FAY L CUNNINGHAM 1944-1995

In September, 1944 I was one of the nine out of our group of 30 who got orders to report to the Manhatten District, Corps of Engineers, Oak Ridge TN. After several muddy days there, Kermit Lundell and I were sent to Boston, stopping several days in New York City waiting for a second security check by the FBI. Upon arriving in Boston we were taken to a men's clothing store where the Army purchased a complete wardrobe of civvies for us. We were told we were to work at the Metallurgical Project (MP) at Mass. Inst. of Tech under Prof. John Chipman. This was was a branch of the MP at the University of Chicago under Arthur Compton. There were about 8 Army men in the total MP group of about 30. Kerm and I were assigned to a ceramics group which was responsible for developing procedures and equipment to produce crucibles for the final reductions of uranium and plutonium at Site X (Los Alamos). Kerm and I had the responsibility of designing equipment to reproducibly tamp the damp powder to a "green" crucible which, when fired at 1700 degrees C would meet the strict specifications required. We were successful and all of the material in early A bombs was processed in our crucibles.

In Jan., 1945 the Army in its wisdom, chose to send us to Ft. Devens, MA to separation center and we were placed in the Army Reserve. In Sept., 1945, after the bombs were dropped and war ended, we went back to Ft. Devens to induction center and went back to work at MIT, only now in uniform and on active duty. We transferred the crucible technology to the Norton Abrasives Co. in Nov. and I was reassigned to the beryllium group. We were trying to improve the physical properties of Be as it was a critical component of the bomb. We were grossly overexposed to Be dust and vapors and I and others had a bad episode of acute beryllium poisoning. Several of the civilians in the group died in the next few years. I have beaten the odds so far but Be is carcinogenic and the particles are still in my lungs. They keep close track of my health and I received a big packet of info from NIOSH just yesterday. While at MIT I saw Cas Wooldredge once and Bill Dawson several times when they were home.

By May, 1946, I was elgible for discharge when we were practically begged to waive separation for four months and go to Bikini Atoll as a radiation monitor for Operation Crossroads. I accepted and went to Oak Ridge and subsequently to Oakland Army Base where we shipped out on the Haven, a hospital ship converted to a lab ship (because it was air conditioned for our instruments). While at Oak Ridge I went to Atlanta and spent two days with Russ Willmon. Enroute to Oakland we passed through Cincinatti and Chicago and Sam Willis and Jake Zelenitz came to meet me. At Bikini, I was assigned as the radsafe monitor on an Initial Boarding Team of ten. Our duty was to board the assigned target vessels ASAP after the blasts and assess the damage. I advised the team leader, a Navy Captain, as to the radiation levels and safe times, etc. I was the only EM and the only Army man as all the others were Navy officers. I got aboard vessels within a few hours of both tests and was aboard nearly every kind of ship the Navy has as well as a Japanese and a German ship (Sakawa and Prinz Eugen). This was a most exciting time! I was in a pool of monitors after the first few days after each test, which allowed me all kinds of interesting jobs such as working with hard hat divers who were diving on sunken vessels. I received a official commendation for this work. I got

back in Oak Ridge about Sept. 1 and was separated at Ft. Bragg a few days later. I managed to get to see Sam Willis in Cincinatti before I got home to Lansing, MI.

I enrolled back at Michigan State University in Sept. 1945 in chemical engineering. My ME credits didn't help me much and what with course sequences and schedules I did not get my BS Ch E (with honor) until June, 1948. The GI Bill helped a great deal during this time. I worked part time at Fisher Body those two years.

In 1947, I became engaged to Geraldine Smokovitz whom I had dated at MSU before going in the Army and had corresponded with all through the war. We were married June 12, 1948. She had graduated in 1945 and had taught 6th grade in Battle Creek for three years. I had explored job opportunities at some length and chose to join The Upjohn Co. in Kalamazoo, MI in R & D. Geri became an elementary teacher in Kalamazoo and taught ultimately, after time out for children, for over 30 years.

