein lies the bauxite zone — if any. I plodded across two counties without adding to our nation's supply of aluminum ore and was then told to get in my car and drive to Little Rock, Arkansas where I joined a growing group of young, eager but green, geologists who were watching a number of drill rigs drilling for bauxite south of Little Rock (an area called "Sweet Home"), and about 35 miles southwest of Little Rock near the company town of Bauxite. The drilling program was run by the U.S. Bureau of Mines and at its peak comprised 20 drill rigs, drilling two shifts per day. The holes were staked out by Bureau of Mines engineers and the cores were logged by U.S. Geological Survey (USGS) geologists.

As time went on, the drilling program declined and the drill rigs and the geologists were sent to other parts of the country to look for other critical minerals for the war effort. Eventually I was the lone geologist left in Little Rock.

In February 1946, I closed down the project and went to Washington, D.C. I took my first leave since joining the Survey and went to visit my parents in New Haven, Connecticut where I received a phone call from Harry Ladd, one of my bosses on the Survey, asking me if I would like to join a large group of scientists who were going to Bikini Atoll to study this area before and after two atomic-bomb test explosions. So I agreed and flew across the country to board the U.S.S. *Bowditch*, AGS-4, that was to be the base ship for the oceanographic group during the tests.

USGS Associate, Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560-0137

BIKINI ATOLL

Many of the scientists — oceanographers, biologists, and I, the lone geologist (until Harry Ladd arrived) — sailed in March 1946 from Mare Island, California, and used the long voyage to Honolulu and then down to Bikini Atoll to plan our programs. As most of us had never seen an atoll, there was little planning that could be done until we reached our destination.

At Bikini, our problem was to examine the reefs from seaward margin to lagoon at a number of traverses around the atoll and to examine all islets, large and small. We also made traverses at Eniwetok, Rongerik, and Rongelap atolls.

In the summer of 1947 we returned to Bikini for five weeks with a drill rig and drilled several holes, one to a depth of 2,556 feet, with all drill rods in the hole. A number of cores were attempted, but core recovery was very poor. During this period, Ladd and I revisited most of the traverses that we had made the previous year. Because of the radioactivity remaining from the two atomic bomb detonations in 1946, it was necessary that we always be accompanied by a monitor with a geiger counter wherever we went. We noticed little evidence of the nuclear explosions and the radioactivity was only noted by our monitors.

THE ISLAND OF GUAM

I spent over three years (from 1951 to 1954) on Guam, the largest and southernmost of the Mariana Islands (Fig. 1). It is 30 miles long, from 4 to 11 miles wide, and has of an area of 212 square miles. The northern half of the island is a broad limestone plateau bounded by cliffs and the southern half is a dissected volcanic upland that is commonly deeply weathered (Figs. 2, 3). No streams flow on the porous limestone in contrast to the southern volcanic area, which contains numerous streams. Typhoons are common in the vicinity of Guam (Fig. 4) with the chances about one in three that one or more damaging typhoons will hit the island in any given year.

My main concern as field party chief was mapping the geology of this island, surveying the offshore reefs (Fig. 5), determining the water resources, and studying the soil profiles (Fig. 6). This was a major undertaking that involved a team of well known scientists including: K.O. Emery (marine geology); J.T. Stark (petrology of volcanic rocks); S.O. Schlanger (petrology of limestones); C. H. Stensland (soil studies); and W. Storrs Cole (Foraminifera). It was one of my most satisfying undertakings and resulted in many published reports , most notably the USGS Professional Paper 403 A-H published in 1964 *et seq*.

Working on Guam had its challenges, particularly dealing with steep cliffs and, in some areas, very dense vegetation. In one these heavily vegetated areas we were acutely aware of being watched by Japanese soldiers who had not surrendered and existed by scrounging from a U.S. Air Force dump at the base of a cliff. At one point an Army bus was stopped by one of these fellows who calmly removed his worn sandals and turned himself in.

Figure 1. Our headquarters on Guam, November, 1951.

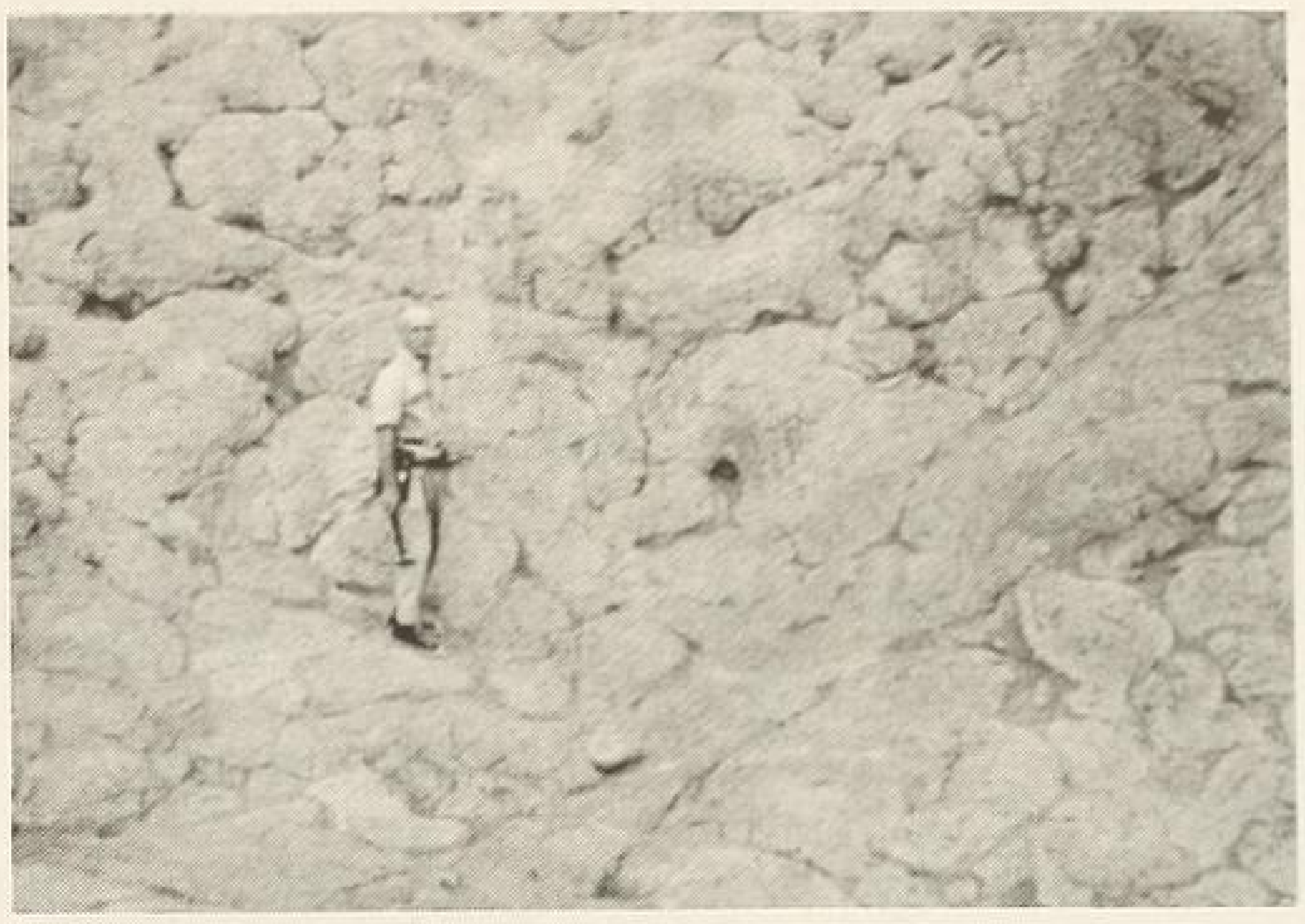


Figure 2. Jack Stark standing on extensively weathered pillow lava, Guam.

