

**The Venturesome Voyages of Scripps
Into the South Pacific Ocean**

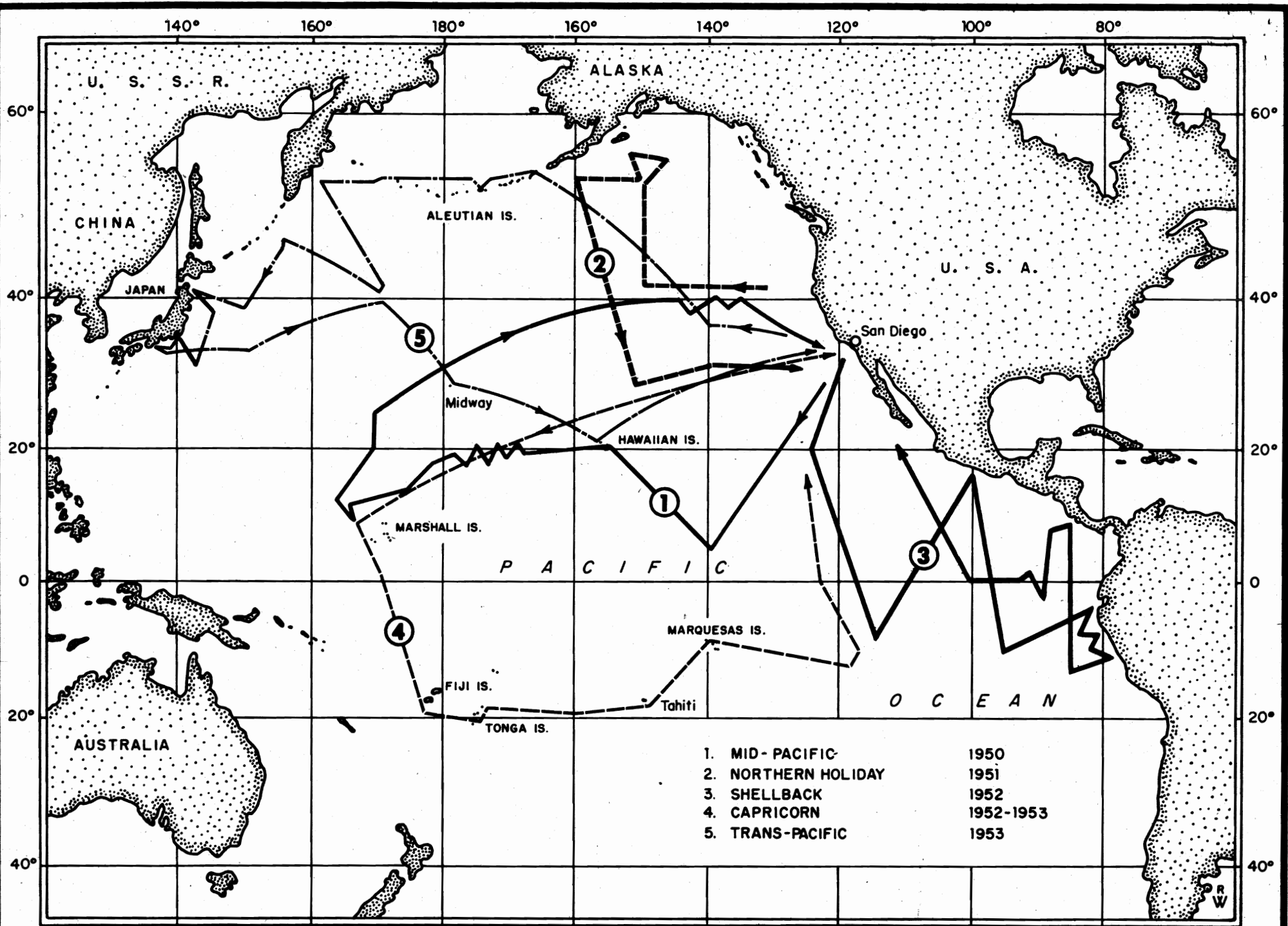
1950 and 1952

- I. 1950: "Mid-Pac" — The First Big Step**
- II. 1952: "Operation Ivy — Capricorn Expedition"**

by Edward S. Barr



**Discovering the MidPac Mountain Range on my watch!
Edward S. Barr and the fathometer on Horizon
MidPac Expedition, 31 August 1950**



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| 1. | MID - PACIFIC | 1950 |
| 2. | NORTHERN HOLIDAY | 1951 |
| 3. | SHELLBACK | 1952 |
| 4. | CAPRICORN | 1952-1953 |
| 5. | TRANS-PACIFIC | 1953 |

Part I.

1950: Mid-Pac — The First Big Step

Dedication to Roger Revelle

who took the time and interest to give a young man a lift, and a fulfilled dream.

In the early spring of 1950, while completing my junior year at Point Loma High School, I decided that it would be a very rewarding experience to work with Scripps Institution of Oceanography. I particularly wanted to be involved in their efforts of collecting data from the ocean. So with my father's encouragement, I made an appointment with Dr. Roger Revelle, then Acting Director of the Scripps Institution, and met with him at his office concerning possible summer employment. To my surprise, I found that Scripps Institution was planning, for the first time, a long and extensive expedition to the South Pacific! This trip sounded very exciting to me, and Dr. Revelle seemed equally enthusiastic. Dr. Revelle indicated, however, that no high school student had ever been employed previously by the Institution to participate with the scientific group on any expedition. In particular, he was unsure as to whether it would be possible for a high school student to be included on such a long trip, particularly since it was the first time that the Institution had ever conducted such an extensive venture. Summer employment had been available at the Institution in various capacities at their shore facilities and, in some cases, they also had hired high school students to work on board ship as members of the crew. My interest, however, centered around being part of the scientific group aboard ship at sea, thereby being exposed to the knowledge and experience of the expeditionary staff and their work of collecting and interpreting the data. Dr. Revelle seemed interested in the possibility of my going and advised me that he would let me know in a short period of time as to what could be done.

In early June, 1950, Dr. Revelle called and said that I was hired! He explained that they did not have a formal budget for my type of employment, so my pay would be limited to \$75 a month. For lack of a better description for my employment, they called me a "laboratory helper." I naturally was very excited about what I thought would become a very thrilling adventure. Eager preparations were made for going aboard ship. The expedition, as planned, was scheduled to leave San Diego in the middle part of June, proceed to Honolulu, and then out to the Marshall Islands for some experimentation on Bikini Atoll, the site of the 1946 atomic bomb experiments. From there, the expedition was to go on to Kwajalein Atoll and then on down into the southern latitudes for further experimentation in the deep South Pacific. My part of the expedition only involved the first half; I would be returning by plane to San Diego from Kwajalein, while the ship continued northward. Nevertheless, the time I would spend with Scripps would be for the

month of June through part of October. With enthusiasm and great anticipation, I looked forward to the next four months.

On Monday, June 19, 1950, at the Naval Electronics docks on Point Loma, I boarded, for the first time, the research vessel *Horizon*, a converted Navy tug of steel construction and diesel power. Her length was 143 feet. The ship had a very low profile near the stern which made convenient access to the ocean. Up forward her bow was quite high. Under full power, with twin diesels and a single propeller, the *Horizon* could make about 12 knots. Running on one diesel she could make about 10 knots. Having a family background in yachting, I think it would be proper to describe the *Horizon's* general condition as being a pile of rust covered with some paint. The ship had already been used extensively in oceanographic work. The ability to keep her in bristol fashion was just not possible, considering the amount of time the ship was kept at sea. As a result her metal hull and upper structure were subject to extensive rusting. The best that the crew could do was to keep painting over the rust, occasionally flaking off big slabs and then painting a new coat under that.

The *Horizon* got underway on Tuesday for a practice run, after loading a tremendous amount of gear, including a one-and-one-half-ton generator, various cables, and deck equipment. The sleeping quarters, deep in the ship's forward area, were kept dark in order for people who were up most of the night on watch to have an appropriate compartment in which to sleep during the day. Dark on board this ship meant total dark! In fact, without a flashlight it was difficult to move around. The compartment remained in this condition at all times. As a result, I occasionally found myself fully dressed and up on deck at twelve midnight, thinking it was already the next day! Having no way of telling day from night down in what we affectionately learned to call the "pit," I found it very difficult to determine what day it was, or the time. On such occasions, since I was already up, I frequently would visit the bridge and watch the crew operate the ship and observe how she behaved in the ocean swells. Early Wednesday morning the sea had developed into a choppy condition with approximately 20 to 30 knots of breeze. The ship was awash aft with seas and spray coming over the sides near the stern. "How could any scientist or crew handle heavy equipment over such a pitching, rolling and wet deck?" I wondered.

Soon, in spite of poor weather conditions, preparations were made to begin testing the various equipment which was on board for the long expedition. At the stern of the ship was installed what we called "the rack," similar to what tuna clippers used as a place from

which the fishermen stood to catch fish and pull them aboard. On the *Horizon* we used this rack for getting down very close to the ocean surface to handle the heavy steel equipment which we were lowering and raising in and out of the ocean. "Rack work" was always very wet work. The ship was at rest while we were testing our equipment; she just lay in the sea without forward motion, rolling back and forth in very wide sweeping arcs. The choppy waves would pour into the rack and over the rails onto the deck, placing us in churning water above waist level. Since none of us was very experienced at handling this experimental type of heavy equipment, we had some difficulty controlling its tons of weight. Some of the equipment that seemed to be more easily handled, however, was a water sampler, a pilot weight, various depth-sounding gear, and the bottom-sampling apparatus called the "Phleger Corer." Following the end of this testing period, I worked with the technicians in the bacteriology lab, testing their ocean-bottom samples.

The following day the sea was much more calm. We spent all day preparing for one of the largest pieces of oceanographic testing or sampling equipment that had ever been used. It was referred to as the "Kullenberg Core Sampler," and consisted of drilling pipe in 30-foot sections. The assembled sections of nearly 100 feet in length would be lifted from the deck, hoisted over the side, and rotated into a vertical position, at which time very large weights would be attached to the upper end of these long pipe sections to give it the downward thrust necessary to drive it into the ocean bottom. As a general procedure, this type of equipment could only be used when the sea was extremely flat. The approximate weight of the Kullenberg Core Sampler, when ready for lowering, was in excess of 2,000 pounds. The state of the art in oceanographic deep-sea winches in 1950 left much to be desired. Our winch consisted of a deck-mounted drum around which was wound 20,000 feet of cable. The winch was electrically powered with a 25-hp electric motor. One of the immediate problems with the winch was the clutching mechanism, which also served as a partial brake. With the ship moving up and down over the ocean swells, the pull on the winch cable was very uneven, so the winch tended to get out of control and start unwinding too fast. To solve this, a combined brake and clutch were used to reduce the winch's speed fluctuations. The clutch occasionally got so hot that it emitted clouds of smoke. Obviously, further refinement of this braking system would have to be made after our trial run was completed. It took all day to rig the Kullenberg Core Sampler and get it over the side. Then, all through the night, we let the device down into the ocean depths to the

bottom. When it was winched back on deck, we had obtained a beautiful 28-foot bottom-core sample which was extracted and analyzed. The following day a new device was tested which could record the temperature of the ocean bottom. It was called the "Heat Probe."

Upon completion of this test, the ship headed back for San Diego. We had an amusing time with sea birds, which looked like albatrosses but were dark gray in color. Our cook decided to tie some meat on the end of a long string and trail it astern of the ship. Those birds, being somewhat less than brilliant, would sweep down, pick up the meat and swallow it, not knowing that the line was tied to the food. There was, of course, no hook in the meat. We could pull a bird, while it was flying, down to within about 15 feet of the deck. The bird, frantically trying to fly away, eventually would pull the meat loose. Such a confused-looking group of birds! I am sure they didn't know what to make of all this. Neither did we, except that it developed into a keen sport, each of us trying to land a bird on deck. The same creatures would come back over and over again to pick up the meat, never seeming to grasp the connection between the food and our "bird line."

With the refinements necessary on some of our equipment, there would be a lengthy delay before the expedition could begin.

For the next several weeks, the ship underwent a rather thorough overhaul at the shipyard. I temporarily joined the deck crew in the effort of cleaning, painting, chipping, and hauling vast quantities of stores, piping, wiring, shackles, line, scientific equipment and spare parts aboard. Early in the morning, July 14th, our yard period ended, and we headed proudly from National Steel Shipbuilding back to Naval Electronics Laboratory, looking very trim and pretty. Upon arrival, there were about five tons of food in crates and boxes on the dock awaiting us. Later that day, we received news that the Navy ship, #857, which was to accompany us on the expedition, had failed in her trial runs up in the San Francisco area, and was not fit for sea. The ship had to return to the shipyard for repairs. We were concerned that our expedition would be further delayed. The following Monday we continued to load provisions, with tons of additional food coming on board. I don't believe I have ever seen so much jammed into a ship so small. Where could it possibly fit? My job was to stand at the bottom of a long ladder in the forward compartment and catch the food boxes as they were being slid down planks to the lower level. Once caught, the next move was to throw the boxes to the next fellow in a sort of chain-gang style to the final storage area, deep in the ship's hold.



Ed Barr extracting Kullenberg core

On the 19th, we got underway for a second trial run, again to test our equipment. The sea this time was calm, and by 10:30 we had arrived at our testing location, and commenced drifting as before. First sent down was the Heat Probe, followed by a Phleger corer, from which we obtained a good bottom sample. I spent a great deal of time in the laboratory watching the scientists analyze the cores, determining their composition and characteristics. We also tested the plankton nets which were towed behind the ship to collect micro-organisms. During the evening we decided again to lower the Heat Probe and did so using the big winch. The clutch once again overheated. When we retrieved the equipment, we found 300 feet of the cable hopelessly kinked, which we later had to chop off. Early next morning we moved the ship into shoal waters where we could test the "clam bucket," a glorified way of saying that we wanted to pick up some bottom surface samples by dragging a bucket.

It is well to note that in 1950 the shipboard equipment used in oceanographic research was highly experimental, crude, heavy and terribly unsophisticated. Nearly everything we were working with at sea was equipment designed ashore, with assumptions as to the effectiveness on board ship. In some cases we were trying procedures and using devices for the first time, with no assurance that they would even function at all in the hostile environment of the sea.

Later in the day, the hydrophone lines were streamed astern of the ship, and used to pick up ocean sound waves. The temperature-recording device in the Heat Probe apparently was malfunctioning, so that night it was lowered to the bottom three different times, each occasion with a different set of electronic components. Art Maxwell, our probe expert, put in a very long day, as did the winching and support crew. I, at 17, couldn't keep up with these supercharged situations, so was unable to stay awake for the whole performance. Friday morning, with the tests completed and the recording devices apparently functioning properly, the ship headed back to San Diego.

On Sunday the 23rd, the Navy ship, designated only by number 857, arrived in San Diego from San Francisco, having successfully completed her sea trial. The word was that our departure for the South Pacific was to occur the next Thursday. Tuesday we went down to the Union Oil dock in lower San Diego harbor to take on 26,000 gallons of diesel fuel, and 2000 gallons of lube oil, which topped our tanks to their capacity of 53,000 gallons. Upon returning to our Point Loma dock, we loaded a large amount of explosives and a remarkable quantity of cigarettes. (It seemed to me to be an ironic

combination!) On July 27th, I packed my sea bags — 3 of them, said goodby to the family, got my first butch haircut, and, with my father, drove down to the ship.

At 1:30 P.M. we at last were underway on the first deep-sea expedition in Scripps's history, heading southward at 8 knots on one engine. Our reduced speed was primarily to conserve fuel. The ocean is very patient with those who are curious. Besides, since this was an expedition, who was in such a big hurry anyway? We, of course, had the Navy ship in company with us. Immediately, in true Navy tradition, the two ships needed to adopt "pet" military names for each other. The *Horizon* was called "Seclusive," and we referred to the Navy ship as the "Notable 857."

My first night was terrible. Someone had taken my mattress and blanket. In the pitch black of the "pit" there was no way to determine who the culprit was. From the supply locker the problem was resolved: a new blanket and mattress were issued to me. After breakfast the meteorologists decided to send up one of their weather balloons off the foredeck. Life on board the ship in those early days was quite relaxed, generally speaking, with not much visible pressure evident in anyone's activities. Much time was spent by me reading, and assisting in the laboratory in making preparations for the various experiments that would be conducted in the weeks to come. Three albacore and one skipjack were caught on one morning which assisted the cook in making an attractive tasty meal. On the 29th we stopped early in the morning at our first pre-planned station. The experiment involved Russell Raitt's hydrophones and seismic-recording equipment. Three hydrophone lines were cast overboard and strung out astern. The 857 proceeded to move away from us, dropping TNT charges as she went. Raitt's equipment would detect these explosions through hydrophones and record them in the laboratory, thereby getting information concerning the velocity of sound in various ocean bottom layers, and also information about the speed of sound in varied water conditions from the surface to the ocean.