I was a development chemical engineer working in the pilot plant at Upjohn. Our fundamental job was to scale up synthetic organic chemical reactions from the lab to the pilot plant to the production plant. At first we had no plant and I was involved deeply with the design, installation, and startup of production facilities as well as pilot facilities. We had to be a "Jack of all trades" then as we had little support engineering staff. My ME training and auto plant experience came in handy. I was involved in process development on folic acid, a vitamin B component (14 steps) and the synthesis of progesterone from stigmasterol which had to be separated with great difficulty from soya sterols first. Later I worked on the entire gamut of steroids such as cortisone, hydrocorisone, prednisone, prednisolone and some dozen or so other advanced intermediates for other pharmaceutical firms. After 9 years at a number of different levels, I transferred to the Fermentation Development group where I was Research Manager of separations engineering. After the fermentation is complete the desired compound must be isolated from the very impure, very dilute broth. In the early 60's I introduced mathematical modelling and computer use to solve simulultaneous partial differential equations to run some of these complex processes. I have a number of technical paper presentations, publications and patents in this area. I was involved in the search for new antibiotics, the development of a number of them to production, and many steroid transformations. I became Fermentation Pilot Plant Manager and in 1972 after 15 years in fermentation I moved back to the chemical area as Research Manager of Chemical Engineering Development. For the next 12 years I managed the engineering development of processes for such drugs as Motrin, Halcion, Zanax, prostaglandins, minoxidil (Rogaine), many new steroids, many veterinary products, and many reprographic chemicals (for Polaroid and Xerox).

During this period I became involved in recruiting PhD chemical engineers and visited Big Ten schools as well as top schools such as MIT, Berkely, Stanford, Delaware, Carnegie-Mellon, Colorado, etc. I presented seminars at graduate schools and became well acquainted with ChE faculties. I traveled to Britain to work with pharmaceutical firms there in introducing our proceses there. I organized and conducted symposia of technical papers presented at ACS and AIChE meetings. In 1983, I organized a training program in scaling up chemical reactions for two groups of Egyptian scientists at the request of the National Science Foundation who administer the Agency for International Development (AID) technical program. In 1985 the NSF sent me (and Geri) to Egypt twice to assist in the scaleup of the first Egyptian developed chemical processes for

pharmaceuticals. This was during the rash of plane and ship and hijacking in that area. In 1983 I was made Director of Chemical Production, which post I held until I retired in 1988. Geri and I made a two week trip to Japan and Taiwan in 1986. I had always planned to retire early at 60-63 but was having so much fun I stayed until nearly 66 and put in 40 years at Upjohn.

In 1954, Geri and I had a son, Bruce. In 1957, we had a daughter, Debi. In 1958 we moved to our present large home which has a pool and lots of privacy. We did lots of car camping as the children were growing. I was a Cubmaster for 4 years and chairman of a Boy Scout Troop Committee for 3 years. I was a PTA president, President of the Kalamazoo Management Association and involved with numerous other organizations. Bruce attended the University of Denver and settled in Salt Lake City (largest city close to big time skiing) and has his own firm, Cunningham Construction Co. He and his wife, Karen, have two daughters, Echo 23, and Shilo 17. Debi attended Western Michigan University. She and her husband, Patrick Reynolds, live in the mountains (at 9200 ft.) SW of Denver. They have one son, Remington, 16 months. We visit both of them twice a year and they visit us regularly.

Over the years, I have played many sports but in the last 40 I have concentrated on skiing, tennis and backpacking. Geri and I have skied since 1947 and we introduced our children to it when they turned 5. We have two minor ski areas within 20 miles of us and had season passes for 20 years. Bruce became a competitive racer and placed in nearly every meet and taught racing at our local area. Starting in 1970 we went to Colorado to ski annually and have ever since. After college they both settled in the west, partly to ski. The day I retired Geri and I left for Switzerland to ski and the next year we skied in Austria. Geri's arthritus finally caught up with her and she had a total knee replacement in Oct. 94 and has had to give up skiing and tennis. She still can golf as she has for some 40 years. I took up golf at 70 so that I could play with her. I still play tennis three times a week. In 1967 I got back into backpacking and have gone annually for a week until last year. I have made many trips to the middle and southern Appalachains, one to the Tetons, one to the Sangre de Christos, two to the Park range in CO, six in MI, two in Canada, and five to the Wind River Range where we have done some fairly serious climbing. We were last there 3 years ago. Geri and I love to travel and in addition to the trips mentioned above, spent a month driving around western Europe visiting 8 countries in 1976. Since retiring 7 years ago, we have been to Europe six times, Australia, New Zealand, Hawaii (twice), Alaska, Hudson Bay, St Maarten and Morocco. We have been in a total of 34 countries. We have been in 49 of the 50 states. We have driven 2500 miles in Britain, 2500 miles in Scandinavia, we hit Moscow two weeks after the coup on Gorbachev in 1991 and have had many interesting and exciting experiences.