Figure 3. Frank Whitmore on folded bedded tuffs and a remnant of a laterized plateau, June, 1952.

Figure 4. Large breakers on Cabras Island, Guam, following a typhoon, December 17, 1953.

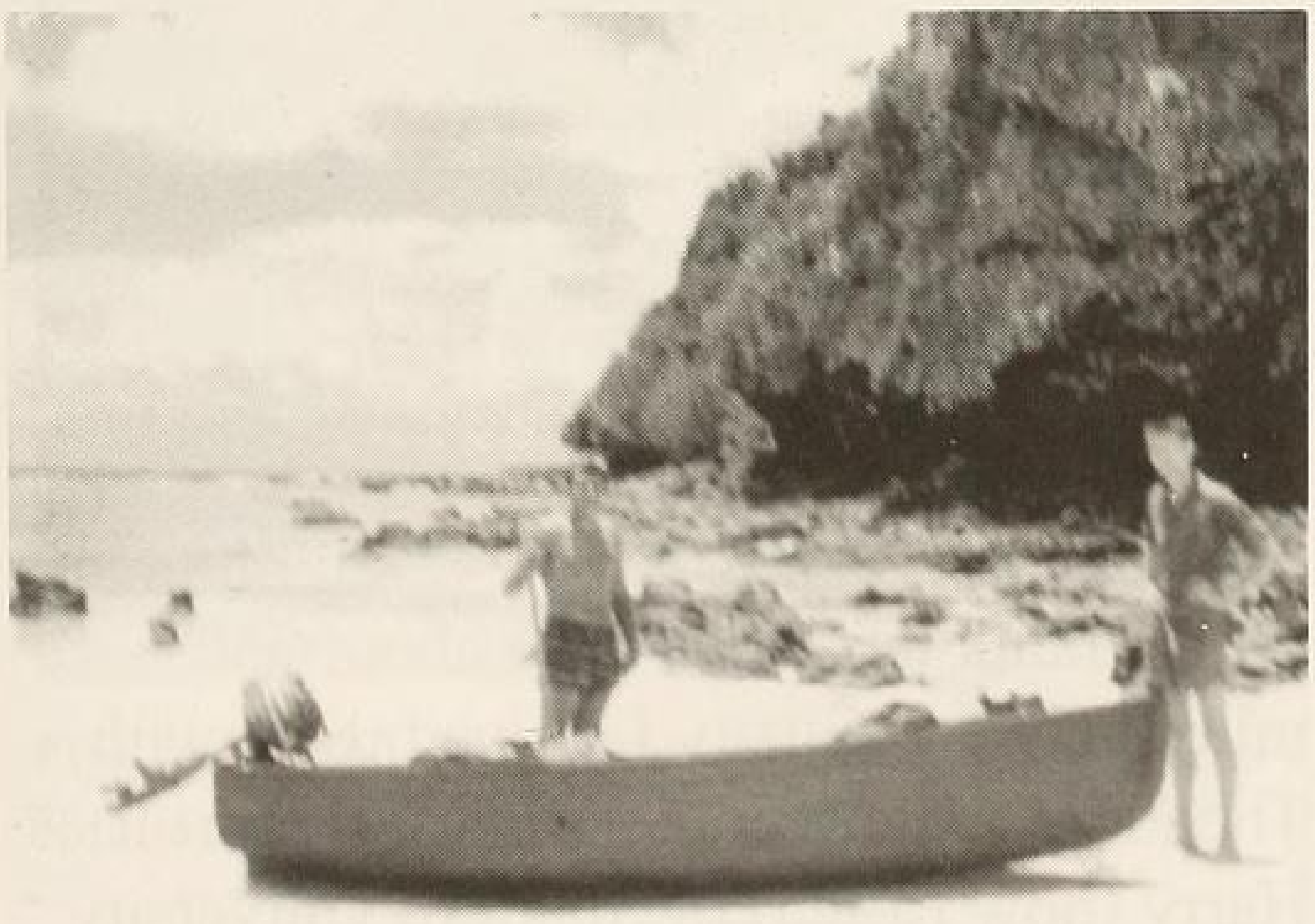


Figure 5. With a dinghy on Hilaan Beach, Guam, where we were looking at off-shore reefs (Josh Tracey on right).

Figure 6. Soil-trench survey, Mt. Bataa, Guam, July, 1954.

During my assignment in Guam I made several side trips to other islands, most notably Pagan and Fais and the islands of Ifaluk Atoll, the fourth of five Pacific Science Board atoll surveys. On Pagan we surveyed a transect across the island ending up on the edge of the volcanic crater at the north end of the island (Figs. 7, 8). Later we visited Fais (Fig. 9) where we again carried out a brief survey and noted some of the activities of the local inhabitants (Figs. 10, 11).

Figure 7. Pagan Island crater with inner cone.

Figure 8. On north wall of crater, Pagan Island.

Figure 9. Landing on Fais Island, September, 1953.