By recording these different velocities, Dr. Russell Raitt was expanding a new seismic technology in correlating the sound velocities to types of material through which the sounds were traveling. By measuring sound, speed, time, and direction through extremely complicated formulations, Dr. Raitt was developing the ability to determine the type of bottom strata (the type of material) through which the sound was traveling. It was during this initial hydrophone set that one of the buoys holding up one of the many microphones came loose. The buoy was about 300 feet astern of the

ship. I decided to swim out to retrieve it. All went well initially, except that I miscalculated the roughness of the ocean. It appears to be a great deal more calm when you are standing on board ship than when you are in the water swimming! Secondly, my perception of distance was highly distorted, because I had nothing to use for a reference. After a ten-minute swimming sprint, the buoy still didn't seem to be much closer. I then realized that the buoy was being moved along away from me by the wind and waves. Looking behind, my ship began to look mighty small. I decided to slow my pace and continue. It seemed like an eternity before I reached that damned buoy! The towing effort back to the ship seemed even longer. I seriously questioned whether I could last. The experience certainly illustrated that decisions involving the ocean should not be made on impulse. The ocean can be most uncompromising on those who have failed to do their homework.

The next day we were underway for our next station (a pre-selected ocean position). During this transit period, I read in the morning and helped Dr. Raitt with his hydrophones. Dr. Raitt developed quite a shipboard reputation regarding his equipment. Without doubt, his equipment was the most messy, the most cumbersome, the most involved pile of wire, buoys, lines and paraphernalia imaginable! Stowing and unstowing his equipment for each experiment took hours. He didn't want this equipment to be a safety hazard for people on deck, and this effort required great patience and a tremendous amount of project dedication. Dr. Raitt was a man of endless energy, and an extremely pleasant man to work with. He always had an unending amount of enthusiasm, optimism, and smiles. Though it was hard physical work, one couldn't help enjoying working in his presence. He seemed never to tire in his dedication to his project. His popularity grew as we headed ever farther from our home port of San Diego.

That evening we viewed one of our "famous" movies — one of the few general entertainments on board. I was curious to know who selected these classic films. I never found out! Where could Scripps find these museum items? Many were over 15 years old. That night we saw the "Bowery Boys." I don't know its age, but I am convinced that the movie was older than I was (17 at the time). The show wasn't really any good, but under the circumstances any entertainment was enjoyed.

The ship's daily routine at this point began to focus on essentially three operating groups: (1) the deck crew, operating the ship from the bridge; (2) the watches in the laboratory; and (3) the engineering group, operating the ship's propulsion and power service

facilities (water and electricity) from below. All three operations continued without interruption around the clock. My initial watch was serving with Dr. Rittenburg. We had a lot of fun from midnight to 4:00 A.M. trying to get the GEK working properly. The GEK is an abbreviation for an electronic piece of equipment called the geomagnetic electrokinetograph. Since the name was a mouthful, we referred to it as the GEK or the "gek." The three groups (deck, lab, and engineering) required constant coordination. The activities of the laboratory and scientific staff would invariably require the services of the deck crew in positioning the ship and helping with the equipment. Also, services from the engineering staff were needed in terms of electrical and power requirements, and winch-operating personnel. The coordinating skill required between these three groups increased as the trip progressed. It is one thing to have a coordinated organization of three very diverse and very specialized types of people on a short-term effort. But it becomes crucial when you schedule intensive projects for almost 30 straight days at sea. With only open ocean to see, personality factors became acute. Now that I look back on it, even a rather small requirement for a little extra personal effort not given, or given begrudgingly — or a change in the personal routine on shipboard — or a change in the operational plans — could generate an amazing amount of tension and/or resentment from those who would be affected. For example, if the scientific group decided to conduct an unscheduled experiment, such as lowering a sampling device, this single evolution would require the coordinated effort of many people. Precise navigation, changes in the watch schedules so that the proper personnel would be available from the three different departments, were all needed in order to carry out the experiment. In general, every time there was any kind of change in the scientific program, it involved changes for everyone on board. I remember our frustrated cook's exasperation while he stood in the galley doorway with a full meal served in the empty messhall, while all the scientists were aft on the stern examining an unscheduled newly-caught sea creature! A great deal of diplomacy and careful judgment were required on the part of the scientific leader and the ship's captain to be able to make these changes occur gracefully. Initially, each expedition is scheduled in detail; i.e., what is to be done each day, and from what location, and where you are going to be two weeks from now. This is all planned out ashore, long before anyone comes on board ship. When you get to sea, however, numerous unplanned things happen, such as rough weather, problems with winch cables, winch breakdowns, power failure, and a multitude of other problems that were not on the

original "master plan." This would mean numerous changes in the original itinerary. Innovation is the key to solutions. It is then up to the coordinator of the expedition to determine and implement whatever changes might be required or be possible. The job of being the managing scientist of the expedition is not easy. It involves dealing in a tremendous complexity of personalities, temperaments, and priorities for different scientific programs. On board ship we had a staff of meteorologists, seismic personnel, chemists, and microbacteriologists. We had the bottom-sampling group, biologists, and geologists — each one with his own specialized expeditionary program, involving problems to which he wanted solution values on this one trip. This expedition might be the last chance for years to collect the data required. To consider all this within the framework of 34 men jammed into a tiny 143-foot ship, it was amazing that so much was accomplished. Many times disagreements would occur about whose project would receive the highest priority at a particular station. In fact, frequently one of the biggest controversies involved discussions as to where the ship should properly be. One scientist would want to be to the west, while another would want to be to the east. Some wanted to stay on the present station for an extra day or two, while another group would want to get underway and head 300 miles south. Also involved were the effects of the ever-changing conditions of the sea. Certain scientific activities could not be conducted at all in rough waters. Other activities could. If it was good weather and calm, coring operations could be conducted. The bottom-coring personnel would naturally wish to take advantage of calm sea conditions and stay longer, whereas the other participants would be anxious to move on. The scientific leader on board a research ship on a long expedition certainly assumes a ticklish and delicate combination of responsibilities, involving both the technical evaluation of problems in addition to the personality factors. It is not a job which is easy, as some might imagine.

One of the blessings for everyone that came out of our smallest specialized sub-groups was the "radio shack" (the radio operator: a group of one). Art Carter provided the entire crew in the morning with a typed-out summary of the news which he would pick up by listening to the overseas radio late at night. He then typed it and presented the single copy for our entertainment and information, with breakfast, and sometimes it included tidbits of shipboard gossip. Thus, we had our own newspaper, which was "published," under a variety of titles, such as "The Horizon Sword of Truth," "The News, Nothing But the News," etc. It was typed on long rolls of

teletype paper. Sometimes our newspaper would be 30 feet long! We would sit side by side in the galley, and slide the long strip of news along, reading each morsel as it slid by. It was probably the most widely read copy in newspaper history.

Much of the ocean that we were now covering was completely unexplored. This was intentional. There seemed little point in steaming directly toward Honolulu, because that is a well-traveled route. We therefore proceeded on a zigzag course pattern across those ocean areas on which ships rarely travel. In this particular case, our general trend was toward the equator. At a certain southerly point the ship would then head for Honolulu. The laboratory watches were alternated daily so that you didn't stand the same evening watches in succession. They were gradually rotated so that everyone had an even chance to get the "mid watch" (the least-favored midnight to 4:00 A.M.). During every watch a consistent and continuous system of record-keeping was maintained. This included frequent monitoring of the fathometers that provided a continuous track of the bottom depth and all the configurations of the bottom as we proceeded. At a later date this information would be used to improve and update the charts of the ocean bottom. We also used the GEK regularly. This device was used to record the variations in the magnetic lines of flux in the earth. The BT winch (an abbreviation for bathythermograph) was used every hour. This device recorded the variation in water temperature on a continuous basis from the surface down to 800 feet. It recorded the temperature gradation on a smoked slide. The readings were obtained when the ship was under way, but a degree of human skill was required. The little BT power winch was operated from the side of the ship. One would lower the recording device — which looked like a rocket — over the side, and let it drop, free-wheeling, to a predetermined depth. Then the brake would be applied, stopping its descent. Winching power was then applied to reel the device back to the surface and aboard. This operation would be done, in most cases, when the ship was underway at 10 knots. At night the BT operator found himself at the side of a rolling ship in total darkness, with the spray and the waves only a few feet below his feet. In any kind of rough weather, this BT position was frequently subject to waves making a clean sweep of the deck. In spite of breaking waves over the side, the operator had to hold his station, because the equipment was already over the side. One could not run for shelter, as the brake and hoisting power were combined in a single hand lever. To let go of this lever would cause all the wire on the winch to unwind, sending the recording device and all its cable to the ocean bottom

forever. It was not at all uncommon, from the protective position of the laboratory door, to look back and see your watch-mate at the BT winch completely disappear from sight as a wave would come crashing over the side of the hull and sweep aft over the BT winch and its operator. We were always very careful in rough water to watch our companion when he was aft on deck. Under those conditions, no one else would be in the stern area. A man washed overboard without an observer would have little chance of survival. We also took turns taking BT readings. It wasn't fair for only one person to get wet consistently — why not alternate the soakings?! At night, the possibility of getting washed over the side was very real. We tried to be very careful on that slippery, heaving deck.

There were several occasions, while operating the BT winch, particularly between midnight and 4:00 A.M., when I would ask myself: "What the devil am I doing out here?" My thoughts at that time would be on my dry, soft stable and warm bed waiting for me at home. I longed for an uninterrupted night's sleep. While standing alone, soaking wet and cold on the back end of the ship, careening through the ocean with my hand on the BT winch handle, I would frequently question the importance of my involvement in data-gathering for scientific evaluation. At age 17, there seemed to be several shipboard scientific activities that did not appear to me to be very relevant to the present world, or important to the extent of the hardships and costs involved. Now that my perspective includes a number of additional years, I can appreciate that one very frequent observation of new scientific inquiries involves considerable skepticism of their merits. In most cases, however, the observer is considering only the short-term view, as was I at 17. New investigations almost always appear, at the time of inquiry, to have little consequence to the "real world." This is particularly true for those who are not personally interested in the subject. How completely senseless our expedition must have appeared at that time to those who were not interested in oceanography, or those who, in general, were not interested in obtaining new knowledge about the oceans! The cost of running a ship at sea with the personnel we had aboard was approximately \$1,000 a day. Those that support basic research — learning more about the earth and the universe (particularly those who supply the capital resources for doing so) — have to be either highly perceptive or highly dedicated to the longer term view. American industry has a tradition of looking ahead. It is fortunate, for us, that it does!

On Tuesday, August 1st, we arrived at another pre-arranged station. The Kullenberg core sampler was made ready for descent.

We also rigged our small boat, the "tuna tender," over the side for a trip over to the Navy "857" for a new supply of movies. Actually, the movie exchange between ships consisted of a mid-ocean bargaining session — each side trying to get the best from the other and exchanging for it the worst that they had! Bartering was lively, noisy, and an amusing sight. Involved was our 18-foot "tuna tender" alongside the comparatively huge Navy ship. Scores of Navy men lining the rail were engaged in spirited and enthusiastic argumentation. As the expedition continued in the weeks to come, this movie exchange became an intensely competitive event: Scripps vs. Navy. The all-important question after each session was: "Who got the shaft and how vigorously did our 'ambassadors' represent our interests?"

Hoisting the tender back on board the *Horizon* frequently was difficult. Weighing over one ton, the boat had to be hoisted to the boat deck, which was some 20 feet above the water. As the ship rolled, the boat deck was very unstable as a hoisting platform. The tender would crash into the side of the *Horizon* and then swing far out away from the hull and then once again come crashing in. We had to be very careful not to get caught in the middle.

It was at this station that we first had our encounter with the sport called "Sharks." Late in the evening of August 1st, we discovered a large shark nearby and decided to catch it. A very large shark hook was baited and dropped over the side. The fight was on! And after some struggling, we got the shark alongside and over the rail, aft near the laboratory. I dashed for my camera to get a shot. By the time I had returned, the shark had bitten the steel hook in two! We were amazed at the shark's toughness. Even with the tremendous punishment of being beaten with a fire axe, it was rare that we could penetrate the shark's tough skin. Sharks must be among the most durable creatures in the sea.

After 9 days at sea, many of us were out of clean and dry clothes. Our imaginative engineers rigged a portable scrubbing board for us on the port side at the rail. On the board we would do our washing in seawater and rinse in fresh water. Looking out across the vast expanse of puffy tropical cloud patterns overhanging the sparkling white-capped sea, with sounds of rushing bubbles passing by the ship, presented the most exotic environment for "washday." What a magnificent "bay window" to enjoy while working on domestic chores. These were the moments that offset the BT winch operations after midnight. But even those moments (or hours) in the wind and cold held their unique charm, magic, and fascination, as the stars and the sea blazed in twinkling light.

To those who are unfamiliar with shipboard life, it might appear that a four-hour watch separated by an eight-hour off period would offer a comfortable working schedule. This might be so if one could depend upon this schedule. On a research vessel there is no such thing as a standard day or schedule. The eight-hour so-called "off" period was frequently unreliable. If a bottom core was being lowered or raised, which might take 10 to 15 hours, those responsible for the coring program would, of course, be on hand. If they needed additional assistance, they would call those required, whether they were on or off watch. Everything seemed to evolve into a day-to-day, hour-to-hour continuing evaluation of our activity schedule. When additional assistance was required, one of the less popular tasks was being assigned the job of groping around in the "pit" to wake the wanted man — who just might have been on deck for the past 24 hours. It was very hard on one's popularity to bring those tidings. I dreaded being selected so frequently. Sleep interruption became a way of life. A point was reached when many of us with 15 or 20 minutes to ourselves could lie down anywhere and go to sleep. Soon there were hammocks strung from bulkheads and stanchions — great for cat naps. When mattresses were brought on deck, as the tropical heat set upon us, the captain put his foot down: "No mattresses on the weather decks. They are a hazard to the deck personnel at night, and they will get soaked in salt spray in heavy weather." By now the "pit" was a sweltering 95 degrees, with humidity over 80% (no air-conditioning back in those days). It was a great temptation to sneak a mattress topside in the middle of the night. (The captain's judgment was correct, however.) We in the "pit" envied the meteorologists living in their now-comfortable tent on the foredeck. The cool ocean breeze made their quarters the most desirable of any on board.

An excerpt from my diary revealed on Saturday, August 4th: "We arrived on our new station and scheduled a full planned day. First, 1:00 to 6:00 A.M., we dragged the trolling net, then sent down 2 little Phleger corers, then refueled the 857 from which we hoped to get 3 more movies. We will drag the trolling net again, and after that I will do my wash. Later we will get another core, and to top it off for the day, we will send down the [Heat] Probe. I have the 8:00-12:00 watch on the BT, and we are out of milk. I am going to start using those calcium pills my mom made me take." A rather full day of activities!

On the evening of August 6th, we selected one of the three movies previously obtained from the Navy ship. We naturally hoped that we had the better part of the bargain in this latest round of

exchanges. With great eagerness, we put onto our ancient sound projector the film "Outpost of Morocco." It turned out to be a disaster from the standpoint of entertainment. The sound was absolutely terrible — no one could hear a word of it. The Navy had really done it to us this time!

For the next few days we were on a stop-and-go basis, spending a few hours at each station. At these station stops we performed some coring operations; sometimes the heat probe was sent down; other times we would go very slowly through the sea, dragging our nets behind, trying to obtain biological samples of very small sea creatures. There was also that frequent operation with Dr. Raitt's seismic buoys, his multi-hydrophones, and his multi-miles of cable strung out to sea astern of the ship. It was during one of these brief stops that we had the heat-probe lowered. When it was time to pull the probe out of the bottom, the ship no longer was positioned directly above the instrument. The sea current apparently was unusually strong and the ship had drifted away from the vertical. As a result, a tremendous amount of tension was required in order to pull the probe out of the muddy bottom. In attempting to do so, the cable snapped, resulting in 5,200 meters of cable being lost and the probe itself. What a disappointment for "Mr. Probe" — Art Maxwell — to lose his instrument. Fortunately he had a spare. The cable loss, however, represented a very high percentage of what we had on the drum (5,200 meters is approximately equivalent to 15,600 feet). The decision was made to splice together end to end the wire from the ship's other smaller winches. In this manner, all of the various cables would be combined onto the big winch. The splicing operation took the better part of a whole day, as every strand had to be joined carefully together. Cables of various sizes were spread along the entire length of the ship. Weaving each wire strand was tedious and cumbersome work. When the job was completed, the main winch drum had a combination of 5/32, 9/16, and 1/4 inch wire. The total length was now 5,500 meters, or about 16,500 feet.

The temperature range had become very steady and typical of the tropics (between 80 and 90 degrees). The humidity was quite high, probably near 80%. We continued to develop new shipboard diversions that generally occurred late in the afternoon about sunset. Sunsets and cloud formations in the trade-wind tropics are glorious sights to behold. One of the crew, Mike, had a Spanish guitar on board. We frequently would congregate on the stern late in the afternoon and sing various songs until the sun went down. These were also the occasions when we would have bull sessions relating

to the way-out theories held by some of our scientists and crew members. I imagine that one might today classify those sessions as being the 1950 versions of what is presently called "brain-storming" sessions. Needless to say, at 17, I was tremendously impressed by some of the scientists' views. For example, Dr. Revelle seemed to be most interested in the feasibility of towing icebergs into temperate parts of the world, as a new source of refrigeration and fresh water. He would calculate in his head the estimated pulling force required to drag an iceberg at 2 knots. On one occasion the captain attempted to explain celestial navigation to some of us. I didn't hear all of his explanation nor did I understand very much of it.