In 1991 we bought a winter home (Villa Condo) in Saresota and spend 3-4 months there. What with our semiannual trips west, trips abroad and to Michigan's U. P. to check on Geri's mother, we are in our Kalamazoo home less than half of the time.

Life has been good to us and we feel blessed. I enjoyed a CCC convention at the University of Maryland in 1993 and am looking forward to our October reunion with anticipation! It will be good to see many of the old ASTP gang again.

October 12, 1987

Defense Nuclear Agency
Attention: RARP
Washington, D.C. 20305

Dear Sir:

A few weeks ago I received a letter from the Department of the Army, several fact sheets from your agency, and an ANTPR Participant Summary. This latter summary listed the radiation exposure results from my film badges and a reconstructed external dose obtained during my service as a radiation monitor (RADSAFE) at Operation Crossroads in 1946. Also there was enclosed a list of reports that had previously been issued and their locations. I obtained a copy from the Kalamazoo Public Library. It has been most interesting reading for the last few weeks.

I wish to compliment your agency on the thoroughness and accuracy with which you have reconstructed and reported such a complex operation after some 40 years. It must have been a major challenge reviewing old logs, reports, and other documents, and piecing them together in a coherent manner. I did find a few minor inaccuracies and omissions. I reported these by phone. It was suggested that I put them in writing for you. I also volunteered to send you a copy of the notes I wrote after tests Able and Baker while at Bikini in July, 1946, and enroute home on the U.S.S. Henrico in August, 1946. I wrote the notes in long hand at the time and typed them in the fall of 1946. I had them retyped in the mid-seventies when I ran across them. They may be of some help in piecing the entire picture together, and in particular, reconstructing my personal radiation exposure with more accuracy.

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NOTES FROM OPERATION CROSSROADS

On Sunday June 30, 1946, I awoke on board the USS Haven with a certain expectancy. I knew that if the weather predictions were right, we would move out of Bikini Lagoon in preparation for the test the following day. After breakfast I began getting my things in order, wrote several letters, and drew an issue of Navy fatigues. I was back in the wardroom preparing to go to the navigation deck for a group picture of the Oak Ridge gang when, over the loud speaker, came the four blasts on a bugle which signified that today was officially declared Able day minus one. The voice now came in saying that July 1 would be Able day and How hour was to be 0830. A loud excited cheer went up as the tension was relieved. Up on the nav deck everyone was running around, but we finally got the group together and took several momentous pictures. We broke up in a hurry as every man had his job and a dozen things to do. I stopped in at Wardroom B-2 (USS Haven), and drew my X-263 Geiger counter with earphones, a dosimeter, a radium source, and two "handy talky" radios. I went below and packed my gear in my musette bag. At 1100 we members of initial boarding teams assembled at the mess hall and ate an excellent meal with a T-bone steak as large as a plate, and all of the trimmings. We ate hurriedly and grabbed our helmets, bags, and instruments and assembled in B-1 with the senior monitors and damage control safety officers. At 1130 we left in the motor launch for the Wharton, the HQ of Admiral Solberg, director of Ship Materiel. On board the Wharton we broke up into our various teams of which there were ten. We met the other members of our team whom we knew well from the various practice sessions we had held, including the three days at sea on Queen day the weekend before. That had been a full scale rehearsal, and I had been sick the three days our 125 ft. net tender had pitched about, taking water over first one gunwale and then the other and the bow and stern alternately as well as we rode out a storm in the open sea.