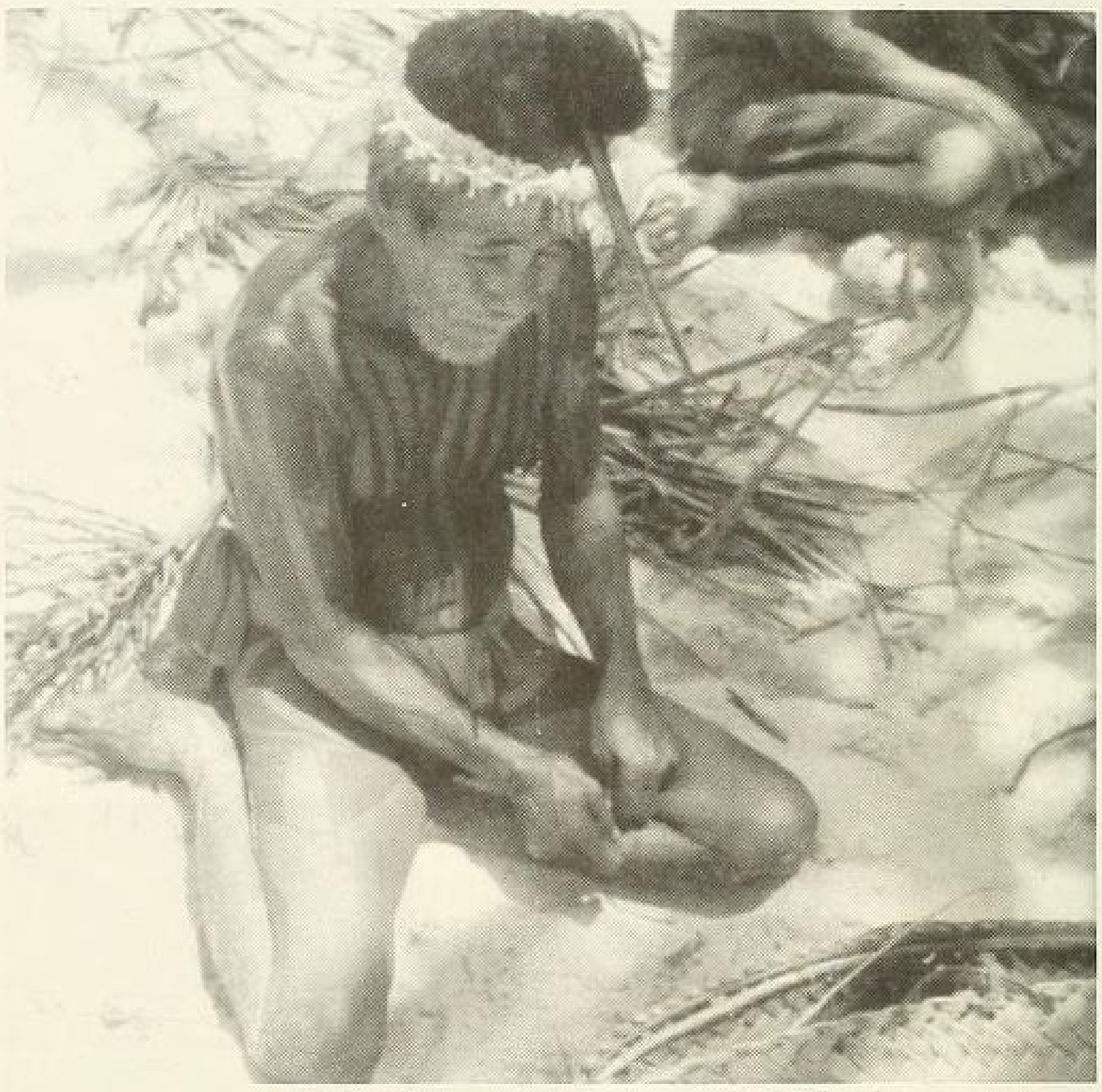


Figure 10. Native on Fais Island making sennet (a type of rope).

Figure 11. Copra bagged and ready for export, Fais Island.

Ifaluk is a small atoll about 350 miles south of Guam. I arrived there with Theodore Arnow of the USGS, Robert R. Harry (now Rofen) of Stanford University and Frederick M. Bayer of the Smithsonian Institution, on the Trust Territory supply ship *Metomkim* on September 12, 1953. We joined members of the first phase of the program who arrived on June 22. Already at Ifaluk were Donald P. Abbott of Stanford University, Marston Bates of the University of Michigan, and Edwin Burrows of the University of

Connecticut. Because of limitations imposed by the U.S. Navy on the number of Americans on the atoll, Bates and Burrows were scheduled to leave on September 18, and Tracey and Arnow to remain only until September 26.

Ifaluk was such a small atoll that it received scant notice from either the Germans or Japanese, or the Americans who had successively administered the Pacific Islands. Few of the native inhabitants had had any experience with the outside world and the atoll had endured only minor acculturation. The Navy wanted to keep it that way. Previously, a pair of anthropologists, Edwin Burrows and Melford Spiro, had been sent to Ifaluk in 1947 by the Navy as part of its Co- ordinated Investigation of Micronesian Anthropology (CIMA) program sponsored by the National Research Council. This was especially beneficial for our project as Burrows already knew the people and was known by them.

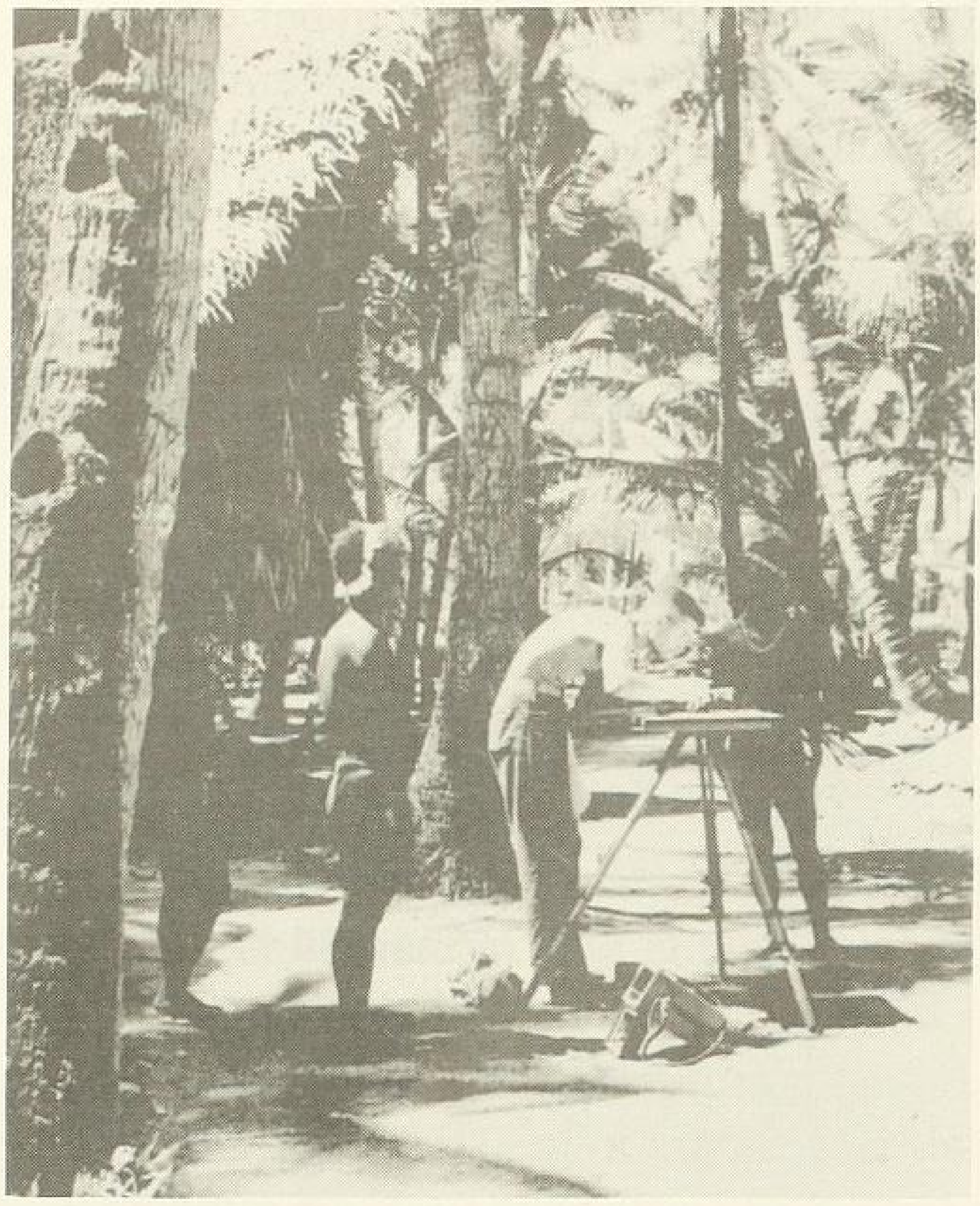
Discovery of Ifaluk is credited to Wilson who in 1797 was aboard the missionary ship *Duff*, but who did not land on the atoll. The first Europeans to visit were Lüke in 1828 aboard *La Séniavine* and Sarfert in 1909 who was with the German Südsee-Expedition of 1908-10, but both Germans and Japanese maintained outposts there during their respective trusteeships.