On Friday, August 11th, we arrived at Point Able, which was our most southerly position. From this point we turned and began heading northwest toward the Hawaiian Islands. The 857 stayed behind so when we arrived at our next station on Sunday, she would be quite a distance astern of us. This arrangement made it possible for us to experiment with those hydrophones again. As the Navy ship proceeded toward us, they dropped and exploded small TNT charges in the sea. We would then pick up the sounds through the ocean from the explosions. Dr. Raitt was very hopeful of obtaining excellent long-range sounding records of the bottom profile, and the approximate density and composition of the bottom sediment layers. Maybe even the hard-rock structure under the soft bottom sediments could be detected. Sunday, August 13th, was our 18th day at sea. We had not seen another ship, other than the 857, nor any land, nor plane during that period. From my diary of Monday, August 14th, this combination of entries was made: "I had the 12:00 - 4:00 midnight watch. . .how gay! Last night we caught an 80 pound shark and watched the movie 'Kiss the Blood Off My Hands.' It was a good picture but the sound was lousy. Tonight I have the 8:00 - 12:00 watch. No sleep. We fueled the 857 and again tried our luck at the movie exchange. It rained all afternoon. Also the 857 reported that she had burned out another clutch. I have been very careful in rationing my candy. So far, a crew member, Buck, and I have been splitting it. There is only 1/3 left. There is no station today so not much doing. I certainly need that! Dr. Revelle sent home a message on radio telephone concerning our well being. I am having trouble getting my laundry, reading, watch standing, deck work, sleep, and all the odd jobs done and still have time to learn more about trigonometry and physics."

The following day at another station we were taking a core. The weather was so warm and the sea so flat that we all decided to go for a swim — in spite of all the sharks. This type of research ship

is an excellent platform for diving, as much of the scaffolding and high super-structure make it possible for very large leaps through the air into the ocean. Some of us managed to dive from the top of the A-frame, a drop of some 30 feet. We all had fun talking underwater near the hydrophones, which would amplify the sound of our voices and broadcast it over loud speakers on board ship. Human voices under water sound like monsters of the deep! Poor Dr. Raitt — What is this expedition coming to?! Those hydrophones were so sensitive that one could hear over the loudspeaker the sound of a nickel being tapped on the deck of the ship, even though the microphone pick-ups were some 300 feet astern. One could imagine the sound volume our voices must have had as we shouted and screamed under water near those microphones. We weren't too popular as we boarded the ship. It was during this swimming party that Robert Dill decided to use some soap for personal washing. In this case we were using Dreft. The idea caught on: a good salt-water bath with Dreft soap. We found later that it was extremely hard to get the damned soap off, and we all ended up feeling terribly greasy. As it turned out, Dreft was never intended to be used in salt water. That evening there was a very strong odor of smoke near the room where all our explosives were stored. We rushed down below and found that it was the fathometer, which was overheating.

Continuing from the diary: "The sea condition ever since Point Able has been completely flat. There has been no wind, but very heavy rains occur off and on periodically. When it is possible, Captain Faughn frequently chases rain clouds so that the ship can get a fresh water wash down, and we can get some laundry and bathing done — including washing our hair in that nice soft fresh water. The rain chase episodes are always lots of fun. An interesting feature is the fact that once we get in one of these tropical downpours, the visibility becomes nearly zero. One can't see too far, so it's very difficult to stay under the rain cloud. We often use full power and a tremendous amount of maneuvering rudder just in time to discover the ship is emerging into bright sunlight, going in the opposite direction from the cloud. We then have to use our full rudder and wide-open power to reverse the ship's direction in order to re-enter the cloud for another deluge.

"The scientists are trying to teach me how to use the slide rule as an improvement over long-hand mathematics. I am finding that over a period of time I can use the slide rule with some degree of confidence. Since our period at sea is now in the 3rd week, it has been decided that now is the time to bring out the beer and make it available in limited quantities for an hour or so late in the afternoon

at the traditional sunset get-togethers. The charge is 15¢ a can (12 ounces). Our movie last night turned out to be another grand slam for the Navy. It was by far one of the worst. 'Northwest Stampede' was terrible, both sound and picture. Since movies generally last till 10:00 P.M. I wasted quite a bit of sleep for that stupid nothing, and had to stand the midnight watch to boot! The crew always seems optimistic that the next movie will be better. The captain announced that we should be able to sight the island of Hawaii tomorrow."

The excitement aboard the ship in the anticipation of seeing land after almost a month of blue ocean produced a very festive spirit. On Monday, August 21st, I got up at 7:00 A.M., and found outside the ship the magnificent and beautiful island of Hawaii only 5 miles away. What a staggering sight. I remember being thrilled at the sight of land and all the greenery on that island. How lovely and how colorful! It just didn't seem possible that the earth had any land — we were so used to just seeing water. I kept looking back at that island, expecting that it would not be there. The city of Hilo was directly in front of us and Mauna Kea to the right and Mauna Loa to the left. Such gorgeous, fertile countryside. For the first time in 26 days we saw an airplane fly by — a DC-3. Everyone wanted to go ashore, but the decision was not to do so. The ship was allowed to drift just off the coastline. We spent the day washing, cleaning, diving and swimming. The current slowly brought the ship down the side of the island, giving us a slow-motion view of its entire expanse. How beautiful this place is! So many waterfalls, descending over the big cliffs and falling with great spray directly into the ocean.

The next day we headed out to sea for one last station from which the island was barely visible. Then at 3:00 P.M. we got underway and headed under full power for Honolulu. That night we saw one of the very few good movies. It was "Command Decision." Everyone thoroughly enjoyed it. At 10:00 A.M. the following day, we picked up a pilot and docked at Pier 27 in Honolulu. This island is fertile and green also. Soon the crew members were scattered all over the island in pursuit of their own personal points of interest. I found myself spending a good deal of time on Waikiki Beach, seeing the aquarium, and consuming great numbers of banana splits and ice cream and all those things which were not available on ship. At one time or another during the day or evening, I saw almost every shipmate at various spots on the island. In port for the first evening, many crew members returned to the ship feeling no pain. They were in a very festive mood. We ended up with a great

firecracker display occurring on the fantail, which gradually expanded to include inside areas. Even the "pit" was not immune to firecracker explosions. It wasn't until after 2:00 A.M. that things settled down and we could all get a little shut-eye. The following day we moved the ship to Pearl Harbor, and stayed there for our remaining stay at Honolulu. I took a guided motor tour of the island, all the way around, and enjoyed watching the surfing regatta which was being conducted that weekend. Then began my stocking-up program: collecting all those goodies that on board ship are so much in demand at sea — such as a very substantial quantity of candy and chewing gum.

At 2:00 A.M. on Sunday, August 27th, we once again got underway and departed from Pearl Harbor for Kwajalein Atoll, part of the Marshall group of island some 2,500 miles west. On Monday, we planned to lower the huge Kullenberg core sampler. The flat bottom, which we had passed the day before, was exactly what we wanted to sample. The decision was made to backtrack, to retrace our path to find this ideal flat bottom. We all got a very good chance to see what an ocean-going tug was like in a rather mountainous ocean. The *Horizon* was a converted Navy tug and as we went crashing into those trade-wind seas she sure threw a lot of spray and was very jerky in her motion. Ocean-going tugs are rather blunt-shaped ships. When we found the proper flat spot, the large core-sampler was laboriously lowered over the side and the cable payed out. At first everything went smoothly. After 3,600 meters of cable were out, the clutch started slipping, and the winch started to run wild. All the brakes were jammed on full. The winch drum came to a squeaking halt. We noticed that this motion had also caused the core sampler to trip itself — which meant that the "audible ball-buster" was now hanging in a position that would not give us warning as to when the core rig was near the bottom. (In order not to ensnare the coring rig after it reached bottom with additional unwinding cable, someone invented the "audible ball-buster," which upon tripping would send out sound waves which could be heard on the shipboard hydrophones.) Under the circumstances, the only thing that we could do was to pull the Kullenberg core-sampler back aboard. Much to our dismay, the attempt to hoist revealed a slipping power clutch. Our engineers tightened the clutch several times. In doing so, they got the clutch to hold, but now the motor could not pull the load. Finally, our chief engineer, John Massey, tried a method that worked. He put full power on the electric motor in neutral, and then jammed the clutch into gear, and in the same instant released the winch brake. In doing

so, the core rig gradually began to come up. Once the rig was back on board, we investigated the cause of our difficulty. We discovered that the tension of the cable on the drum due to weight accumulation had bowed the flanges of the winch drum outward in such a way that the bolts holding these drum flanges were now rubbing and jamming on the surrounding structure. This winch was completely inadequate for this type of oceanographic use. We were sure that in subsequent expeditions a greatly improved type of winching system would have to be designed!

At 4:00 A.M. the next morning, August 29th, electrical storage batteries high up on the boat deck broke loose. As the ship wallowed in the trough of the seas, they slid from one side to the other, throwing battery acid over the deck. One battery eventually disappeared over the side. The wind continued to blow at approximately 30 miles per hour and shipboard life was somewhat uncomfortable with all the pitching and rolling. One of our biologists, Robert Huffer, passed out cold with no warning. He seemed to be quite sick. We found him lying in the scuppers at the rail on the main deck. During our evening meal he passed out again at the dinner table.

The following day — Wednesday, August 30th — we were underway until 2:00 P.M. Dr. Revelle decided that he wanted to let out all of the cable on the big winch. (Through some ingenious persuasion, Dr. Revelle had arranged for a new supply of cable to be installed on the large winch while we were in Honolulu.) By emptying the drum of all its cable, Dr. Revelle was hopeful that the release of accumulated tension of all that wire around the drum would allow the flanges to straighten. He reasoned that this might stop the binding that occurred on the previous occasion. The procedure was commenced. It was 10:00 P.M. before we were able to unwind all the cable into the sea and then wind it all back up again. The operation did produce the results Dr. Revelle had envisioned. The flanges were now straight again so we had the main winch back in operation. The next morning we came across what we hoped was a flat-topped sea mount, known in geology as a guyot. All day we ran a zigzag pattern across the ridge. The depths would vary from 2,700 fathoms up to 850 fathoms. Early in the morning we maneuvered to a high spot on the ridge. We then prepared to lower the dredge. This awkward piece of equipment consisted of chains, acting as a sack behind the steel framework. The purpose of the dredge was to drag the bottom to pick up whatever samples could be trapped. The first time we lowered it we retrieved nothing. The second time it buried itself in the mud and we couldn't extract it. Finally we pulled so

hard that the cable broke. What an empty feeling when one sees the cable tension go limp — knowing that the whole rig is lost. We then lowered a Phleger corer to try to obtain a bottom sample. The sample turned out to be a small quantity of Globigerina ooze. In order to obtain more coarse material, we lowered what we called snappers. These small retrieving devices obtained very little. A smaller core sampler was lowered. It had poor results. These operations continued throughout the night. A second dredge was rigged and lowered. This time several large rocks were recovered. To our surprise, they were basically nodules of pure manganese dioxide. The dredge again was lowered. This time we received a haul of a large quantity of rocks, all with the black composition of manganese dioxide, with a scattering of white-colored coral-like sponge, long and thin in shape. In one of these manganese dioxide nodules a rather exciting discovery was made. One of the scientists observed a shark's tooth protruding out of the black composition. A process of dating the age of the formation and the shark began. The next day the dredge was lowered again. We obtained several large rocks that had petrified Foraminifera included in the manganese-dioxide rock mass. These rock structure samples were new discoveries. The scientific staff was working at an accelerated pace, trying to obtain all of the samples possible. We moved the ship in search of a flat spot, in order to obtain a core sample of sediment rather than the rock-like structure we had recently retrieved. During the night the wind came up to 30 knots. The ship began to pitch. A big wave lifted the bow far out of the water and then she dropped. Her nose completely buried into the next wave. As I opened the laboratory door to look out along the main deck, a green wave of water went rushing by, carrying with it many articles, such as paint cans, shoes, clothing, etc. Those "lucky" meteorologists occupying their comfortable tent at the bow were getting a real soaking now! Some lost much of their personal clothing and equipment. After that the ship was slowed down. By noon it was calm again. We rigged the Kullenberg core sampler as a flat spot had been located. There had been very few flat spots since Honolulu, and those that we were able to see on the fathometer tracings were very small in size. The core was brought up late that night. It had produced only a 3-foot sample containing rough gravel. Trolling nets were lowered late that night. We towed these nets for plankton samples throughout the evening. It was now September 5th. We were still looking for a good flat place to do some coring. Since Honolulu, a zigzag course pattern in general had been followed, covering as much untraveled area as possible. In this irregular

manner, we were slowly working our way out toward Kwajalein Atoll. While this search for flat spots continued, Dr. Raitt's seismic equipment was called into service.

We detonated small charges of TNT off the ship while Dr. Raitt's hydrophones were strung out to sea astern. This effort was to determine whether the bottom below the ship would have a soft covering of sediment or whether it would be rock. On one occasion, a TNT charge was picked up by a shark. When the explosion went off, it made a rather substantial red patch in the ocean, but there was nothing to be seen of the shark. A promising position was located through seismic methods, and a Phleger corer was lowered. From this we obtained a 7-inch core composed of red clay and gravel.

In the evening I assisted Dean Carlson in preparing a numerous series of bottles with messages in them in several languages, to be dropped over the side at different intervals. By this procedure, it might be possible to know more about the ocean currents. These bottles would disperse over many many months, possibly years, to locate on far-away shores. Who knows, some swimmer or shore stroller in a foreign country might pick up one of these bottles, read its message, and write a letter to Scripps! From such a response, the general course of the ocean's surface currents could then be computed.

For the next several days we continued our zigzag course, taking dredge hauls as frequently as we could. In one haul we brought up some fossil coral which meant that at some ancient time the ocean floor at this point was near the surface of the sea. Ed Hamilton was very enthusiastic about this discovery. He was working on his doctoral thesis, and the subject was on the origin of the truncated or flat-topped sea mounts (guyots). This discovery was crucial to the theory that truncated or flat-topped sea mounts became truncated as the result of surface ocean action during some period many millions of years ago when these mountains were at the ocean surface and after truncation were submerged. During their period of time at the ocean surface, coral accumulation did occur. Our obtaining fossil coral on these truncated mountains, many thousands of feet below the ocean surface, would prove their origin.

I spent several evenings working in the bacteriology laboratory. With all these bottom samples now accumulating in the lab area, a great deal of analytical and chemical analysis was being made. I assisted in making silica tests, washed and sterilized many test tubes, and did the other odd jobs that were necessary to the procedures. On Tuesday, September 12th, our plans were changed. Instead of going to Kwajalein Atoll, we would first go to Bikini

Atoll. The 857, also referred to (by us) as "the great greyhound of the sea," left Honolulu on September 11th, after having her propeller shafts relined. Now we could look forward to getting back into the movie exchange business, and of course were eager for our mail. The laboratory procedures relating to all this coring work and bottom-sampling work were beginning to assume a most organized structure. On the 12:00 - 4:00 A.M. watch I started in the bacteriology laboratory in preparation for a coring operation. We hoped to start in the early morning. It was very much similar to preparing a surgical operating room for a major operation. The laboratory was thoroughly cleaned, as was all the testing equipment to be used in the various chemical, biological and geological analyses. A significant amount of research information would be lost if the samples obtained were allowed to become dry or to age. Certain tests had to be performed immediately. A dimension of urgency and speed seemed to be present.

In the morning a Phleger core was obtained and extracted. It was then described in detail, while notes were being taken. A dissection was then performed wherever layers of different materials were observed. Tests for iron, phosphate, nitrate, silica, hydrogen, iron content, and oxidation and reduction content were made. My job was mostly to clean and sterilize the instruments, bottles, and test tubes. Also I added, very carefully, measured amounts of acids and bases into different solutions. At last my "official" job description as "Laboratory Helper" was being fulfilled in practice. It was exciting and interesting work. We worked at these procedures day and all night. For this type of operation the clock would not stand still — the work must be performed now.

The following day I got up for one meal and then crashed to sleep. The day and night procedures, however, continued in the laboratory for another 24-hour period. In a dredge haul the eardrum of a whale or porpoise was found. We did have our relaxation moments within this rather pressing schedule. In the galley on the evening of September 14th, Mike had his guitar and was playing to the voices of 10 enthusiastic singers. Dr. Revelle was really booming out the notes. Frank Vaughn, our head cook, stole the show by blowing a tune on a gallon cider jar. He wore his glasses which made his eyes look twice their normal size, and he had a ruddy complexion. While blowing high notes on that jar he looked like a bomb about to explode. What good times we had!

On September 15th we obtained a core barrel of *Globigerina* ooze. Our work in the laboratory then became almost frantic. This

sample was some 20 feet in length. The numerous steps in analysis of this core sample had us working for another 24-hour period.