My team was a nine man team, being all Navy men but a Marine photographer and myself. We boarded our small boat and went to our ship, the USS Shakamaxon, a 125 ft. net tender (AN 88) with "horns" at the bow, and a friendly crew of 23 men and 2 officers. We boarded and got underway. We stowed our gear in the cabin and our instruments in the Skipper's wardrobe. We assembled in the wardroom for a meeting. The captain of our team was Navy

Capt. Dodson, a youngish naval airman, very capable and most likeable but a bit stiff. His ass't was Commander Roe, an even younger man (Annapolis '33) also very capable, and less stiff. The signal officer was Cmmdr. Cundiff, a large, burly, man with a benign Teutonic look. Dr. Hennessey (Lt. S.G.) and myself were radiation monitors. Our damage control safety man, Dr. (Lt. JG) Sarsfield, is a friendly man who had been a Chief Pharmacist's mate for 10 years and had 19 1/2 years in the navy. He was a walking encyclopedia on naval matters. Lt. JG Moore of Oklahoma City, and his ass't, Chief torpedoman Miller of Dover, Mass., were our ordnance men. Marine Sgt. Aubrey of Greenfield, Mass, our photographer, completed the team.

In our meeting, the Capt. went over our general mission, which was to clear the target vessels for boarding by crew members as soon as is safely possible. He went over each man's individual assignment with him and added to mine the job of making a quick survey of all army equipment we encountered. This was quite a job, as the QMC, SC and Ord. all had samples of most of their equipment on the flight deck of the Saratoga. Each man was given a notebook for each of our alloted ships to record data in.

The weather prediction was very complete, giving wind velocities and direction at all altitudes, and the cloud cover, an expected 20% at the lower altitudes. With this, the meeting adjourned. By now we had crossed Bikini reef and were in the open sea as the swells testified. I broke out into a sweat and was a bit worried, but the fresh air revived me and I set up my cot on the fantail under a gun mount. I ate gingerly at chow and after a good bull session, I started to watch the movie. The moving figures and the roll did things to my stomach however, and I turned in. I slept well with my clothes on and my raincoat for a blanket and musette bag for a pillow.

The next morning, July 1, dawned clear and bright as usual. I felt fine and ate a good breakfast of eggs, bacon, and pancakes. At 0800 I placed casualty badges around the ship at various locations. These provided a check, as well as those carried on our person, as to the amount of radioactivity we had received. At 0815 we gathered on the top gun mount (20 mm.), and the crew gathered in the mess hall. We were excited, yet not tense or nervous. Curious is perhaps the most fitting word. We had our goggles on our foreheads when word came that 0900 would be Mike hour, the time of actual detonation. We were

at this time approximately 15 miles from the target array. On the bridge beneath us the radio was tuned in on the bombing plane and the signal, 10 min. to go, came through. Then 5 min., then 2 min., then 1 min., then 30 sec., then BOMBS AWAY. We pulled our goggles down and commenced counting the seconds till the detonation. I had my eyes tightly closed and each second seemed a minute. A flash which I could barely see through my eyelids and goggles caused me to open my eyes and see the ball of flame through the goggles that allowed only 1/30,000 of the light to pass. I shoved up the goggles and stood with awe as I watched the pillar of flame and smoke rise. Soon it was only a column of smoke rising rapidly in the blue Pacific sky. It's speed of rise was amazing but gradually slowed down as cooling commenced. It then began to mushroom out at the top into the familiar form. At first glance one perhaps would think this an ordinary cumulus cloud, such was its form in the cloudless west. It's hue however gave it away as man made. A most delicate shade, somewhere between rose and peach distinguished it as a cloud of lethal particles instead of ordinary vapor. By now it had risen and the herniated effect of former atomic explosions was becoming noticeable. All of this time the radio had been going and observers from the press ship were describing their views. Drone planes (pilotless) were darting in and out of the cloud and photographic planes could be seen wheeling about at a safe distance. The drones (B-29's and Navy F4F's) carried radio operated Geiger counters sending back a continuous report of the poisonous rays about it, as well as filter bags which sampled the deadly particles.

The cloud had drifted and was not over the atoll now. Observer planes were broadcasting, telling what they could see of the target fleet. By now it was 1030. An announcer said, "There is a fire on the flight deck of the Saratoga." This ship was our first priority ship, and we conjectured as to whether it was the two planes loaded with gasoline on the fantail. We gathered around the speaker, and hung on every word. Lawrence, of the N. Y. Times, an observer of both the Nagasaki bomb and the Alamagordo test compared this explosion as being less intense in flash, and the cloud as much smaller and more slow to rise. By now we were in sight of the target fleet as we steamed along in line from N. to S. on the outside of the reef on the east side. Smoke could be seen rising from many ships but the fleet seemed to be there.