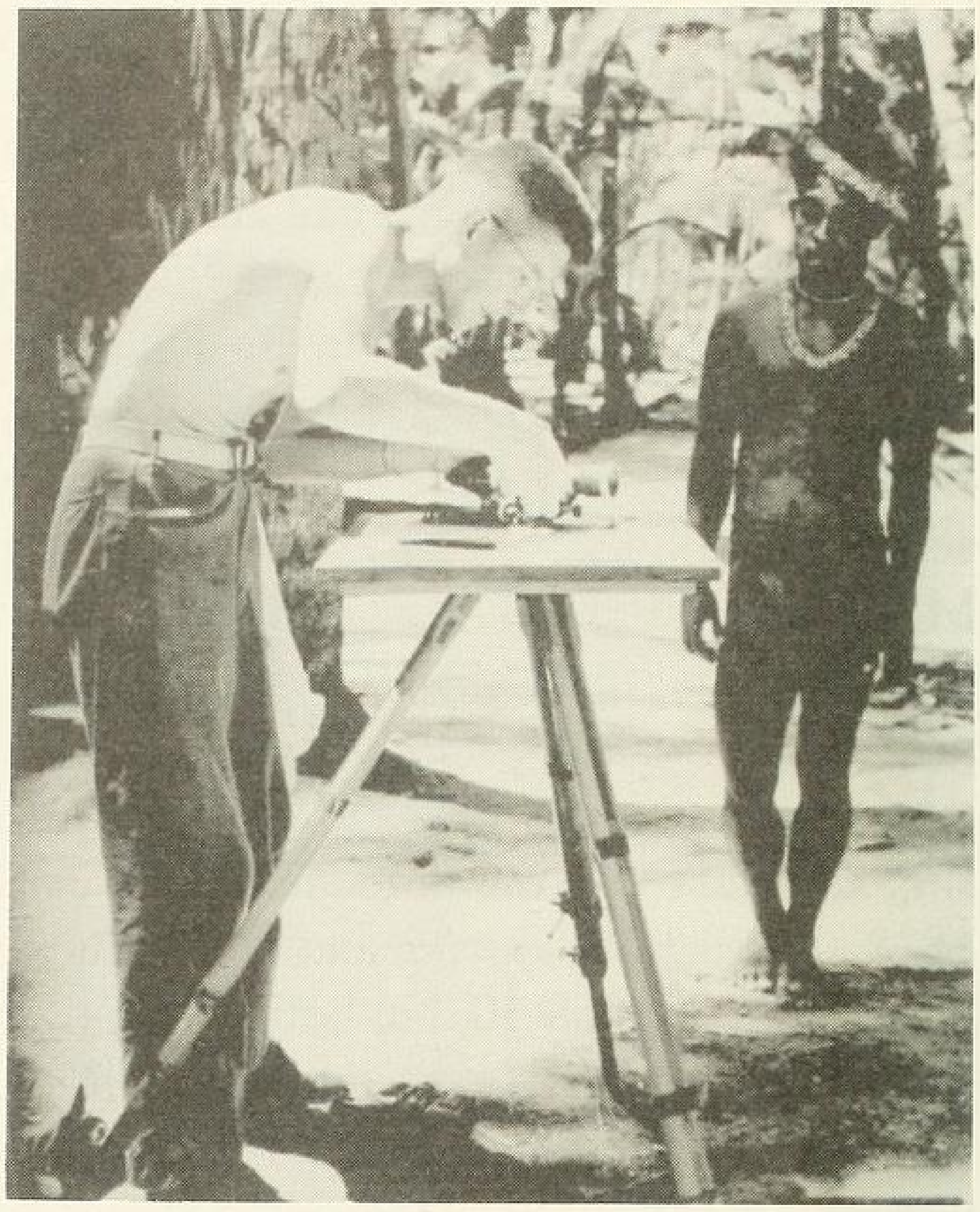
The land area of Ifaluk is only about half of a square mile and supported a population of 260 inhabitants (Fig. 12) at the time of our visit. Although we interacted with several "commoners" who acted as interpreters and field assistants, our "official" hosts were the chiefs of the atoll: the high chief was Fagolier; the second was Maroligar (Fig. 13); the third, Toroman; the fourth, a woman whom we did not meet; and the fifth, Wolpaitik — minor in rank but major in bulk, as he was the only person on the atoll with a full-fledged paunch.

Figure 12. Ted Arnow photographing a group of children, Ifaluk, September, 1953.

Figure 13. Maroligar – the second chief of Ifaluk. (Photo F.M. Bayer)

With the help of two local young men, Talimeira and Sagolimar, we made a quick survey of the islands. I would peer down the plane table telescope (Figs. 14, a, b) and wave my hands to communicate with my two assistants who





Figures 14. Josh Tracey surveying on Ifaluk: (a) Setting up plane table with assistants looking on. (b) Close up of plane table with native assistant. (Photos F.M. Bayer)

took turns handling the surveying rod. In short order the coastlines were surveyed and contours added — not much to show as the islands were only about 15 feet above mean sea level.

It was during this survey that we discovered that the north end of Falarik Island had been a separate island up until relatively recent times. This was indicated by a conspicuous indentation on the windward side of the island, and vegetation patterns, and was confirmed by the old chief, Toroman. I also spent time looking at the reef topography on the reef flats and checking the quality of water in ponds (Fig. 15) and wells.