The following day, late in the afternoon, the 857 appeared slowly over the horizon. It was certainly good to see her again. It was nice to see anything floating! We lowered our lifeboat. Bob Dietz, Carl Shipek, and William Menard were taken back aboard the 857. They had been on board our ship temporarily while the Navy ship had been undergoing repairs. In exchange for these fine gentlemen, we were able to bargain and get two movies. These were the first we had seen since Honolulu some 21 days earlier. We also got mail, which stopped everything on board the ship until it was read. Promptly at 8:00 P.M. we warmed up our ancient movie projector to view a movie called "Scene of the Crime," starring Van Johnson. In spite of the great sales pitch by the Navy regarding Van Johnson's acting ability, the film and picture were quite poor. If it hadn't been for such high expectations before each show, we probably would have given up attempting movies on board ship a long time earlier. (Hope springs eternal...) With so little in the way of major diversions to experience, the movies were about the only universally controversial subject on board ship in which all participants had equally bad information! The members on board ship had almost equal vocal opinions. Fortunately, none of these opinions could ever be proved in advance. So blind hope became our ultimate sanctuary. There we would be, all crammed into the sweltering eating area adjacent to the galley, watching the flickers, as the ship rolled slowly back and forth, while her diesels roared out their monotone. Attendance was nearly 100% for each showing, except for the watch-standers. Another curious thing about movie time on board ship was that, in spite of how bad they got, no one seemed ever to get up and leave in the middle. We all seemed to be hypnotized at seeing on the screen automobiles and on-shore activities. We became fascinated by the possibilities of an improvement in the film as the movie progressed. But, as on so many previous occasions, the movie did not improve and the hour became late. It was my fortune to have the midnight watch from 12:00 till 4:00 and my new watch partner was Robert Huffer. The 857 was with us again, so Dr. Raitt was really back in his business. As usual he was raring to go. An intensive seismic program called the "leapfrog technique" was started. This required that the Navy ship approach us from astern and proceed on ahead, dropping TNT charges at periodic intervals. Then in the evening we would chase after her while she lay motionless. By morning we would be many miles ahead. Then we would stop, string out the hydrophones for listening purposes, and

the Navy ship would again approach us, dropping charges on the way. The "leapfrog" process would then be repeated. In the afternoon of the 17th, during one of these stops, we unfortunately got the hydrophone cables caught underneath the ship and all twisted up in the propeller, which was slowly turning. Many of us went into the water to untangle them.

During that day came a general announcement over our loudspeaker system throughout the ship that the ship was now straddling both yesterday and tomorrow. This seemed like a reasonably profound announcement to make. The ship apparently was drifting slowly across the 180th meridian. We were told that everyone on the port side of the ship was in tomorrow and everyone on the starboard side of the ship was in yesterday. In other words, we had moved from September 17th to September 19th drifting across this 180th-degree meridian. September 18th in my diary is crossed out as never happening.

The following day, during our continued leapfrogging program, we sent down the Kullenberg core sampler. Upon retrieving it, the core revealed what had never before been seen: red clay was found on top of calcareous ooze. The balance of the day was spent analyzing this core sample. No immediate conclusions were offered. The lab work continued until after midnight.

Once again it was my turn for the midnight to 4:00 A.M. watch. After the watch ended and after a bit of breakfast, I couldn't stay awake any longer, so out like a light I went. The phrase we frequently used at times like this was "I'm all eyeballs and shoelaces." Would you believe that a day later, in the absence of anything better to do, the movie "Scene of the Crime" was shown a second time? Once again, it was shown to a "full house." This had to be a new low for our evening entertainment programs. My diary only contains a curse and brief mention of this event: "How terrible!"

On Friday, September 22nd, we made our last stop in our leapfrog series. Another Kullenberg corer was lowered. This was to be our last full day at sea, for tomorrow we would arrive at Bikini Atoll. The plan was to put ashore for three days, with five men to do some research work on the island. Meanwhile, the *Horizon* would put back out to sea to do more coring and photographic work outside the atoll. Atolls consist of numerous small islands, usually less than a mile long, in a circular pattern with an overall diameter of about 20 miles. Inside the circle of islands is the atoll's lagoon, consisting of water reaching a maximum depth of only 150 feet. The lagoon water is pale blue-green, due to the coral bottom. Outside this circular pattern is the deep ocean, which is a very dark blue.

Between the deep ocean and the shore of each island is a series of reefs. The ocean swells break on these reefs, which may extend over a half mile from the shore line. This reef shelf has a multi-colored spectrum of colors, as this is the area where marine life and tropical marine growth occurs.

That evening we pulled up a core sample containing a rather odd combination of Globigerina ooze and red clay. The layers alternated, giving the core a rather extensive striped effect between red clay, the dark material of terrestrial origin, and Globigerina ooze — a very light, almost white substance, of biological origin. In all, there were ten layers of each. The following morning at 11:00 we sighted Bikini Atoll. As we approached, it looked like a patch of forest growing out of the ocean. This certainly was a strange sight. One could search the rest of the horizon and see nothing but the vast expanse of the sea, and then in this one localized sector of the distant horizon see a mass of vegetation just growing out of the ocean. The land on the islands, at its highest point, was about 10 to 15 feet above the sea level. It wasn't until we were quite close that any land was visible. Both ships entered through a narrow channel into the lagoon and anchored in the protection of this ring of islands off the shore of Bikini Island — one of the many islands in the atoll chain. The 857 tied up alongside for fuel. At 4:30 we went ashore. Buck Miller and I launched off on a round-the-island tour. We saw numerous reminders of two major historical events: one being the wreckage of World War II, and the other being the 1946-1947 atomic-bomb experiments conducted at Bikini Atoll. It was during these atomic tests that an entire task force of some 30 ships was destroyed in this huge lagoon, first by an air-dropped bomb, but more conclusively by the subsequent A-bomb from under water. During this second A-bomb experiment several large warships were bodily lifted out of the water, into the air, and in one piece cast many hundreds of feet through the air. As we strolled along the lagoon side of Bikini Island, we saw numerous wrecked landing craft and various vehicles, including a very rusted jeep. We decided to head across the island to the windward side, the outer perimeter of the atoll, to view the ocean and outer reefs. This course meant going through the island's interior, which consisted mainly of a very thick jungle. Fortunately, the island was only about 300 yards wide. Using knives and in many cases crawling around or over large vines, we hacked and crashed our way through the dense foliage. It took 45 minutes to transverse the width of this island. Upon emerging on the windward side, the vast expanse of the ocean was before us.

Of incredible beauty at our feet, extending out for half a mile, was the island's inner and outer reef. The water varied in depth on the inner reef from 3 to 6 feet. All shades of green and blue were present, including blotches of every other color in brilliant hues. From the outer reef, where the breakers from the ocean swells would crash, the water color seaward was a very dark blue. Inside the breaker line, on what we called the inner reef, were the lighter, more brilliant colors. The entire atoll of Bikini had, for several years, been uninhabited. The natives had been moved to a distant island. All of the floating objects adrift in the nearby sea had been piling up for years on the beach. There were Japanese glass fishing-net balls — many of them. The sand on the beach wasn't really sand in the usual sense, in that it consisted of rock particles. Sand here was ground-up coral, lightly packed and very white. We found an old jeep road that cut through most of the jungle, even though the jungle had grown in the years across the path in numerous places. This road appeared to lead toward the lagoon side of the island. Since it was getting dark, we followed through. There we found the entire crew, assembled for a party in what used to be an old recreation building constructed for the 1946 bomb experiments. After World War II and just prior to the atomic-bomb experiments, over 40,000 people lived on this island. Around many of the military buildings the jungle had taken complete charge. In some cases, we would find an officer's quarters or barracks or some other structure under our feet in dense vegetation. The recreation building was very near shore, so the jungle had only partially taken over. Painted with clear lettering over the door were the words: "Back and Atom Club." Considering our presence and mission, it seemed quite appropriate.

A beach party was in full progress. As the sun went down across the lovely lagoon, the beer flowed and the party tempo accelerated. Somehow we all managed to return to the ship by 10:00 that evening.

To my pleasant surprise, I was one of those selected for the shore party to stay on Bikini Island. Early in the morning I had all my gear packed for the three-day camping expedition on the island. In all, there were six of us: Robert Dill, Dean Carlson, Wayne Runyon, Dick Morita, George Brayton, and myself. Dr. Revelle accompanied our group ashore and assisted in setting up our new "living quarters." At long last we were going to live in the luxury that the meteorologists had enjoyed!

Once set up, the tent housed our cots, personal belongings, cooking equipment (such as it was), and in the center a home-made mini-laboratory. For furniture in this effort, we used old benches

and tables left over from World War II and the atomic experiments. Our tent gradually assumed a rather respectable look, reminding me a little of Albert Schweitzer's tropical mission: clean, purposeful, but with obvious personal sacrifice!

The tent was in good condition, all braced for the wind and the rains. We decided to go slightly native by spearing fish and exploring off the reef structure of the atoll. It is unlikely that I will ever see anything in the world more breathtakingly beautiful than the rock and structure around this outer reef. It far surpasses any maritime display that I have seen anywhere, including those famous exhibits at some of the well-known maritime institutions. The fish we observed, such as parrotfish, blowfish, etc., were too swift and too leery for spears, but the sight was gorgeous and very much worthwhile. We really didn't want to spear any of these lovely creatures anyway. Everything was going quite well until a big shark was seen at close range. We headed immediately for the shallow waters of the inner reef.

The ship was now out at sea. We were alone on the island. Our first evening meal — beans — should be described in terms of the stove. We fashioned this using Yankee ingenuity! Our stove was the remains of a wheelbarrow, turned upside-down, with holes punched in the bottom.

Navy tradition continued to be with us. Our camp needed an official code identification! The radio code name for our camp was "Little Petunia." Every day "Little Petunia" called "Seclusive" (the ship) to report our happenings.

During the evening we walked down the beach toward the Back and Atom Club. What a peaceful environment. We decided to sleep outside the tent, as the evening temperature was still warm — about 80 to 85° with a very high humidity. A heavy downpour hit at 2:00 A.M., thoroughly soaking us. We immediately moved back into the tent. With such warm temperatures, one doesn't find being wet too uncomfortable.

The next morning, after a makeshift breakfast, Bob Dill outlined a watch list. It was then that he discovered that we had no can-opener. Promptly there was a spontaneous briefing on how to open cans without a can-opener, after which the discussion on our watch list resumed. The review included a detailed description of the various stations that we would routinely visit, day and night, taking water samples and temperatures. With these samples, diagnostic comparisons of the seawater at various locations could be made. Comparative chemical tests might lead to an understanding of the origin of tide pools that had formed on the rocks near shore.



**Eating lunch at Bikini Island encampment "Little Petunia." L to R:
Edward Barr, Bob Dill, Duane Carlston, George Brayton, Wayne Runyon**

The watches were divided so that, instead of operating as a team of two, we would operate alone. I had my first watch at 6:00 P.M. This left for me the balance of the day to do other things. Since we did not have any refrigeration on the island, we did not have any fresh food. I thought it might be nice to catch a fish or spear something for fresh meat. I was only able to come up with an 8-foot octopus! For lunch we had octopus, suction cups and all. None of us had the slightest idea of how to prepare it, so it was just plain boiled. Boy, was that thing tough! It must have been quite a sight to see us around the wheelbarrow, gnawing on the tentacles. They tasted like lard, and were about as tender as a rubber tire.

In the afternoon we decided to swim out some distance into the lagoon to observe and explore. An incredible array of wreckage and miscellaneous items such as chairs, ventilators, tables, oil drums, etc. were strewn along the bottom. This swimming activity continued to be a happy occasion until a 10-foot shark got too curious and too close for comfort. We headed quickly for shore.

The following day was so hot that none of us left the tent except for our watch-standing rounds at the tide pools. The heat was suffocating, making us avoid deep breaths. You could almost chew and taste the air, it was so heavy. By noon it was the hottest — hotter than we had ever known it to be before. In fact, much too hot to do any cooking. We estimated the temperature to be 120°, with the humidity approaching 70%, and no wind. Tuesday, September 26th, was supposed to be our last day on the island, so I decided to take my last tour. Very early on Bikini I learned never to stay out in that sun for any length of time, unless I was fully dressed. Wearing a full set of clothing is very important as a guard against dehydration and sun stroke. Tan skin absorbs heat, while white clothing reflects it. I can now more fully appreciate the Arab style of dress.

With my camera, I started out on the five-mile hike around the island. I saw a very large rain squall coming. This made it possible for me to get a refreshing wash, clothes and all. Heavy squalls contain such heavy rainfall that day almost becomes night. Along the windward beach, several bottles had washed ashore, appearing in stark contrast to nature's paradise. One seemed to contain something, so I ran over and looked inside. What it was I couldn't see, so I used my knife to break the bottle. It reeked of the smell of whisky. Inside, however, was a letter that read as follows:

"This bottle was thrown from the S.S. President Monroe on June 19, 1949, while enroute from the Panama Canal to Los Angeles, California, by Ruth E. Heinrich, 1240 Lay Rd.,

Brentwood P.O., St. Louis 17, Missouri. Please write me where and when this bottle was found."

Imagine — this bottle and letter were adrift at sea for over one year and three months, and had survived all perils. They had reached the shores of a little island less than three miles long, after crossing 5,000 miles of open ocean. Incredible! I couldn't wait to return to camp to tell the others about my sensational find. I cut back through the jungle to the lagoon side. For a last panoramic view, I decided to climb one of the many remaining observation towers. These 100-foot tall towers were constructed shortly after World War II for the purpose of housing cameras that took pictures of the atomic experiments at Bikini. The vines by now had grown up the sides of these towers some 55 feet, and the towers themselves were getting rusty and rickety.

That evening we had what we called a Bikini Luau. It didn't have very much in the way of extras, but it was the best that we could arrange. We ate the remaining food and savored every bit. With a beautiful full moon, lovely cloud coverage, and a nice campfire, the setting could not have been more beautiful.

My rounds of the tide-pool sampling that evening were scheduled for 4:00 A.M. At the proper hour I awoke, strapped on the bag of empty sample bottles, and started out for the tide-pool area, about a half-mile down the beach. The gentle rain that was descending at first came down harder, until it assumed downpour proportions. It was almost impossible to see the way, even with the aid of a flashlight.

The procedure we followed in taking sea-water samples was centered on two major requirements. First, one must remember the precise location of each of the sampling stations by rote memory, under all weather conditions, day or night. Secondly, one must ensure that the seawater was allowed into the sampling bottle without any bubbling. Most of the ten stations we were sampling were located on the inner reef. The water depth along the irregular bottom between tide-pool rock outcroppings was 2 to 4 feet deep. It was a spooky feeling to be stumbling around alone in total darkness and pouring rain on that far-off reef. The most difficult task in our rounds, however, was doing the last "station." This so-called station was grossly misnamed; it was not a station at all. It consisted of taking samples and temperature in the deep ocean. This was only possible if one could somehow get outside of the reef breakers into open sea. If a water sample were taken inside the reef breakers, the water's oxygen content, due to agitation, would produce an incorrect reading. It always required mustering all my

nerve to get that last sample: to stumble fully clothed, including boots, for one-half mile, out to the crashing seas that were pounding along the outer reef; then to wait for the right moment to catch the breakers' ebbing surge; to be swept off the reef shelf out into the darkness of the deep sea; and meanwhile to keep above water the sample bottle so as not to cause premature contamination. While rapidly treading water, boots and all, I would allow the seawater to enter the sample bottle slowly and carefully, being sure not to cause any bubbling. During this process my imagination would run wild. "Where are the sharks? Surely they don't sleep at night. What could I do if I were attacked? I have no defense. It's pitch dark out here. These boots are getting very heavy, but I need them in order to avoid being cut by coral. What would happen if I got caught by a large breaker and dashed onto that menacing reef? Who would hear my cry for help? No one would. I'm all alone. It's really scary out here. During the day one can see the oncoming waves and can see deep into the ocean depths for those ever-present sharks and can signal for help. But not now, not at 4:00 A.M." It seemed like an eternity while the sample bottle slowly filled. I imagined that every menace in the sea was reaching out for me. I thought at each moment that the ultimate terror would strike. Once the bottle was filled, I instantly started the procedure to prepare to land back on that reef.

Where the deep ocean joined the outer reef, there was no beach at all. The depth of the water reduced from hundreds of feet to three feet almost instantly. That was where the breakers crashed. It was a vertical ocean cliff under water. Landing on the reef from a breaking wave was similar to a paratrooper's drop to land. Feet in front, I would brace for the impact. It was amazing that we didn't break our legs or seriously sprain our ankles during this unusual night program. This sort of activity illustrates some of the determination and risks that scientists will undergo when motivated to complete a study. I am sure that many people without this zeal for knowledge would think that we were just damned fools. This may help explain why so few people engage in frontier research, where so many unknowns are present.

While I was struggling ashore, a tropical wind-and-rainstorm hit the island with tremendous intensity. In the tent everything was soaked. The wind was blowing hard enough to drive the rain almost horizontally. It appeared to be coming from all directions. There didn't seem to be any shelter. All our bedding was completely soaked. Even some of our equipment was swept off the laboratory bench. One comforting factor was that it wasn't cold. Like most

tropical storms, within an hour it was calm again and the stars twinkled brightly, and the drying-out process began.

The morning of September 27th, we were informed by radio that the *Horizon* would be a day late in arriving. Not only were we out of food, but our water supply, which was in galvanized containers, had become completely foul. It had been discarded after our "feast" the evening before. How stupid not to have saved some food in reserve for emergencies. The only thing left to eat was a sack of flour and coconuts from the trees. Fish were impossible to catch. For lunch, flour and coconut juice were mixed into a paste and fried. It didn't look very good, but at least it was an attempt at food. Dinner consisted of coconut chips in the floury paste, prepared by Chef Carlson.

Wayne Runyon, during the past few days, had not been very careful about the dangers of too much sun. His bottom by now was badly blistered and he was most uncomfortable. Another casualty was the condition of Dean Carlson's toes. Two were quite infected and swollen. He could not explain this, as there appeared to be no visible injury.

That night we discovered that we were not alone after all on this little island. Creeping around the edge of our campfire were a black-and-white cat and a small dog. Both were totally wild and would disappear into the jungle if any of us made a move toward them. They were apparently marooned in 1946 when the Navy departed. It is amazing that both animals seemed to return successfully to the wild state of survival, with no visible ill effects.

At 5:30 the following morning, September 28th, our alarm went off and we made very hasty preparations for breaking camp. By 8:00 all was ready. We had, of course, no breakfast, as there was no food. Besides, Dean Carlson had run out of "appetizing" new ideas for us to try. About 9:00 A.M. the *Horizon* came into view and soon was anchored offshore in the lagoon. Robert Dill poetically and emotionally described our approaching floating home as "a beautiful white bug crawling over the ocean."

I really loved Bikini. Some day I hoped to return. Little did I know then that in only two years I would again be back on the shores of Bikini Island. The following day I decided to write to the lady whose letter I had found in the bottle. After two hours of written description, I had the letter finished. I found it most difficult to explain the circumstances of how her bottle was found. Would anyone believe a teenager finding a bottle after its drifting thousands of miles onto a deserted South Pacific island? A rather

substantial amount of excitement aboard the ship developed over the bottle letter. Without my knowing it, there was a crew member who had recalled an article in a magazine some months earlier, concerning two rich old ladies who, while cruising around the world, had bet one another a substantial amount of money that if a bottle with a message was dropped in the water, it would be found and answered. In the magazine article these two old ladies had offered a rather handsome reward to anyone finding their bottle. The point in the ocean into which the bottle was dropped was, according to one of the crew members, somewhere between Panama and Los Angeles. Their speculation was that I had found that letter. Various offers were made to buy it. The rumored reward was, as I later found out, approximately \$10,000. The confidential offers that I received were becoming larger. The first was between \$50 and \$100. I was overwhelmed with amazement at such extreme interest in this letter. My monthly salary from Scripps was only \$75 a month. This was my first job!! \$500 for a letter from a bottle — ridiculous! The bidding then broke into open conversation, some crew members bidding against each other. Tempers got heated. A crisis was at hand. Those not bidding were advising me as to what I should take. Eventually the news of this letter and the price bidding reached the ears of Dr. Roger Revelle. He immediately contacted me and told me not to sell the letter. He indicated that such a procedure could not be conducted aboard ship. In fact, he wanted to take the letter and lock it up in the ship's safe until we reached San Diego. I assured him that I would not sell the letter. With that assurance, Dr. Revelle let me keep it. The word was passed that the letter was not for sale at any price. Shipboard activity then settled down to a more normal routine. Privately, however, I was somewhat disappointed. I had visions of immediate riches. "Instant rich" is a very exciting emotion!

The *Horizon* got underway for Kwajalein Atoll, only a few hundred miles away. I began the tedious job of packing souvenirs and personal belongings for my departure. The harbor of Kwajalein, though basically beautiful, was full of obstructions. Many wrecked and sunken ships from World War II still dotted the shore line. Our first afternoon ashore was spent at the Officers Club, where drinks are cheap and very little else goes on. Our adopted theme song, staggering back to the ship that night, was "Cigarettes and Whisky and Wild Wild Women." The island had more than an adequate supply of the cigarettes and whisky, but as for the wild wild women, forget it!

A few days before our arrival in Kwajalein harbor, which is part of the very large atoll lagoon, 24 unlucky people had been eaten alive by sharks when their plane crashed. The lagoon is heavily shark-infested. This event again reminded me of those evenings on Bikini, swimming out alone from the outer reef, taking those deep-water samples in the pitch-black darkness!

On October 1st, I said goodbye to the dear old *Horizon*, which at this point was looking pretty rusty from all those miles at sea. With the others that were also departing to fly back to San Diego, I made my way to the Kwajalein airport. Amid a great deal of paperwork, red tapè, and rain, we spent most of the day waiting for our flight. During this waiting period, numerous DC-4 planes were arriving, unloading wounded men from the Korean War. Some men were terribly burned and charred. It was not a pleasant sight. We boarded our MATS flight at 4:30. The plane was a good old reliable DC-4, though internally arranged as a cargo carrier. Our seating arrangement was along the windows facing the opposite side, with an immense mountain of cargo between. Off we headed for Hickam Field in Honolulu. The airfield on Kwajalein was very short. The pilot positioned the plane at the extreme end of the runway, put on the brakes full, revved up the engines wide open, then released the brakes, and we were off like a slingshot. After a couple of hours in the air, we got a box lunch and some coffee. I tried to sleep, but it was useless. No sound-proofing existed in this cargo airplane. The engine roar was deafening. Bob Dill; Dr. Revelle, Bob Huffer, Dick Morita, and I had a humorously long yelling talk, reviewing the highlights of our experiences aboard ship. About 1:00 A.M., nine hours into this flight, the lights went on in the forward panel saying "No Smoking; Fasten Your Seat Belts." One engine had conked out. We were going to be landing on Johnston Island. The descent from 9,000 feet in a non-pressurized cabin bothered my ears. We wobbled quite a bit as we passed over the reef and bounced and bumped onto the runway. We soon found out that the one troubled engine was ruined. Another plane would be available later in the morning. We were directed to the Quonset huts for temporary quarters. After a couple of hours' sleep, we were told that the next plane would not be available until 2:00 P.M. We all took a nice walk around the island to burn up time and inspect at close range the many planes that had crashed during the war, and which had been bulldozed off the end of the airstrip. Many more were sticking out of the water. There was even a wrecked Japanese Zero. At 2:00 P.M. we were off again for Hickam Field, Honolulu. This plane had bucket seats along the walls

with a pile of cargo in the middle almost to the ceiling. Claustrophobia inside that plane was rather acute.

Upon arrival in Honolulu at 6:35 in the afternoon, we spent the usual long period of time passing through Immigration and Customs, with the usual amount of red tape, both military and civilian. At 9:45 the following morning we took off on another DC-4. In today's world of moon landings and supersonic travel, I think back with amusement at that noisy, vibration-filled, 12-hour, piston-powered DC-4 flight from Honolulu to the west coast.

On October 3rd, 1950, we arrived in San Diego, and I prepared to re-enter high school for my senior year. As I looked forward to the future, even then I knew that the memories and lessons of the past three months at sea with the Scripps Institution of Oceanography were unique. I realized that to experience and to be part of field research life — as it was happening, from where it was happening, while it was happening — could not be duplicated in any classroom by any lecture series. Experiences of this type have to be lived to be fully appreciated and understood.

For this opportunity, I am ever grateful to Dr. Roger Revelle and to my shipmates, who together shared with me in being part of that "first big step"!

Part II. 1952: Operation Ivy and Capricorn Expedition

Introduction

Following the 1950 Scripps Mid-Pac Expedition, the author graduated from Point Loma High School and had enrolled in Stanford University — majoring in Biology, and now was 19 years old.

The following account is based largely on the daily diary maintained by author Edward Barr during the Scripps expedition: "Operation Ivy" (military portion) and "Capricorn" (the civilian science portion).

The narrative begins on the last day the research vessel Horizon was in San Diego. It should be noted, however, that preparations for such a long ocean expedition started many months before departure on September 26, 1952. The author began his 1952 employment with Scripps 3 months earlier, in June.

November 1990

Dedication to Helen Raitt,
who pioneered the possibility that all can participate in the
oceanographic expedition experience.

Scripps and the Bomb

Our final day of loading the R/V *Horizon* began Friday, September 26, 1952, at 8:00 A.M. Bill Bascom, my boss, was pacing the deck nervously. At 10:30 Danny, the chief engineer, called and informed me that I was to be his new "oiler" — the regular oiler had become ill and was unable to be on board.

Since I had been offered a school-related research position on board, with academic credit, the thought of me babysitting the ship's main engines was the farthest thing from my mind.

I called Clem Stose, the Personnel Officer, and raised some hell. That didn't work, but a call from my family did. A radarman was transferred to tend those testy engines, and I was reassigned to the laboratory. Needless to say, I was very unpopular with the ship's deck crew.

We departed the San Diego dock at 5:30 P.M. and were soon ploughing through the open ocean — an event not too welcome to several seasick mates.

I had the mid-watch from 12:00 midnight to 2:00 A.M. The next afternoon I stood watch again, taking ocean bottom soundings or profiles, as they're called in the trade.

Late in the afternoon, Win ("Brother") Horton, one of the above-mentioned seasick shipmates, managed to revive long enough to wire acoustically the 143 feet of the *Horizon*; his purpose was to record some of the typical shipboard conversations for posterity, blackmail, or both!

Monday, September 29th. For the past few days we've been recording the ocean bottom profile with a replacement fathometer. The wind has shifted aft on the ship, and the seas are boiling over the rails on both sides. We are in the trade winds now, and spirits are high.

We enjoy a near-full moon at night. It shines upon a cloud-scattered sky making moonbeams, great reflecting shafts of light upon a sparkling sea.

The days quickly pass. Our destination is Eniwetok, a small atoll in the Marshall Islands, 5,000 miles from San Diego. The *Horizon* cruises on both engines at ten knots. A typical day begins at 7:00 A.M. with the cook, Tom O'Callaghan, beating on a pan to raise the "troops," and ends with a ship's happy hour at 4:00 P.M. Seasick "Brother" Horton has recovered enough to tend bar and sell beer. Evening target practice, using some of the ship's arsenal of .22 rifles

and .22 automatic pistols aimed at floating debris, completes some of our routine days.

October 1st is very significant. During my afternoon watch we discover a 12,000-foot mountain range, which has never been recorded before. Dr. Ed Hamilton calculates that for every six feet that the ship moves forward, the mountain rises one foot. Unfortunately, there isn't time to survey it further. The ship must press on — DESTINATION: the MARSHALL ISLANDS. Our scientific mission is to record the effects of the world's first HYDROGEN BOMB blast (a surface detonation).

Today we got clean linen. I decide to take my first shower since leaving San Diego (8 days earlier). Also, along with seven others, I am growing a beard — a constant source of irritation — but promising in appearance. Alan Jones ("Jonesy") is still seasick — he looks terrible, but continues to work on the wave recorders — the project headed by "Bad" Bill Bascom (the man you love to hate but always respect!). The wave recorder project is best described as an attempt to measure the nature, size and speed of any waves created in the ocean by the H-bomb surface explosion. Some scientists, including Dr. Norman ("Jeff") Holter, feel that there is some possibility that a tidal wave will result from the big bomb blast. Since I will be assigned to an island in Bikini Atoll, along with others, when the H-bomb is detonated, Dr. Holter has devised a whole series of emergency procedures, including climbing the nearest tall palm to escape a wave crossing the entire island! With some sense of high adventure, I marveled at the dedication of scientists in their quest of new data. At age 19, I am confident that we can survive any calamity. John MacFall, the ship's photographer, and I climb to the top of the 30-foot steel A-frame, mounted on the ship's stern early in the morning of October 6th. Directly ahead lies Necker Island, the westernmost island in the Hawaiian chain. Repairs to the ship's steering chain can be completed in less time while at rest in the calmer waters near the island. Necker Island is sheer-sided with 300-foot cliffs above the sea. It is only inhabited by birds, which have not had contact with humans. Of the albatross type, they land on many parts of the ship. One even perched on my head. John was quick with his camera to record this unexpected meeting between man and bird. By 2:00 P.M. the ship is heading west again at her usual cruise of ten knots (about 11.4 miles per hour).

Nights are now so humid and hot that the spaces below decks are intolerable (no air-conditioning). Several of us drag our bedding up to the open air on deck to stay cool. This arrangement works well

except that tropical rains can make a mess of one's bed very quickly, and any sleepwalkers are in peril!

Before long the foredeck frequently became the focus of philosophical discussions held by members of the scientific staff. Late into the night clusters of Ph.D.'s would expound on their ideas of the origin of the moon, the stars and other natural phenomena.

Lighter moments included a lab watch in which "Brother" Horton and I attempted to demonstrate grand opera. Jonesy turned on all the loudspeaker switches for the ship and we proceeded to imitate Wagnerian arias — I screaming in a scratchy falsetto soprano and Win booming forth in a powerful baritone. This late-night disturbance throughout the ship caused the Chief Engineer to leap from his bunk, believing that one engine had exploded! Our performance had only this one-night stand. Any repeat would have caused a real danger to our health!

A second testing of the *Horizon's* atomic wash-down system was conducted with good results. When fully activated, the ship literally became enveloped in a saltwater downpour. It was believed that in the event of radioactive fallout that this automatic continuous washdown would shield the ship from contamination. Later in the expedition we would discover how wrong this assumption was.

On matters relating to security in the advanced staging area of the "bomb zone," we were told that there was to be no note-taking, no conversations, and no pictures taken regarding the event in Operation Ivy (the official code name for the H-bomb experiment). Further, the contraband items would include all film, all cameras, knives, and firearms. This news made me feel a bit uneasy, but I decided to be very discreet about my diary and picture-taking. I reasoned that if no one keeps a written chronology of this event, history will be cheated out of a once-in-a-lifetime record. I felt that accurate history would ultimately become more important than the fear of the Russians! In 1952, this attitude was not shared by anyone I spoke with.

Of great concern among the scientists was the mysterious appearance of the chapters of a superdooper sex story — "Of Restless Nights"— written by various anonymous scientists while on night watches in the laboratory. This sequential saga involved the story of Jeff Cleater and his romantic adventures with Angel. The only limitations to the story's unfoldment were the limits of each author's imagination. Personally, I believe Jeff Holter started it all. And I now confess that I did steal two of the chapters (now preserved for history).

Jeff Holter could get more mileage from a cigar than anyone. He could make them last for an hour. When down to a tiny stub, Jeff would insert a toothpick and continue smoking until the tiny remnant was consumed, including the toothpick!

Dr. Holter also had pronouncements concerning hazards. "We now have only three things to worry about: typhoons, tidal waves, and radioactivity." To deal with these he suggests: hang on in a typhoon; practice chin-ups and push-ups to be able to quickly climb a palm tree in the event of a tidal wave; and keep under cover in the event of radioactive fallout. It all seems so logical!

Happy Hour on October 13th was held in the "Peacock" room, the affectionate name given to the ship's galley and mess hall. We are told that as we approach the Marshall Islands, the U.S. Navy is watching us constantly. The *Horizon* is not the average-appearing ship in this part of the ocean; in fact, the *Horizon* is a puzzlement to all that see her anywhere. She is streaked with rust, small in size, slow in speed, and shows no guns, but looks very confusing with all her winches, cranes and strange rigging. I can understand why the Navy might be alarmed by our approach to this highly secret location. Sure enough, near midnight, October 14, I was awakened by a deafening roar and a blinding light in my eyes as a PBM Navy seaplane roared above the ship with searchlights sweeping our decks. I thought at the moment that we were under attack.

The harbor pilot came aboard on October 15 at 6:00 A.M. from a military AVR patrol boat. Within hours the *Horizon* was anchored inside the lagoon of Eniwetok Atoll. We were anxious to go to shore to get our mail and feel solid ground under our feet after 20 days at sea.

My "buddy" for on-shore activities was Warren Beckwith. We consumed ice cream and malts, went to the officers' club where a *Horizon* drinking "blowout" was in full swing, and later in the evening attended the daily outdoor movie — this night, "Carson City." Afterwards we returned to the officers' club where there were only a few still able to navigate. John MacFall and "Brother" Horton had already passed out. We carried them to the landing barge which served as a shore boat. Gradually the *Horizon* crew returned to the ship.

The following morning, Bill Bascom assembled his group to locate the best spots to lay the wave-recording cable. Our group, this day, included Warren Beckwith, John MacFall, myself, and our fearless leader— "Bad" Bill. We utilized the ship's launch, the TT₂ (tuna tender #2) for this exploratory survey. We were not permitted to land on Runit Island as our security badges had not yet been

issued, but we did identify the places where the heavy recording cable would be placed (this 12,000-pound cable is at least 3 inches in diameter and is very stiff).

Warren Beckwith and I were tossed out of the officers' club that night because we looked so bad (no T-shirts and short pants are allowed).

On October 17th, the *Horizon* got underway to lay the cable along a path marked the previous day. With wind, current and coral rocks, the cable project involved a back-breaking effort. By day's end we all were exhausted.

The 18th, with Q-clearance security badges attached to our clothing, we completed the difficult cable-laying project on Runit Island. On this island is a blockhouse with walls about six feet thick, obviously something to do with the atomic-energy program.

The following day we proceeded to Jean Island — the site of the H-bomb device. Dr. Russell Raitt was to conduct a seismic profile of this island and the waters surrounding it. The island had a strange appearance. In its center was a tall tower. From the tower's base a large white rectangular snake-like tube extended across several adjacent small islands for a distance of about two miles. Also at the tower's base was a very large, strong looking, square "blockhouse" building. We planted 2 seismic sonobuoys off the island's outer reef and then proceeded to make seismic runs outward from the buoys.

Our next "project" was to locate several suitable seamounts surrounding Eniwetok on which we could anchor Bill Bascom's floating wave-recording devices. This was started on October 20th. But on the 21st the ship arrived at Bikini Atoll in order to start another project. This was to establish two shore-based camps on Bikini which also would house wave recorders. Soon the ship was at anchor in Bikini Lagoon off Eninman Island. The work parties were hastily formed. Bascom, Beckwith, Todd Carey and Darsey were to survey locations for laying the cable. Holter, Horton, Jones, MacFall and myself were assigned to a trip across the lagoon to Bikini Island, the site of the Mid-Pac 1950 encampment. We were to load supplies into our borrowed, very worn-out Navy LCT landing craft. These supplies were to sustain the Scripps shore party that would remain on Bikini during the H-bomb. Of course, I was delighted to find myself returning to Bikini Island after a two-year absence. I soon rediscovered the remains of our camp site from 1950 and the trash residue remaining from our big all-ship beach party blowout at the "Back and Atom" Club that same year. The commander in charge of Bikini Island asked me, "Who the hell made this God-awful mess?" I just shrugged (but with a snicker). It was one hell of a good party!