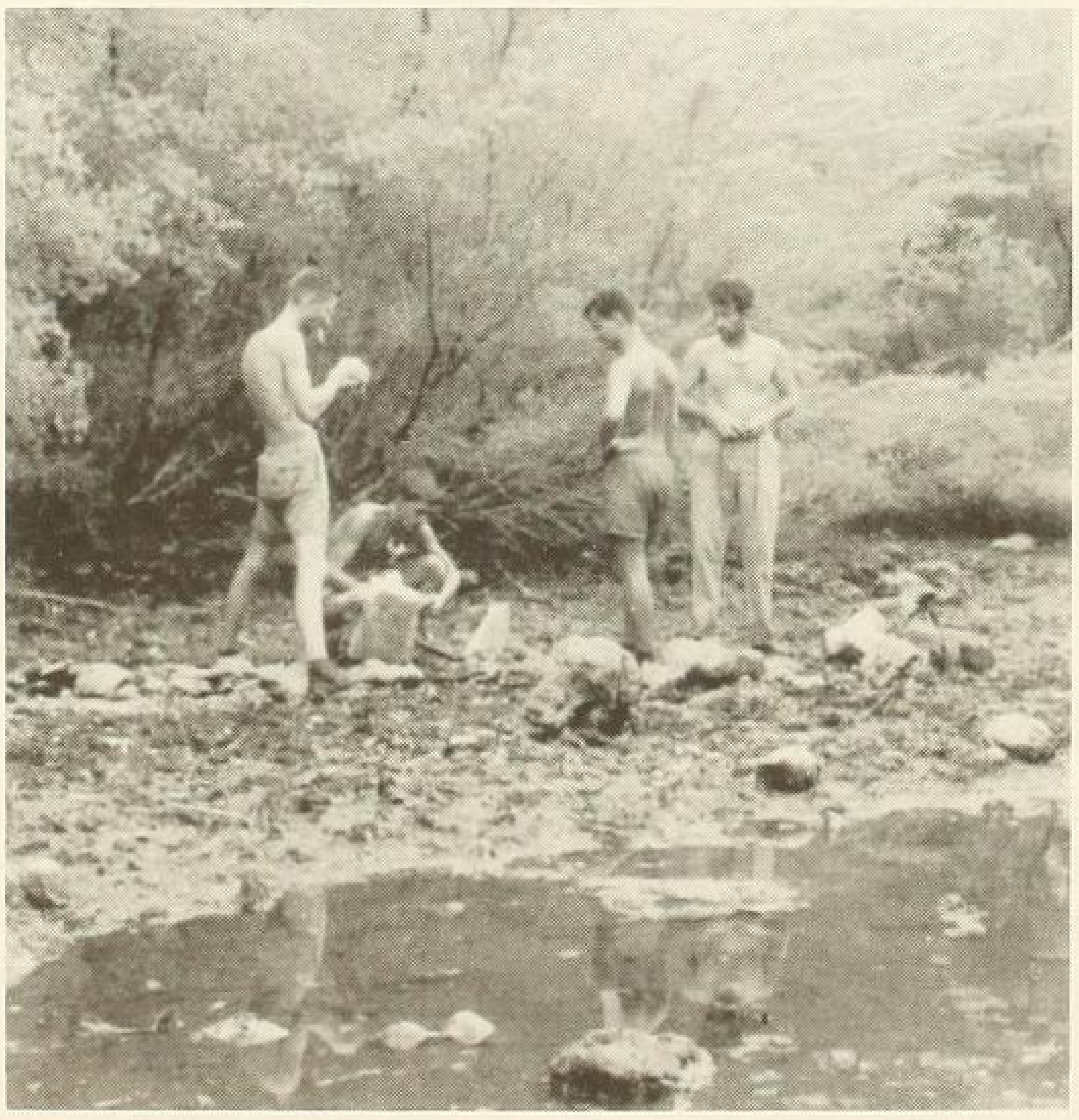


Figure 15. From left to right, Josh Tracey, Don Abbott, Bob Harry and Ted Arnow inspecting a pond on Ifaluk. (Photo F.M. Bayer)

When I look back at my experiences on Ifaluk, probably the most memorable ones were the times of using the open outhouse over the lagoon and casually greeting the various passers- by. Privacy was a minor concern on this small island.

DRILLING ON MIDWAY ATOLL (1965)

In 1960, in his Presidential Address to the Geological Society of Washington, Harry Ladd proposed the drilling of Midway Atoll in the Hawaiian Islands. His reasons for desiring a hole on Midway sprang from his idea that Tertiary faunal migration had proceeded westward from Pacific island centers towards Indonesia, following the tradewind and current patterns, rather than eastward from Indonesia into the Pacific, as was believed by most paleontologists. Ladd had noted three molluscan zones in the lower Miocene at Bikini and Enewetok, and thought if he could find these three zones at Midway, his ideas would be confirmed.

To justify an expensive drilling program at Midway required some assurance of a section above volcanic rock thick enough and old enough to contain the hoped-for lower Miocene faunal zones. Ladd persuaded George M. Schor and associates of the Scripps Institution of Oceanography to run two seismic lines in March, 1963 and December, 1964 along the southern and northern sides of the atoll. Their interpretations suggested that the sedimentary section over volcanic rock thickened from less than 1,000 feet south of Sand Island to 2,000 to 3,000 feet along the northern part of the lagoon, a section thick enough to justify the drilling.

Promoting a drilling program on Midway required support, and the Department of Defense and the Atomic Energy Commission, which had underwritten the Marshall Islands drilling, had little interest in the depth to volcanic rock at Midway. So Ladd joined with George P. Woollard, Director of the Hawaii Institute of Geophysics, University of Hawaii, and Gordon A. Macdonald, also with the university and formerly with the USGS Volcano Observatory, to apply to the National Science Foundation for a grant to support the drilling and they were successful in receiving the funds.

Geologists who participated in logging the drilling and in carrying out studies of the reefs, lagoons, and islands of Midway and Kure that were undertaken concurrently were: H.S. Ladd (Fig. 16) and J.I. Tracey, Jr., of the USGS; M. Grant Gross of the University of Washington; Ted Chamberlain, William Ebersole, and Ted Murphy of the University of Hawaii; and W. Storrs Cole of Cornell University.

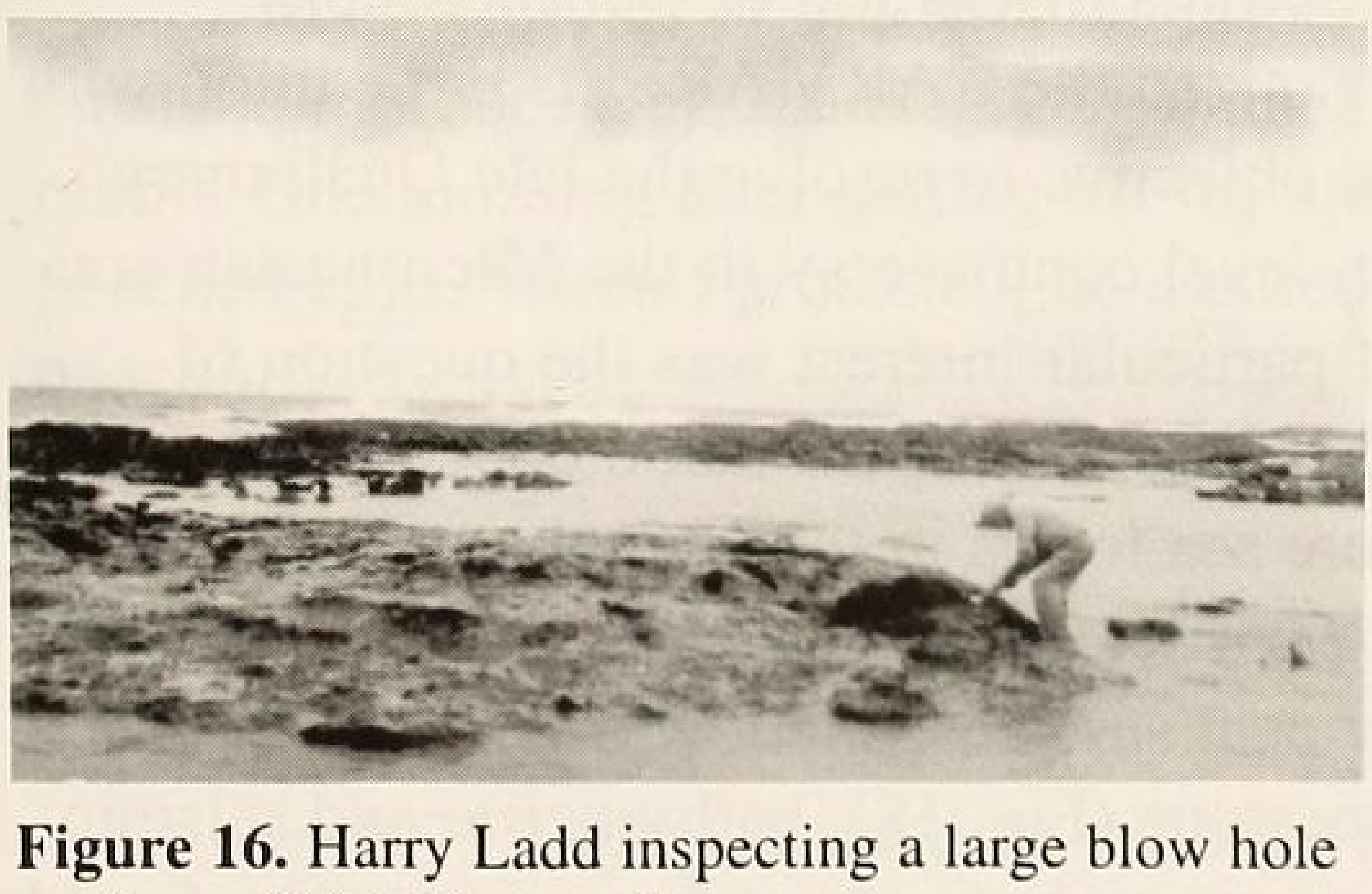


Figure 16. Harry Ladd inspecting a large blow hole on the reef flat, Enewetok.

The drilling was carried out in July, 1965, under contract with Layne International, Inc., of Hawaii under the supervision of William Craddick. Two crews totaling seven men operated continuously on 12-hour shifts. The drill was a truck-mounted Failing 2500.

Coring below a depth of 70 feet was accomplished using a rubber-sleeve core barrel that attained a remarkable recovery of 72 percent in the Sand Island hole and 92 percent in the Reef hole, even in friable or unlithified sections. The Sand Island hole, which was drilled on the north shore of Sand Island, contained 516 feet of post-Miocene and upper Miocene

(Tertiary *g*) sediments overlying 52 feet of basalt.

In order to drill the Reef hole, a site was prepared about 80 yards inside the northern reef where the lagoon floor was eight feet deep at high tide. The drill and all the necessary equipment were positioned in a Navy barge, which was towed to the site and sunk (Fig. 17). The drill tower when raised was guyed to nearby coral heads and to the "Reef Hotel," an abandoned loran station on pilings in the lagoon. Drill crews and geologists had to be brought by boat from Sand Island four miles away, a pleasant trip in good weather. In the Reef hole, 400 feet of post-Miocene limestone were penetrated, underlain by 75 feet of upper Miocene limestone and dolomite, followed by 370 feet of lower Miocene limestone and dolomite, 180 feet of marl, carbonaceous clay and volcanic clay, 40 feet of clay and conglomerate, and finally 393 feet (cored) of basalt.

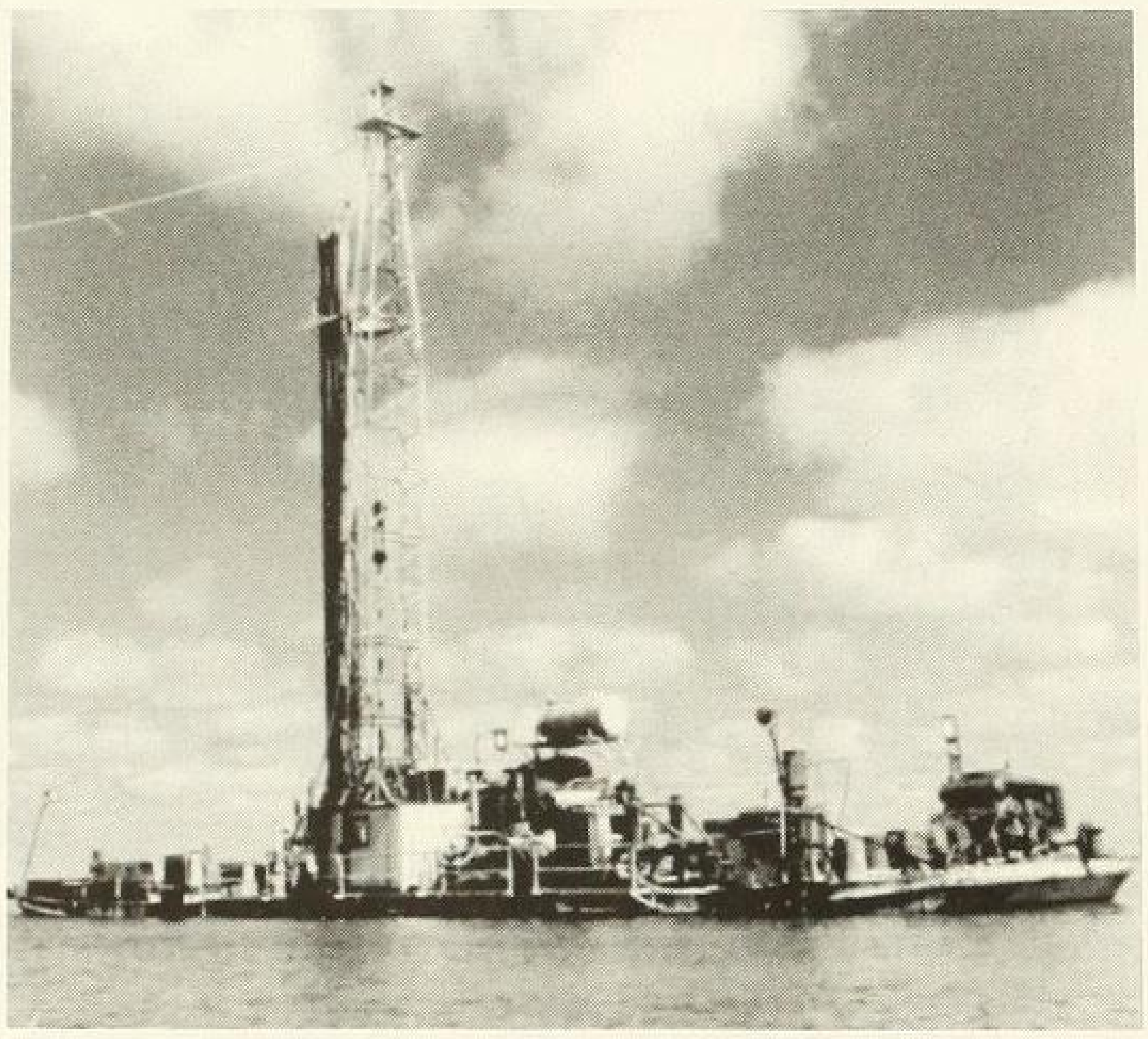


Figure 17. Drilling barge sunk in the lagoon of Midway Island, July, 1965.

Freeing and floating the barge took almost three days, after which the nearly three-month- long program was ended. The drill rig and all equipment were left on the barge, which was towed to Pearl Harbor by a Navy ship, but was swamped in heavy seas and sank before getting home to port. Fortunately all boxes of cores had been shipped separately!

CARMARSEL EXPEDITION (1967)

Scripps Institution of Oceanography organized the CARMARSEL Expedition with the objective to resolve the late Quaternary sea-level controversy in the Micronesian area. Of particular interest was the question of whether or not in the last 6,000 years there were sea levels in this area that were above present sea level. The work included probing for peat samples, shallow drilling into coral limestone (Fig. 18), bathymetric and seismic surveys, and searching for emergent reefs and rubble ridges. The investigators included

Figure 18. Drilling a shallow hole on one of the small Truk islands, January, 1967.