October 22nd we started to build the two campsites that would be "home" for the wave-recorder operators before, during, and after the H-bomb. Two islands in the circular island chain of Bikini Atoll were selected: Eninman Island and Cherrete. Eninman is about one mile long and one-half mile wide. Cherrete is nearly circular in shape with a width of about one-quarter mile. Each has a maximum elevation above sea level of about three feet. While Bascom's group was laying recorder cable, Jeff Holter was in charge of erecting the two campsites — the little one on Cherrete, the base or main camp on Eninman. The supplies for the anticipated 12-day stay on Bikini were unloaded from the LCT onto the beach. A small division of this pile was transported to Cherrete, about 8 miles from Eninman. On both sites we erected or pitched the tents, set up cots, stacked the boxes of food and water, and handed into the tents the very awkward 300-pound radio transmitters (battery-powered).

October 23rd started with preparation of the cable-laying equipment for Cherrete Island. It was a beautiful day — perfect for color pictures. Late in the afternoon the cable was laid and attached to the wave recorder inside the Cherrete tent. We drove the amphibious DUKW into the landing barge boat and returned to Eninman Island. The *Horizon* departed for sea to search for and anchor wave recorders to suitable seamount sites. Scripps personnel remaining on Eninman Island were Dr. Martin Johnson, Bernard Darsey, Dr. Norman Holter, and myself. We four were now the Bikini shoreside "group." In a way, this situation reminded me of the 1950 encampment of personnel on Bikini Island while the *Horizon* conducted oceanographic operations at sea. Our present interests centered on making our tent more livable. We found wood to create a floor over the sand inside the tent and piled all our supplies around the support poles. When finished, our little tent camp at Eninman looked somewhat livable. On Cherrete, very little customizing was done. Just the radio, wave recorder, some supplies, two cots and the tent were arranged in an orderly fashion.

On October 26, it poured steadily all morning, though we did splash our way in to the construction camp for breakfast. The half-mile walk along the shore and through the jungle was very pleasant, rain or no rain. Later Darsey, Jeff, and I went shell hunting near our camp. Specimens were poor and very scarce. Darsey and I then extended our search to include several adjacent islands which were separated by small, deep, narrow tide channels containing fast rivers of moving water flowing in or out of the lagoon. A four-foot shark made a pass at my legs as I bent over to tie my shoes. He just nicked the shoe leather, but gave me a real surprise and a shot of adrenalin.

Small sharks were frequent visitors to the warm shallow waters of the reefs encircling each island. It was wise to keep your eyes on them. Wearing boots was essential in order to protect one's legs and feet from the ever-treacherous coral. Some swimming, however, in the strong currents across the channels was necessary. Wearing boots made it a very difficult task. From Jeff's earlier experience we learned that being a strong swimmer with good endurance was a must. We finally were back in camp — an exhausted twosome — by 4:30. From an "unknown" source a sign greeted us outside the tent. In large letters it said: "Tourist Information Center."

The next day it rained hard. The trip over to Cherrete, sitting on that rusty old landing barge, was wet, windy, and cold. We dug a four and one-half foot hole in the sand to install a "dead man" device in order to secure our recording instruments. On the 28th, Darsey and I made an early trip to Cherrete to test the equipment. It rained in buckets.

Via a nearby LST ship, 150 construction men arrived today [Oct. 29]. The meal lines are very slow with all those new mouths to feed. Rats on this island are numerous. As one walks in the evening along paths, with flashlights in hand, or along trails cut by jeeps or tractors, the rats run in front of you in herds by the hundreds. In order to create a "rat stampede," all one has to do is aim the flashlight beam down the road. Once confronted with the bright light, they slither off at high speed. Sometimes one can get the feeling that he is a rat shepherd! Such a "sport"!

On October 30th, we discovered that the radio on Cherrete was not operating properly. We exchanged radios. The call signs for our stations were "Abstain 1" and "Abstain 2." These two designations were probably picked because of the lack of women in the area, or possibly it was because neither of the radios put out very much!

The H-bomb was scheduled for detonation early Saturday morning. Our operational plan called for Darsey and me to man the Cherrete Island station while Holter and Johnson would operate the equipment on Eninman Island. On Friday, October 31, Darsey and I packed for our stay on Cherrete. After lunch, final instructions were given by Jeff Holter. We then loaded our gear onto the "M" boat and headed for the island. A strange, quiet tension was building in each of us as the accumulation of uncertainties regarding the World's first Hydrogen Bomb raced toward their test with reality. In less than twenty hours all of the sweat questions the world had been pondering would be answered. For the ultimate outcome, we had front-row seats. To each other, we would privately admit that our survival was now at stake. Thoughts regarding the rest of mankind,

so totally unaware of this moment's occasion, were heavy in our consciousness. This atomic test was such a magnificent example of man's confidence in the truths of physical sciences. But now it was nearly time for the ultimate corroboration of scientific extrapolation. Moments for any doubt were fast drawing to a close. Reality would soon be demonstrated. We tested our equipment; then, in a pensive mood, we quietly walked around the island picking up coconuts and a few shells. Darsey and I said nothing to each other. These were moments when we were within. These were solemn and isolated moments which each of us would experience in his own thunder of silence.

Upon our return, we engaged in a coconut feed. We then lay in the gentle tidal surge at the water's edge, finding relaxation in the steady rhythm of its ebb and flow. Time dragged on. To collect firewood in order to heat our "C" ration dinner was next. A dinner of beeney weenies, hamburger, spaghetti, cocoa, candy, and coffee was prepared. We weren't hungry. It just was something to do. It was so quiet. Radio contact was established with "Abstain 1" on Eninman Island. All seemed well with Martin and Jeff. Our recorder was set into operation. Again it tested properly.

Darsey and I again reviewed very carefully the countdown sequence of events for M-1 (the day before the bomb) and M Day (day of the bomb). They appeared as follows:

<u>Time</u>	<u>Bomb Day</u>	
1900	M-1	Start recorder 3/4"
2000	M-1	Secure recorder
0100-0600	M	(each hour) radio listen watch
0515	M	start recorder, 3/4" with new battery
0615	M	wind Esterline Angus again
0630	M	start continuous listening radio watch
Bomb explodes	M	switch calibration on for about 30 seconds; if no flash seen, listen for radio mark time
	M+1	check the calibration switch
	M+3	button up recorder
	M+(7-14)	alert listening for code warning from Eninman Island
	M+14 on	observe wave visually and on recorder

In spite of our being wide awake from sheer tension, at 10:00 P.M. Darsey and I took a Benzedrine pill to further increase our alertness. This was the one occasion on which we did not wish to be found sleeping at the switch. So much planning, money, and creative

thought were now resting on a few key pieces of electrical machinery. Any failure would negate years of preparation work. As we viewed it, our equipment now looked so pathetically frail. So many little components could malfunction, ruining so much work!

For the next several hours we lounged about the tent engaged in conversations about how to acquire wealth and about various controversial shipboard personalities. It seemed that we were groping for any pastime that would keep our minds away from the morbid possibilities of the Bomb.

The diary on M Day contains the following:

Our attempts with radio contact both at 1 a.m. on November 1, and at 2 a.m. were negative. Very definitely the Benzedrine is taking affect [sic]. I have a dry taste in my mouth and wrote one of the craziest letters to my girlfriend. 3:00 a.m., at last, we establish radio contact with "Abstain 1" on Eninman Island. It is now just a matter of waiting and letting the clock run itself out. We have 3 hours and 15 minutes to go. The atmosphere here is extremely tense. All our meters now are working perfectly. From our small fire, we have prepared coffee and cocoa. In my mind, I keep reviewing my responsibilities. At blast time, I am to be standing outside the tent facing the bomb with my feet and lower legs buried in tightly-packed sand. One minute after detonation, I should feel any ground shocks. Considerable distance separates us from the bomb. Over 100 miles of open ocean stands between Jean and Cherrete Islands!

Ground shocks might continue up to four minutes after H-blast. Air shocks could be expected at M plus 14 to 15 minutes. The evacuation signals over the radio are "ABLE ABLE ABLE," meaning a destructive tidal wave is expected to affect the entire Pacific area, or "BRAVO BRAVO BRAVO," which would signify destruction to just the local area, or "CHARLIE CHARLIE CHARLIE," which would designate a minor tidal wave, or "DOG DOG DOG," no tidal wave at all.

It is now 6:00 a.m.; dawn is upon us. I have read the instruction pages innumerable times — they are memorized. We are making frequent checks of time and equipment operation in complete silence. We have, for several hours, referred to our station on the radio as "Desperation Center," the lonely outpost with two nutty inhabitants. Too much Benzedrine and coffee! Only 30 minutes to wait. We are on edge.

The evacuation Navy LCM landing barge is drifting slowly by off shore, her diesel engines running at low speed. This vessel, if reached in time, is our only escape to safety in the event of a tidal wave or any disaster which might strike the island. Again, we establish radio contact with 'Abstain 1.' We are just waiting; I have dug the holes in the sand. With one minute to go, I am now standing in those holes. Darsey is calling out the seconds: 30 seconds to go — 10; 5, 4, 3, 2, 1, MARK! Dead Silence! No Sound! Nothing! waiting 30 seconds, then a bright pink illumination in the early morning sky from the center outward shooting upward, making everything bright red; this lasts about 4 seconds, then gradually a return to nothing again. I keep waiting for a ground and/or wind shock. Still nothing — Darsey is yelling for the time. I pull loose from the sand and join him. We wait anxiously for radio contact concerning any tidal waves — 5 minutes, 10 minutes, finally 15 minutes. According to the instructions, we were to evacuate after ten minutes if no radio contact had been made. A possible tidal wave, by calculation, would arrive in 20 minutes. That would give us ten minutes to complete an evacuation. But we have already waited 15 minutes for that damn radio to say something. Panic sets in — maybe the transmitters have been swallowed up by the H-Bomb. Then at 17 minutes, the following terse, loud, clear message is received: "Drop What You Are Doing and Get the Hell Out!" With this, Darsey and I went into an absolute frenzy. At best, we only had 3 minutes! In my haste, I forgot to make the recorder fast to the deadman. We clawed for belongings, threw them into our heavy rowboat and ran with it to the water's edge. (Moving this 400-pound boat normally takes 3 or 4 men.) Within seconds we were away from the beach, out in deeper waters heading toward the LCM. At this point, the sound and fury of the H-Bomb began to arrive.

It was totally awesome. It was deafening. It was magnificent. It was like the sound of one hundred thunder storms coming at us from all directions. It would seem that the heavens would burst. We all stood in stunned awe before this largest display of man's use of the Hydrogen Atom. For minutes the holocaust of sound continued, thereafter gradually subsiding. Earaches and ringing sensations were experienced by many for hours. I felt absolutely sick about leaving the instrument unsecured on that island. Soon, however, as luck would have it, the all-clear signal was received over the radio. We

again returned to the tent. The station was secured with the recording device continuing to operate. By 11:00 a.m., we had returned to Eninman Island. Behind and above us was the gigantic thunderhead cloud of the Hydrogen Bomb. We were totally exhausted both emotionally and physically. After a small meal, we lay down for a much-needed nap when suddenly, with no warning, a tremendous explosion occurred outside the tent. We leaped from our bunks in time to witness a sheer wall of white water over 100 feet high go by. Two hundred yards away, the Navy had detonated underwater 2,500 pounds of dynamite, in order to eliminate coral heads along the beach. This was minor excitement compared to the big bomb. We again fell asleep.

That night the "Scripps group" was moved into the Navy LST ship which now was beached bow-in near our tent. In addition to our small party of four, the entire camp of 250 construction men was also to be berthed in the ship for the night. There was mounting concern about radioactive fallout occurring from drifting clouds. The ship was jam-packed with every sort of person. We were herded down into the cargo hold. "Three hundred sardines in one can" was a remark frequently heard. The Navy held its traditional evening movie topside above the bunking area. With the number of men on board, every flat space was occupied. Some even perched on the long nose of a mechanical crane. After the excitement of this day, the movie was a total bore. Early Sunday morning, the Navy put all the "extra" bodies ashore. No radioactivity had been recorded the previous night. After breakfast Dr. Johnson, Darsey, and I went shell hunting. (Just a day of play and loafing.) We found a deep hole in the outer reef in which there were many beautiful cat's-eye cowries. After lunch, because Dr. Holter had fallen asleep on my bunk, I decided to visit the inner sanctum of Holmes and Narver. In their tents the heavy construction workers were busy weaving hats with palm-tree fronds. Their subject for pastime conversation was the usual — girls!

Again we were aboard the Navy ship that night and again we were exposed to one of the worst movies in history; this one was called "Hunted Man." Reveille was sounded at 6:00 A.M. By 7:00 we were on shore having breakfast at the Holmes and Narver camp. About noon the following day, we were looking out across the ocean and found to our delight the "great" white ship *Horizon* coming toward us over the horizon. We rushed back to camp to inform the others. Before long, Bill Bascom and Walter Munk were ashore. These energetic organizers soon had a big party planned. The beach party was to be held on Bikini Island in that "famous" Scripps

meeting structure from two years earlier, the "Back and Atom Club." This time, however, the occasion was the conclusion of the first Hydrogen Bomb. Our "crew" was united again. We wanted to celebrate!

The brief voyage across Bikini Atoll lagoon to Bikini Island, on the opposite side, was completed in less than two hours. Overcast skies and rain squalls occurred shortly after our arrival, but this did not dampen our spirits. Sentimentally, I revisited the site of our original camp in 1950 and found everything much the way we had left it. The upside-down wheelbarrow which had been used for a stove was now rusted completely. It remained just as a shell. The officers' club looked much the same. The volleyball courts were almost entirely covered by vines. I selected one of the remaining 1946 100-foot observation towers to climb. It was now very weak. As I climbed the 90-foot ladder to the observation platform, it groaned and swayed. A 25-knot breeze was blowing. What a spectacular view! Around the western horizon was the entire sequence of small islands constituting Bikini Atoll, all covered by lush growth, tall palm trees and white beaches.

Meanwhile, at the "Back and Atom Club," an all-out beer bust was in full progress. A few were trying to set up the movie projector. The evening show was being billed as a real humdinger, entitled "The Bend in the River," starring James Stewart. For once the picture was in fact good. Feeling no pain, we all somehow managed to return to the ship by way of an amphibious DUKW. It was during the party that I first began to hear stories about the tension-filled life on board the *Horizon* at the time we were camped on Eninman and Cherrete. It seemed that achieving proper spacing and anchoring of the Bascom recording instrument had been a most difficult project. This beach party also served as a release for pent-up tensions which had been accumulating between various members of the crew.

Descriptions of the hydrogen bomb from shipboard personnel indicated that the bomb was first seen as a very bright flash, even with the specially constructed dark glasses in place. The flash was followed by a rapidly rising fireball. Soon an ominous looking, mushroom-shaped cloud rose to about 100,000 feet, seeming to hover over the *Horizon* as it spread out in all directions. Later on, radioactive rain fell on the ship — the first manned ship in history ever to experience fallout. The trusty washdown sprinklers were activated for a period of three hours. Then the whole ship was manually sprayed down and scrubbed, using high-pressure fire hoses. The "hottest" spots were ropes and anything porous, such as

all objects of wood. Geiger-counter operators were stationed at each doorway. Only a few people were allowed on deck. Doors were kept closed. The ship was sealed. All portholes were closed. All ventilation systems were turned off. Heat and humidity began to accumulate below decks. Living conditions became insufferable. The ship had no air-conditioning, yet the machinery continued to operate, adding even more heat to everyone's discomfort. Unpleasantness broke out between people as tempers lost their constraints. Life had become a miserable amalgamation of confinement and cramped quarters including stale, hot and humid air being consumed by short-tempered sweaty shipmates.

All "hot" (radioactive) loose gear was thrown into the sea. Included were wooden shelves, dock lines, cots, boxes, lumber, laundry and hammocks. Anything radioactive was heaved overboard. The hottest items of all were the Bascom wave-recorder rafts. These "sitting ducks" were totally unprotected from the atomic fallout. After 24 hours of being anchored on top of seamounts, these rafts had accumulated a reading of 1500 milli-roentgens per hour. After the instrument packages were retrieved, each raft was sunk by rifle fire. The *Horizon* was the only ship in the entire naval flotilla to receive radioactive contamination. The official explanation for this was that "she was too damned slow to get out of her own way!"

On Wednesday, November 5, I became involved in a mini-expedition with Bill Bascom, Pat Carroll, Warren Beckwith, and Walter Munk. The plan was to use the ship's outboard-powered small boat in order to dive over the test fleet of sunken ships resulting from the 1947 atomic-bomb experiments in Bikini Lagoon. One of the larger ships lying on the bottom in this lagoon was the famous aircraft carrier *Saratoga*. Unfortunately, the water was very murky, for reasons not clear, so we could not find any of the sunken ships. What a disappointment! Shortly, the *Horizon* picked us up and we returned to Eninman Island to break camp. Upon our arrival, we received by radio the unexpected news of a tidal wave on its way from the Aleutian Islands. Calculations revealed that we had only about 15 minutes to clear the tent of personal possessions and try to get our wave recorders in operation again. At full speed, the *Horizon* raced to Cherrete Island to get that recorder going. Shortly after energizing our wave-recorder device, the shore waterline moved up the beach about four feet and then slowly receded again. These gradual oscillations continued for approximately one-half hour. The wave recorders picked up a nice record of these mild tidal surges. No breakers or surf action occurred, however. We concluded that the numerous islands across Bikini Lagoon had slowed the tidal wave's

strength and speed. We were recording on the lee or protected side of the atoll.