Francis P. Shepard, William A. Neuman, Arthur L. Bloom, Norman D. Newell and myself. I participated in the work on Truk and Ponape. It was indeed an interesting time working with this distinguished group of scientists.

The result of this work was that there was good evidence for a higher than the present Holocene sea level on tectonically active Guam but none at all on the more stable Caroline and Marshall Islands.

DEEP-SEA DRILLING (1970)

From October 8 to December 2, 1970, I was cochief investigator, with George H. Sutton of the University of Hawaii, of the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) D/V *Glomar Challenger* 8th Leg, which extended from Johnston Atoll to Tahiti (Figs. 19, 20). It was very busy work on eight-hour shifts

Figure 19. D/V *Glomar Challenger* at the dock in Honolulu, Hawaii.

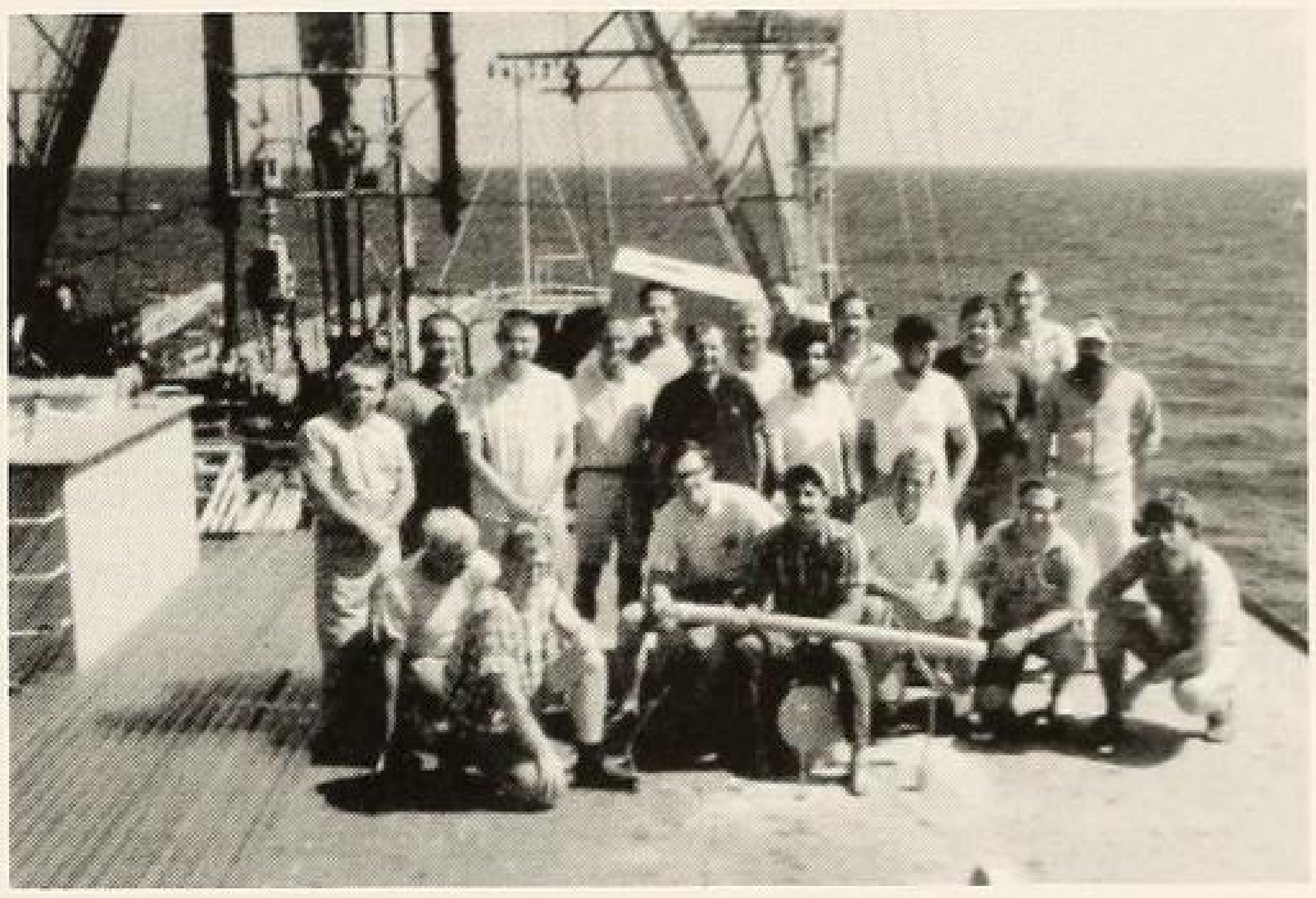


Figure 20. Research team for D/V *Glomar Challenger* Leg 8. Josh Tracey is standing third from the left.

during which I spent most of my time describing the cores with both binocular and petrographic microscopes (we had a technician on board who made thin sections).

My memories of this trip, other than the heavy work schedule, were of the outstanding food. Our Thanksgiving dinner included turkey, prime rib, steaks, and rabbit. One morning after getting off my shift the cook loaded up my plate with three poached eggs. When I protested, he assured me that you lose most of the egg when you poach it!

ENDERBURY ISLAND (1971)

In 1971 I spent some time drilling (Fig. 21) shallow holes to determine the recent history of the formation of this island. We drilled four holes ranging in depth from 54 to 103 feet. The very small drilling rig was mounted on a frame about 25 feet high (Fig. 21) that was carried from site to site by a helicopter. The water used in the drilling was likewise carried by helicopter. The small core barrel, about one inch inside