When the swinging oscillations were over, we disassembled our recorders and tents and loaded them aboard ship. By 6:00 P.M. we were underway for Eniwetok. With sadness, I again said goodbye to Bikini Atoll, a real garden spot on this globe.

"News flash — we just received word that Eisenhower has been elected president!"

Upon our arrival at Eniwetok on November 6, many of us met at the officers' club. There we heard more about the magnitude of the big bomb. Its mushroom cloud was some 65 miles across. Three islands were blasted from the face of the earth. Radiation still was intense 500 feet above the bomb site. The bomb had rested on the ground inside that strange blockhouse I had seen earlier. The uprising blast column, after detonation, ascended at a rate of about 200 miles per hour.

"Dr. Holter today left the ship to fly home. We all will miss him." He was a great shipmate, a creative thinker, and a much-needed supporter of morale. At sea, on long voyages, these are the desired traits in a shipmate that make for successful results and a happy time for all. The present state of morale on the ship was none too good. Many in the science group were indicating a readiness to return to the U.S.A. At the base of the discord seemed to be the view that there were too many chiefs and not enough Indians. No single authority in the scientific staff appeared to be in charge. As usual, direction by committee action was having its negative effect on morale, incentive, and achievement. Some, who had been designated with leadership responsibilities, could not command the willing support from others. This loss of direction resulted in each scientist attempting to do his own project. There was little appreciation of the fact that the *Horizon* was at sea to serve the purposes of all. A coordinated plan of action was conspicuously lacking. For many of us, it became increasingly difficult to function in this loose, free-for-all environment.

Using a Navy LCM on Friday, we made a run to Runit Island. Our party consisted of Bill Bascom, Warren Beckwith, myself and one of the Navy's radiation experts. We were instructed to put on gloves and canvas slippers before going ashore, as the ground was radioactive — some 75 to 100 milli-roentgens. The wave recorder there did receive a good record. We completed our task by recovering the recorder and the pressure head. We then returned to Eniwetok Island.

Saturday, the next morning, November 8th, Warren Beckwith and I were summoned to meet Bascom on the big Navy ship *Oak Hill*. The Navy high command was anxious to recover a crashed jet reconnaissance plane which five days earlier had crashed and sunk with its pilot still aboard in waters inside the rim of Eniwetok Atoll. Scripps was asked to devise a recovery program. Bill Bascom, with his limitless zest for innovation, was the man who could come up with a plan. Armed with several grappling hooks, lines, aqualung gear, and a Navy LCM boat, we set out to locate the downed plane. An observing Coast Guard longboat with fifteen spectators aboard tagged along, watching and studying our every move. It was like conducting an impromptu school. We zig-zagged repeatedly across the supposed impact area without seeing anything. Bill and Warren then innovated and implemented a search procedure which later became the basis for an official letter of commendation from Admiral Wilcones, the Task Force Commander. This procedure is used today in search and rescue operations. It involved the use of four people. Assignments were numbered one through four. Number one was the "searching diver." Some 80 feet below the surface, equipped with an aqualung, this man was towed through the search area by hanging onto a long weighted line attached to the LCM above. Position two was the "observing diver," on the surface directly above the man near the bottom. From this position, with mask and snorkel, the observer could see both the diver below and the towboat ahead. He was dragged through the water by means of a knotted tow line.

Position three involved the "tow boat operator," who determined its course and speed, and responded to any signals from the diving observer astern. A fourth position was a "standby," in rotational readiness. This man would enjoy a rest period on the tow boat in preparation for his turn. Positions were rotated every 30 minutes. It was fatiguing work. The deeper water was quite cold and hanging onto the tow line was not easy. Sharks presented a constant threat. They, however, were always viewed by Scripps personnel as "normal" occupational hazards. We paid sharks little notice unless they became overly curious at close range. It was then a matter of making a carefully executed move to safety. This procedure had a way of fully exercising one's adrenal glands! By late afternoon there was no sign of the jet plane. We secured for the day with plans to return on Monday.

That evening on Eniwetok Island, Warren and I sat under his poncho in pouring rain to watch the movie. It was amazing how much of a habit those movies tended to become. Everyone from the

Admiral to the dishwasher attended — no matter what the weather or quality of show.

While we were conducting the diving project, the *Horizon* was at sea shooting off TNT charges, part of Dr. Russell Raitt's seismic-refraction studies.

On Sunday, November 9, Warren and I went ashore at 6:30 while the *Horizon* continued to do more seismic work around the atoll. This day we did absolutely nothing constructive whatsoever. In the morning, for an hour, I practiced on the recreation hall piano. Armed with a small hacksaw, Warren began sawing in half a large stainless-steel propeller shaft from the strut of a wrecked LCVP Navy landing craft. He said it would make a very nice coffee table stand in his home. After lunch at the officers' club we continued taking turns sawing. By late afternoon Warren realized the whole project was ill advised. The shaft section, finally severed, weighed over 250 pounds; we could hardly move it! What a foolish, wasted effort! The shining steel shaft was left behind in the sand. Disgusted, we dragged ourselves to one of the bars and had six Tom Collins, a can of peanuts, and four cigarettes. We no longer were disgusted. The world at that point appeared most rosy; we were again ready to meet the future with zeal.

Monday, the next day, we again went diving for the lost plane. For the second time we had no luck at all. A shark made a pass at Warren, but missed. We did innovate the use of some new equipment, however. By attaching a bridle to a board, we were able to use the board as an inclined plane. By positioning the board with a downward angle, while being towed, we were able to make surface dives down to about 30 feet. In this way the surface observer was able to get a much better broad general view of the ocean bottom than the diver who was down at the bottom 80 feet below. That day, while under water, we could clearly hear the *Horizon's* TNT detonations, even though we were separated from the ship by many miles of ocean. Underwater sound can transmit, under special conditions, for very great distances.

Tuesday we again dove all day with no results. This was very exhausting work. It involved being in the water for approximately 7 to 8 hours per day. We were informed that the downed jet pilot was supposed to make test flight runs through the H-bomb cloud. It was rumored that he ran out of fuel and crashed. His lead suit probably prevented him from escaping.

Wednesday was another full day of being dragged all over Eniwetok Lagoon — still with no results. Scheduled for the next day was the air drop detonation of a large atomic bomb from a B-36

bomber. Already, the H- bomb had practically vaporized everything within seven miles of Jean Island. A huge crater now stood where the target island once stood. We viewed the upcoming atomic blast with little enthusiasm.

Security breaches had made censoring of the mail a certainty. A memo from the high command was circulated to all ships: "Serious concern is felt over the breaches of security restrictions during the current operations which have thus far resulted in courts of inquiry and another investigation just commenced. Commanding officers will personally brief personnel on security directives. It is emphasized that no other nation would permit uncensored mail from the site of an atomic experiment and that each individual of this task force has a duty to self and country to preserve this unprecedented American privilege. Loose talk here and at home after the operations are completed can cause untold damage to our security and prospects of continued freedom." This was signed by Admiral Wilcones, Commander of Operation Ivy.

Thursday was scheduled for the air-dropped atomic bomb. At 11:30 A.M. the *Horizon* put to sea. We stationed ourselves about 20 miles from the blast site which was directly above Runit Island. The bomb was classified as the largest air blast in world history. Rain squalls were frequent with overcast skies. At the proper time we received a fifteen-minute warning; planes were heard. We waited patiently, holding our special dark glasses in place. At the five-minute mark, a postponement of fifteen minutes was made. The sound of airplanes continued. At the next 10-minute mark, the operation for the day was called off because of bad weather. It was fortunate they did, as rain started to pour in torrents. If the bomb had gone off, the ship would have again been doused with radioactive fallout.

That night Seaman Stanley O'Neil and I headed for the outdoor movie ashore. Rain came down so hard we could hardly see the screen. The sound, in addition, was terrible, and the focus was poor. We both were very cold and wet. Because of bad weather, the shore boats stopped running; it looked like another night ashore. Sure enough, we were assigned Quonset hut 4b. What a racket with rain on that tin roof!

Atomic bombs take two days to prepare, so we had a free day. It was suggested that it would be fun to go on a shell hunt. The tuna tender (TT₂) was lowered from the *Horizon* which towed both skiffs down to the island across from the main entrance, about 12 miles away.

Bill Bascom and others who thrive in Bill's unique presence (this especially includes me) joined and walked with him out to the island's end onto the extensive coral reef. The crystal-clear water and hundreds of brilliantly ornamented fish motivated him to want to take underwater movie pictures of this exquisite site. We collected all the necessary photography equipment, and, with aqualungs, the whole party of thirteen went out onto the reef to record the wonders of this secluded nature: an awesome display of marine diversity.

One of the superhuman efforts of the day was when Seaman Todd Carey located and brought to the surface a giant 150-pound clam shell from 40 feet of water. He individually wrestled the monster to the reef's edge, where we all joined in the effort to get it ashore. It was some struggle to manhandle such an uncooperative beast over the coral and through the pounding surf.

Saturday morning, November 15, our entire ship's company listened to an impassioned and energetic speech regarding security from Commander Hendricks. He must have rehearsed this speech in front of a mirror! He was out of breath with passion and duty as his message was delivered. He indicated in strong words that there was too much loose talk going on; that we should see nothing, hear nothing, and above all say nothing. He said that FBI and security agents were literally crawling all over the area. He then concluded his remarks with the announcement of a new project to start immediately: "Paint The Laboratory"! This was an all-day ordeal. There was only one interruption. The incomparable "Bad" Bill Bascom came aboard holding a gallon of real ice cream! There was a near riot starting with Stanley O'Neil's frantic lunge for the frost-covered can. Bill was our hero! Only he could pull off such a ploy. It was like delivering the "message to Garcia" — Bill knew what to do and he did it, much to everyone's glee. Commander Hendricks knew better than to interfere.

That evening we learned that the 143-foot *Spencer F. Baird* from Scripps had arrived at Bikini Atoll. Before long, both ships would join in the continuation of the non-military part of the expedition.

On Sunday, November 16, we got underway early for a spot 25 miles to sea of Runit Island. The air-dropped A-bomb was again scheduled for detonation late in the morning. This time the weather was good. At eleven we put on dark glasses, long pants, and coats, and assembled on the bridge. Bomb time was scheduled for 11:29. A false 15-second warning was given, then the corrected one-minute signal. A long blast from the ship's whistle signaled 15 seconds to go.

Our dark glasses were in place. Suddenly, a bright disc appeared before me. After a few seconds I took off my glasses and was blinded by light. At the first light burst, I felt an instant flash of warmth on me. Being blinded for a second, I put back on the dark glasses. A huge fireball was then forming; it was bright red, and out of this red fireball rose, at tremendous speed, a column of boiling fire and vapor. Distinct churning tongues of crimson flame rolled around, kneading itself into folds of white vapor. This continued for about three minutes, at which time the column had reached an angle of fifty degrees from the horizontal. A huge, expanding white cloud with a brilliant but turbulent pink interior began forming into that famous anvil cloud shape, the atomic mushroom. This cloud spread out farther and farther until it was over our heads. The ship was directed into the wind at flank speed (about 12 MPH). Other ships in our task group of approximately seven ships also proceeded at top speed. Their speed was so great that in short time they disappeared over the horizon ahead of us. Again we were left alone. This time, however, the clouds dispersed. The outer edges were visible, but were very thinned out. After several hours of rushing through the ocean, we headed back to our anchorage in the lagoon of Eniwetok Atoll. Dr. Munk, who viewed the blast from Eniwetok Island ten miles away from the bomb, said the earth shook, concussions broke windows, and a hangar was damaged. The noise was deafening. On board ship at a greater distance, we heard only a deep rumble and felt a slight concussion.

The *Spencer F. Baird*, also a converted tugboat and sister ship to the *Horizon*, came into sight at 7:00 A.M. the next day. Her captain, Lawrence Davis, made what must be recorded as the most poorly executed, slowest landing in power-vessel history. The full procedure of coming alongside consumed two hours. Unbelievable! Once secured alongside, the crews of both ships quickly mingled and exchanged sea stories. The *Baird* brought along a surprise, a puppy mascot called Spencer. The dog was a very cute black-and-white mongrel, the pride of the ship's crew. After lunch, all of Bill Bascom's equipment was loaded and stored in the aft hold of the *Horizon*, as it was no longer needed. The military aspect of our expedition was over. Now was to commence the "pure research" portion. We even got a Navy crane to remove that awkward and heavy submarine cable spool. It was no longer needed. A celebration was in order! The two Scripps ships are together — 5,000 miles from San Diego! With our next meal we obtained from the Navy all the ice cream we could eat!

The next day we started to sea early in the morning for a seismic run. The ocean was so darn rough that the captain would only go a maximum of 8 knots; if we attempted any higher speed, the gyro compass might tumble from its normal accurate direction. From the *Horizon's* stern, Max Silverman was in charge of TNT detonations. The *Baird* did all the hydrophone listening. Initially we used one-half pound TNT blocks, then 3-pound blocks, which were followed by 20 pounds, and finally 40-pound charges. The more separated the ships became, the larger the TNT charges became. The work was dangerous and tiring. Charges of TNT had to be hauled out of the ship's hold and detonated every 3 to 5 minutes. The job was very interesting, but, in my opinion, extremely hazardous. Any serious mistake would have blown up the ship. After a few hours of lighting the fuses to TNT charges, which we quickly tossed overboard, one's nerves become frazzled!

The next day the sea was still rough. Reports indicated winds of 30 to 60 miles per hour. On board, our wind indicator showed 38 knots. During rough conditions of this nature, preparing and igniting TNT charges on the ship's stern was an activity taken most seriously. Waves and spray were constantly sweeping our work area. I rigged a temporary canvas tent over the dredge to keep the blocks of TNT dry until we could use them. Even so, a few detonation caps got wet, which resulted in four duds. The ship would roll both rails under water. I was fearful that we would blow up the ship. As 10,000 pounds of TNT lay in storage under the very deck on which we were working, any serious mistake would vaporize the ship.

A radio message was received: "Congratulations to Dr. Barr in his valuable diving assistance in the search for the lost plane." It was signed by Admiral Wilcones. I felt very honored to be so recognized. However, I believe that Admiral Wilcones had confused Barr with Bascom!

That evening we returned to the lagoon of Eniwetok and dropped anchor. Because of storm conditions, the shore boats were cancelled. At 7:00 A.M. sharp the next day we got underway for the atoll's lee side. Winds were still blowing. We had a hell of a time getting the TNT charges out of the after hold. Many of those involved in this project were seasick. Max Silverman, however, is a tough mariner. He pushed ahead, undaunted. We made a detonation run downwind until 5:30 p.m. and then started back. Shooting continued until after sundown. We stopped when poor visibility began to affect safety. Max Silverman, Smitty, our radio operator, and I became involved for several hours in a discussion concerning personnel. They believed that all seamen on board should be

licensed. Also in the discussion was the view that too many scientists were engaged in "scientific joy riding," though we admitted to the problem of defining accurately the term "joy riding." Walter Munk was the chief example in this discussion.

The following day we commenced early in the morning on our final seismic run. The sea was more calm. At noon we were near the H-bomb target island (or what used to be an island). A large, water-filled crater of white and turquoise colors remained where Jean Island once stood. The adjacent islands were totally denuded. Nothing was standing. This bleak condition existed for miles.

On Sunday, November 23, several of us were invited to go on a "liberty party," which turned out to be an ammunition-loading project from the storage bunkers located on Japtan Island, one of the Eniwetok Atoll islands. A military truck was put inside an "M" boat. Bill Bascom, Willard North, Ted Folsom, and I were ferried over to the shores of Japtan from which we drove ashore. Into the truck we lugged 8,000 pounds of dynamite. Our sense of adventure and Sunday rest privileges than took over. "Bad" Bill focused on yet another of his famous spontaneous plans: "Let's tour this island by truck," he exclaimed with a boyish glint. We gave him our immediate and unconditional approval. Off we went, with Bill driving. Through the brush we crashed, over the dunes and through the vines: truck, powder, and all. What a grand ride! We came to realize that Bascom has never known fear! We also now know that he leads a charmed life. Anyone with Bill is touched by "invincibility." A beached, rusty old tanker lay stranded on the reef. Bill made ready his movie camera to record the scene. We then discovered a new thrill: huge four-foot ferocious-looking dragons (lizards) were in abundance on this island. From the protection of the truck we chased these creatures up palm trees, which they managed to climb with surprising ease. They much resembled iguanas in size and appearance, though they were quite green in color. This was no forest for the weak-hearted, though we were told later that the monsters were quite harmless unless provoked. It was fortunate that we elected to stay inside the truck.

After the novelty and thrill of lizard-chasing had subsided, we returned to the more mundane job of collecting coconuts. After a brief swim, it was time to return to the ship. The process of unloading and stowing 4 tons of explosives involved a sweltering, back-breaking effort. And this still was Sunday!

I hope that my request to be transferred from the *Horizon* to the *Baird* will be approved. Duty on both ships was very desirable

from my view. Each ship has its own "personality" — the *Baird* would be a new experience for me. I had never served in her before.

From the diary: "I had more work to do in the laboratory before we left for Kwajalein Atoll, so I stayed up until midnight — then I had the midnight to 2 a.m. watch, after which I slept until 11 a.m. After lunch, Bill Bascom and I had the 12 to 4 watch. One often has no idea how exhausted the body can get. I needed sleep so badly that my bones and muscles ached; I couldn't even think clearly. I found myself becoming cranky and short tempered. This recent sleep should help in these areas. It should make me more tolerable to be around."

Monday, November 24, Bill and I had the morning watch 8-12, during which Kwajalein Atoll was sighted. We took aboard a pilot and headed toward its largest island, Kwajalein Island. Dr. Roger Revelle, Dr. H. William Menard, Robert Dill and others were on the dock waiting to greet us. Captain Davis made another one of his amazing super-slow-motion landings. This time it took only 45 minutes. At the end of his slow approach, he rammed the dock which required the aid of another tug to complete the landing. How embarrassing!

More ammunition was loaded the following morning, after which I went ashore with Todd Carey to take some pictures. After chow, Will North and I visited the P.X., better known as "Macy's of the Marshall Islands," to buy some Christmas presents. Women on this island are terrible looking. There is no beauty in them at all. In the harbor there are two old sailboats at anchor. Seventeen natives live on one of them, and I don't believe that they are more than 40 feet long.

Great excitement occurred that evening. Todd Carey had been seen swimming from the pier out to the ship, anchored about one mile offshore. These waters were shark-infested; it was 11:00 at night and Todd had on no clothing.

A general alarm was sounded by the Navy. Shortly, searchlights, radios, and small military boats were buzzing all over the area. Todd was located about 200 yards from the ship and approximately one mile from the pier. He refused to get into the boat and told the sailors to get lost. "A Navy investigation into the whole matter is being considered."

The next big event for me centered on the announcement that the *Horizon* would leave for Ocean Island and that I was to transfer immediately to the *Baird*. I returned to the *Horizon* in a hurry and packed my gear; by now there must have been at least 150 pounds of it. The *Horizon* then came alongside the *Baird*. In addition to my

change of ships, Walter Munk, Bill Bascom, and John Isaacs also made similar moves.

Sleeping in the *Baird's* fo'c'sle for the first time was a nightmare just as John MacFall had warned earlier. It was so stuffy — hot and humid; I just lay there, sweating. The bunks were 1-1/2 feet apart; one could just barely turn over without first getting out of the bunk.

One of our crew members, Bob Haines, created quite a stir that night by "borrowing" one of the native's trucks. This prank was not treated lightly. He almost got thrown into the brig. Since the *Baird* was leaving for sea shortly, the authorities decided not to press matters. Our departure must have been viewed with relief by the locals. It all reminded me of the play, "Mr. Roberts"!

Our first experiment at sea on the *Baird* was to test the big cable. It seemed to work quite nicely while small weights were attached to the cable. With larger weights, however, slack developed between the winding winch and cable drum. When I attempted to explain why this problem was occurring, John Isaacs scolded me for being "too mouthy." I vowed to keep my mouth shut. That night, while a large load was being pulled, the wire jumped the flange on the guiding block, jammed and kinked the cable, and halted the entire operation. This casualty was predictable and preventable.

Down in the "fox hole" (the berthing area) where over twenty of us tried to get sleep, an adjustable cardboard flap was fashioned over the only ventilation outlet in the compartment. Now a comfortable breeze passed over my bunk! Such a luxury!

"There are four men on my watch: Robert Dill, Russell Raitt, Wayne Larrimore, and me. Painting of the laboratory continues while Chopin piano etudes are being played over the laboratory's speakers. Hi-Fi music certainly makes working conditions much more pleasant and seems to make the watch pass much more quickly."

During the day a solution to the kinked cable was discussed. A long wire splice would be needed once the kinked cable was cut out of the 40,000-foot spool. To facilitate the completion of a splice one hundred feet long, Captain Davis decided to anchor the ship in the calm lee of a near-by island atoll called Namorik.

It wasn't long before numerous dugout canoes set out from the jungle-lined shore and headed our way loaded with dark-skinned natives. Through gestures, and a variety of antics, we commenced several hours of vigorous trading. They had the most delicious bananas. We had cigarettes, clothes, and magazines. Of Polynesian appearance, the natives were most attractive, calm, and polite. They



**Quarters below on R/V SPENCER F. BAIRD, Alan Jones, top bunk, Ned Barr, center and John MacFall lower bunk.
Capricorn Expedition**

were amazed by all our machinery. Of great appeal were *Life* magazines with the large pictures, though the natives seemed to find equal pleasure when the pages were viewed upside down! The unexpected arrival of so many fascinating "guests" was a big boost to the ship's morale.

The following morning I awoke at 4:00 A.M. to go on watch. We were underway and were nearing an area where the winch could be tested, lowering a small Kullenberg core sampler. It took several hours to get the cable out 15,000 feet. Everything seemed to operate properly. To avoid further kinking, an accumulator watch was added, which involved a person's continuous viewing through the after-hold hatch of the cable, sheaves, and tension drums. If any cable slack developed, the winch operator was to be told immediately to stop the winch so the slack could be removed. The core barrel came up empty. Apparently not enough cable was let out.

The following morning, December 2, Tuesday, we rendezvoused with the *Horizon*. Again the Kullenberg core sampler was rigged and lowered. The sun came up beautifully behind dark clouds silhouetting Dr. Raitt and his buoys as he lowered the hydrophone lines over the side. This time the core barrel came up with about one gallon of slop in it — not much research value in that! A probe also had been sent down; it came up with a good record of bottom-sediment temperature. Another core barrel was prepared for lowering. We attached to the 30-foot-long steel core barrel a series of heavy iron disk weights totalling nearly 1,000 pounds. Then the weight stand slipped off the stern "bucket," apparently due to cable slack, causing the whole 2,300-pound assembly to drop about 2 feet. This sudden jerk pre-tripped the core assembly free-fall mechanism. The whole assembly plunged downward. All hell broke loose! The trip arm came down on Bill Bascom while Phil Jackson, Robert Dill, and I jammed ourselves into the bucket's corner trying to avoid the whizzing wire cable. Men on deck hopped about like bunnies as coils of wire were yanked over the side by the runaway apparatus.

For 60 feet, the 2,300-pound core assembly plummeted, after which the whole thing came to a clamoring and shuddering halt by the main hoisting cable. We could not believe that no one was killed. The decks were now clear, where seconds earlier there had been large quantities of coring pipe, weights, cable, line and blocks. A faint voice asked, "Everyone all right?" Except for Bill's bruised shoulder, there were no injuries. Our luck was incredible that day! A close examination of the coring apparatus showed no damage, not even to Jeff Frautschy's ingeniously designed core-barrel nail

coupler. The core sampler was then reassembled and carefully lowered.

The results this time were most encouraging. A 20-foot core was trapped inside the barrel, though the pipe was badly bent. Before the coring rig was hoisted aboard, fearless Bascom volunteered to put a plug in the core barrel bottom, so none of the material could wash out. With an aqualung strapped to his back, he performed this task 30 feet below the surface while several sharks curiously eyed his every move.

December 3rd was, for some, an historical occasion. We crossed the equator! Those people crossing for the first time were initiated into the realm of the deep by King Neptune in solemn and grave ceremonies, assisted by his appointed royal court: the Shellbacks. Upon crossing, all uninitiated pollywogs (those who had never crossed the equator before) were transformed into servants of His Majesty, and upon completion of the required tests of entry would join the realm of fully accredited Shellbacks. The program of initiation for those that were to enter King Neptune's Kingdom was carefully planned. The lowly pollywogs waited dutifully for the announcement of the "King's visit." Being an oceanographic research vessel, the ceremonies on the *Baird* were to have particular significance to His Majesty.

Over the ship's intercom speaker system, finally, a terse announcement proclaimed that King Neptune would hold court aboard the *Spencer F. Baird* at 0900 on the morning of Friday, December 5, 1952. Half the ship's company were pollywogs, myself included. Tension grew as the appointed hour approached.

Just prior to 9:00 A.M. on Friday, the ship's whistle blew, the loudspeaker blared: "Boarding party coming over the side. All Pollywogs report to the engine room." Once assembled, we were herded, all 15 of us, into a totally dark compartment 10' x 7' x 5" called the shaft alley. The temperature and humidity both must have been 100°. One by one we were summoned out of our dark tomb, up a long ladder, through a very small hatch onto the aft main deck. From there we were commanded to crawl on our bellies across the deck to stand trial. Carefully aimed fire hoses were used to make the transit most difficult. The Judge, Robert Dill, accused me of insubordination, murder, and insolence. My defense counsel immediately pleaded me guilty. The judge slammed down the gavel and sentenced me to the chopping block. Blindfolded, I was made to crawl to the opposite side of the deck, under a torrent of salt water. My head was then placed on a wooden block. Hands started to snip, cut, and pull out my hair. Other hands poured a thick oil known as

lamp black over my head, back, and beard. Someone quietly asked me if I wanted my beard spared; I replied, "Please, yes." It was not cut! A hose was stuck up my pants. I was proclaimed to be sick and was dispatched to the royal doctor. The Doctor, Robert Livingston, laid me on a cot and poured about four different kinds of revolting liquids down my throat. The last prescription was the "royal flush" which consisted of a bucket of water in the face. The blindfold was then taken off; I was directed to crawl over and kneel at the feet of King Neptune and his Queen, who proclaimed: "Lowly pollywog, I now pronounce you Shellback. You may now help initiate the others." From then on I took pictures of the proceedings involving my other shipmates. Only the back of my head had been shaved. I considered my treatment to be most lenient. The last person to go through initiation was Dr. Roger Revelle. As usual, he evidenced a good sense of humor. Bill Bascom delighted everyone. He stubbornly maintained the most disgusted look on his face throughout. He frequently would go limp and would sprawl out on the deck. Mr. Isaacs raised such a fuss he was rejected by the judge for bad behavior. Isaacs grabbed a hose, sprayed all the Shellbacks, and refused to face the judge. The judge said, "It really doesn't matter very much anyhow, as one end of your face is equally revolting as the other." The judge sentenced Isaacs to go through the entire initiation twice — his normally flowing bushy hair now looked like a popped open mattress, a solid mass of entangled greasy fibers!

The following day I was awakened at 8:00 A.M. to assist in taking another large Kullenberg core. It went down with the usual frenzied rush that accompanies projects that are conducted by Bill Bascom and Robert Dill. I have never seen two men with so much hustle. The hazards involved in lowering these large Kullenberg core samplers are substantial, the primary one being a pre-tripping of the equipment or the equipment breaking loose from its deck lashings and swinging wildly across the deck. The operation went perfectly for the first time. We retrieved a 20-foot core of red clay and Globigerina ooze. Meanwhile the *Horizon* made seismic runs on us after which Walter Munk and John MacFall were transferred over to our ship. John MacFall gave quite a description of his recent visit on the *Horizon* to Ocean Island. The island was primarily industrial, with great activity in mining phosphate. Women were very scarce, many of them brought over from nearby islands. Native-married females were locked up in a common cage at night whenever their husbands would go out. Not much trust existed; too much temptation. The cage became the solution.

The next large core operation was also speedy and efficient; it set a new "world" record. It was prepared and lowered in 20 minutes. In the process, however, the winch acted up a number of times. Once it free-wheeled with its 5,000-pound load. The bottom pull-out tension was enormous. A total of 8,000 pounds of cable tension registered on the dynamometer. The winch had to be shifted into its lower gear. In order to change gears the winch briefly had to be put into neutral. Again it free-wheeled. Buddy King, our expert winch operator, with all his strength jammed the winch into gear. With a shudder, the plummeting apparatus halted. Dr. Revelle, knowing that a break in the cable at this depth would mean an instant end to all our coring work, was visibly shaken. I asked him what effect these events were having on him. "They make me sick," he replied in his deep rumbling voice. On an expedition of this nature so much of the results depends upon the proper functioning of a few pieces of equipment. One key breakdown can ruin the entire expedition. The core sample brought over the side this time contained, at the top, Globigerina ooze, grading into red clay. At the bottom of the core was a variety of small rocks.

During the late morning of December 9 we approached Alexia Bank, a remarkable ocean-bottom phenomenon. It was postulated that this structure, called a bank, was in fact a coral atoll that had undergone sufficiently rapid ocean-floor subsidence that the surface coral growth could not keep pace with the sinking ocean bottom. This imbalance gradually resulted in the coral atoll sinking ever deeper into the sea. Eventually the atoll reached such a depth beneath the ocean's surface that the coral died for lack of sufficient sunlight. Alexia Bank is between 40 feet and 115 feet below the ocean's surface. It is circular in shape, and has a diameter of several miles. In an ocean otherwise thousands of feet deep, with no land within hundreds of miles, we finally anchored at a depth of 110 feet. Diving preparations were made. Soon Bill Bascom, Dr. Livingston, and John MacFall were surveying the bottom. Before long MacFall burst out of the water with a wild desperate look on his face. Water had apparently entered his air hose. Robert Dill and Phil Jackson quickly swam to the rescue, reaching him just in time.

A more extensive examination of this structure was conducted with a hastily assembled diving party of eight. It was hoped the examination would verify that the atoll had once been above sea level. This could be confirmed by the discovery of wave-surge channel in the reef structure. Diving continued all day without clear-cut results. We later found that we were in the wrong position on the structure. Calcareous algae called *Halimeda* and mushroom coral

plentifully covered the bottom's surface. Sharks were ever present though they didn't slow our work.

The following day we continued to search for the surge channels. A frantic yell came from Bob Livingston, whose aqualung had sent water into his breathing tube. He almost drowned. If he had been any deeper, he never would have made it to the surface. I dove off the ship's stern and swam like a madman for him. The ship's small launch, at full throttle, rushed to Bob's aid. All was well after Bob was dragged aboard.

Early December 11, the coring crew was awakened and preparations were made for a lowering. We were somewhat tired and groggy from our diving exploits the day before. Even the ever-bouncy Bill Bascom was strangely slow and silent.

The core of bottom sediment retrieved was a long 25-foot section of Globigerina ooze. The next instrument to be lowered was Art Maxwell's temperature probe. With frustration, he experienced a series of problems getting his instrument prepared properly. First, he bolted and sealed shut his recorder without first starting it. Then, after disassembling the unit to start the recorder, he forgot to include the hooking lid. This required another disassembly. For the third time, Art reassembled his unit, all the while under the watchful eye of a perplexed but quiet Roger Revelle. Upon cinching tight the last bolt, Roger gave forth with one of his pearls: "Maxwell, you are a toad!" We about split a gut laughing, while Art Maxwell turned beet red with embarrassment. It goes to show that science is subject to human frailty!

When the probe was retrieved, it came up with a terrible bend in its long 15-foot snout. The recorder had recorded nothing. After all that preparation, what a disappointment!

"Dr. Raitt has managed to create competition in the otherwise routine and fatiguing function of pulling in his hydrophone equipment. Two pulling crews now compete for free beer going to the winner of the fastest hydrophone line. It is amazing how Dr. Raitt can seem to get so much fun out of doing the most routine functions. He even gets everyone else to enjoy his doings." An inspired technical leader!

After a lot of controversy and heated discussion, it was decided that the ships would now go directly to Suva, Fiji, leaving out the last station on the schedule.

Friday, December 12th, we were to arrive. I stood my last laboratory watch for Scripps that morning from 4-6 A.M. The island of Fiji lay just ahead. During our approach rain fell in torrents. As the city of Suva neared, the captains of the two ships kept easing

forward the big diesel throttles until it became obvious that we were in an all-out race for the dock-side position. The *Baird* squeezed in front of the *Horizon* by cutting many of the corners in the charted channel. We got our shaft RPM's up to 170, the highest we have ever seen. By the time we picked up our pilot and got inside the reef, the *Horizon* was right on our stern. She never was able to overtake us, though. A fabulous reception committee was assembled on the dock upon our arrival. Among the Americans were Win Horton, Dr. Gustaf Arrhenius, and Mrs. Helen Raitt. Curious Fiji natives lined the dock by the hundreds.

The Fiji natives were proud, fierce, tall, and stately looking, while the Indians appeared somewhat shy and withdrawn. After considerable confusion with customs agents, I went ashore and soon had my reservations confirmed for the flight from Fiji. In a corner ice-cream parlor, I met Art Maxwell and two nurses, one old and one young. Together we started a sight-seeing tour. We were invited to lunch with an Indian family known well by Miss Norton, the older nurse. The Indian family lived in a home high on the side of a hill overlooking the city and harbor. They were most friendly — especially their intriguing 16-year-old daughter. What a beauty! After a variety of Indian foods, we returned to town. A VIP cocktail party aboard ship, on the fantail, was in full swing. From the dock natives and other locals stood in silence while we and our VIP invited guests ate and drank our fill. It was uncomfortable to see so many wishing to join our party without our ability to include them all.

The following morning, after hurried goodbyes to my shipmates, I reached the bus stop for a ride to Nandi Airport, some 135 miles away. The trip took place at tremendous speeds. The driver seemed to ignore all caution. Others on board showed no tension, so I joined them in watching the blur of green countryside rush by.

Before long, life aboard the research vessels *Horizon* and *Baird* started to fade from my current attention. Into those gathering memories would go sparkling reflections of involvement with the sea, two ships, and those certain types of men to whom the ocean will reveal her innermost secrets.