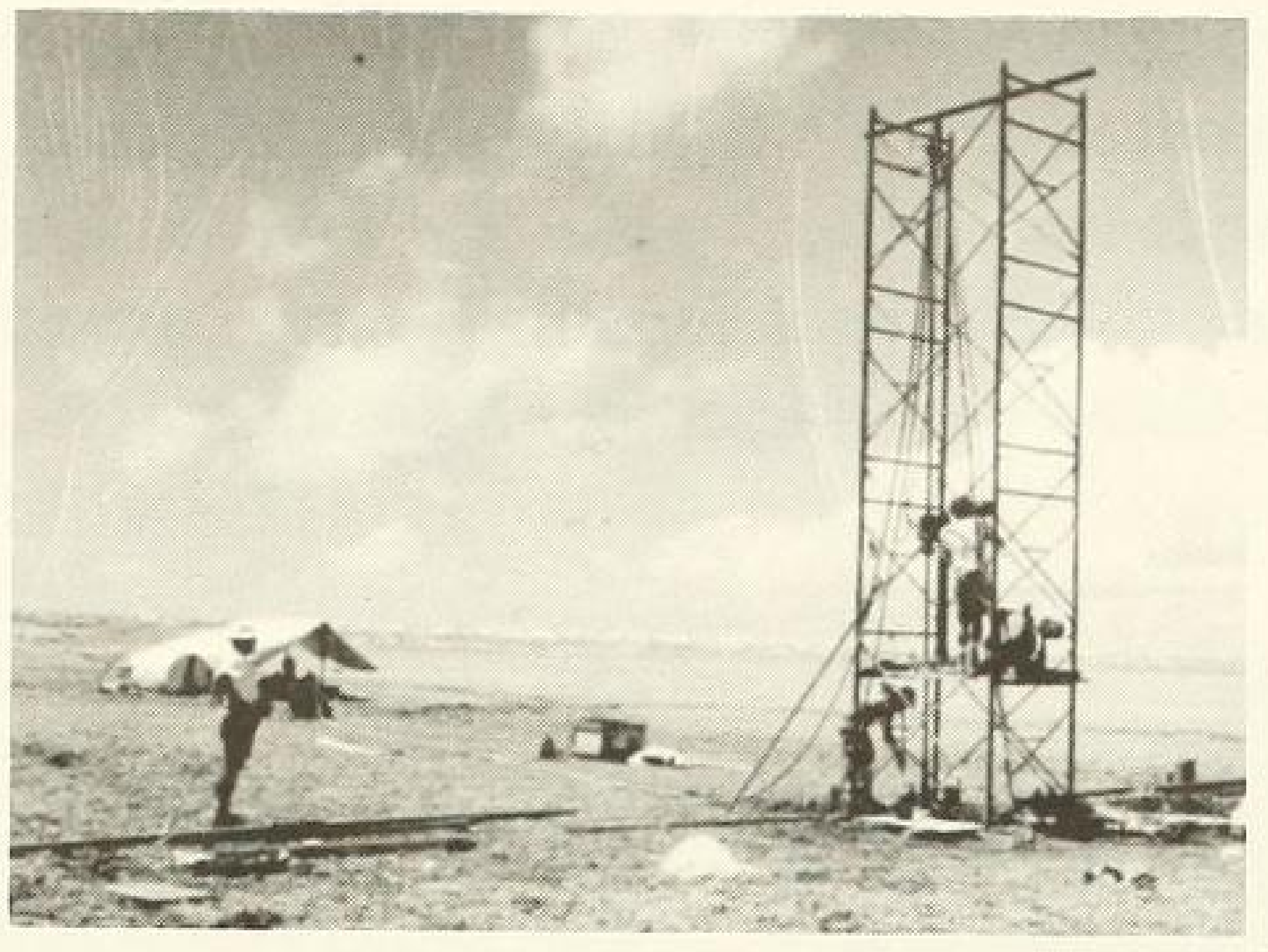
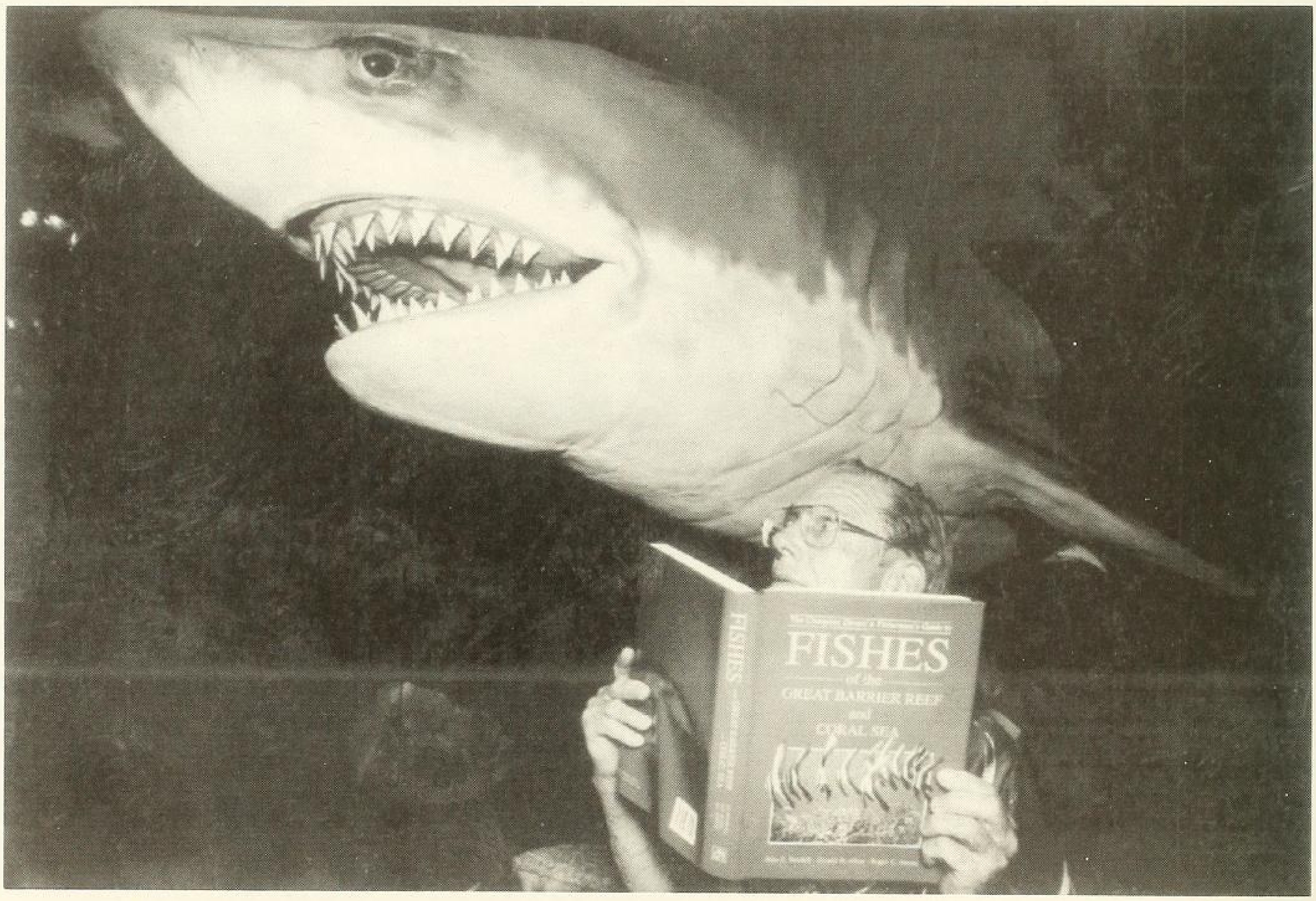


Figure 21. Brian Hackman watching drillers, Enderbury Island, 1971.

diameter, did not get good recovery in the crumbly limestone and gravelly phosphatic sands. Nevertheless we obtained a reasonable idea of the extent of the phosphatic material. Three of the four holes showed the presence of phosphatic sand from a few feet to 8 feet thick that average 5% to 10% P_2O_5 at depths of 12 to 45 feet.

DRILLING OPERATIONS ON ENEWETOK (1971-1974)

I was only involved in some of this work. First in 1972, I participated in the Pacific Atoll Coring Expedition (PACE 1971-1972) when we drill two holes into the Enewetok reef flat to determine the thickness of the Holocene reef section. Later I joined the Exploration Program on Enewetok (EXPOE 1973-1974) that carried out much more detailed coring operations across the island and to the outer edge of the reef flat. The objective was to obtain a better understanding of the reef history in this area preserved in both Pleistocene and Holocene reef sections. This was the last of my field work in the Pacific.



John E. Randall promotes a new book. 1991 (Photo Steven Siewert)