I ate a good meal a little early, and by the time we had finished we were rounding Enyu island at the entrance to the lagoon and saw the cruiser Fall River in its position guarding the mouth. We crossed the reef moving slowly at about 1315 hrs. As we approached the anchored vessels, we could see several were burning and smoke was pouring from them. We approached and carefully circled the destroyer Conyngham. I was on the fantail, and Dr. Hennessey was on the forecastle. We were watching our instruments carefully, having them on the X-1, or sensitive scale, and the earphones on under our white helmets. As we approached, no increase in the dial reading appeared, although the background count increased slightly. Several of the crew were gathered around me watching intently and asking questions. Water drawn in a bucket gave no significant reading. We drew alongside and after checking carefully, the Captain, Dr. Hennessey and I boarded. We cleared the area and the rest of the team boarded. We worked slowly forward, watching our instruments carefully and noting the blistered paint. We worked past the torpedo tubes and saw charred and smoking rope. We covered the entire ship and found it in good order which had been expected as it was one of the farthest ships out. We ran up Able flag indicating she was safe to board. We returned to the AN 88 which had been alongside. As we did, several explosions split the air. It was the magazines on the carrier Independence. The island had been blown off by the A bomb and fires had been burning ever since. An ARS had been alongside the Saratoga and hosed down the fire on her flight deck. Another was pouring water on the furiously smoking Pennsylvania.

We cast off and headed toward the Sara. I took up my position and was answering some of the crews questions when I noticed on the earphones that the radiation was increasing. The needle on the dial swung over and just as it went off scale I switched to the 5 scale and watch it again creep up. Several of the crew were alarmed but I allayed their fears. One very comforting thought was that all through our work, our instruments agreed very closely. We circled the Sara and once the needle swung off scale on the x 8 scale giving an over tolerance reading. A reading of .8 on the x 5 scale for 24 hr. exposure was equivalent to the tolerance level of .1 Roentgen per day set up by the radiology board. We stood off and a LCVP came alongside and the team transferred to it. The cox'n ran it in alongside the Sara, and we circled it there and found over tolerance radioactivity. We tied up to the starboard side of the carrier and boarded her. This was a tricky maneuver, as we had to climb up onto the blister over a landing net with all of our gear. We

checked over the flight deck, and found it to be about twice tolerance on the port side. We went below in the blackened and hot ship. The ship had been closed for two days, and the ventilation off. We descended dark ladders testing often for gases and lack of oxygen. Everything on the hangar deck was in good order. Planes, torpedoes, and bombs. It was hot and as dark as the inside of a cow. Our flashlights seemed so small in all of that blackness. Back on deck we split up and checked the various equipment. I gave the army gear a quick going over and found little damage. Windows blown out of radar trucks, tires burned slightly and paint scorched. A wrist watch, a pocket watch and clock were all running. Some damage was done by the water which had been pumped on the deck to extinguish the fire which had destroyed all of the QMC equipment. It had consisted of cases of food, clothing, mess gear, etc. which had all been destroyed and the wooden flight deck burned and charred deeply. Cans of food had exploded, and frankfurters, pears, canteens, etc. were scattered all over the deck.

It was nearing 1700 hrs. and we had to leave. We ran a Baker flag up meaning, dangerous, and radioed a report of "Geiger Sour" in to HQ on the Mt. McKinley. We boarded the Shakamaxon and steamed around until about 1900 when we anchored near Enyu island. We had cleaned up and eaten by now, and the captain left to report to Admiral Solberg. Several cases of beer were broken out and the movie was rigged on the fantail. The sun went down with its usual glorious display, only this time over a smoking fleet of singed ships.

July 2 dawned clear. We were up, chow over, and underway at 0700. We picked up Capt. Dodson at the Wharton, and then returned to the Saratoga. This time she was "Geiger Sweet" and we replaced Baker flag with Able and made a more thorough check. Upon leaving we circled the tin can Mustin. We were getting more than half tolerance after more than 24 hours. We boarded her and found nothing of import. She had been far out also. Burned paint, broken blast gauges, and little radioactivity. While on the forecastle, I noted the twisted hulk of the submarine Skate drifting down on us. A tug came along and nudged it toward the beach. A friend who had been aboard had found it highly radioactive. From the Mustin we went to the Mugford, another can, and with the same results. While up on the bridge we noticed that the Japanese cruiser, Sakawa was settling by the stern. We watched as she reared and sank. It was the first time I'd seen a ship sink, and it was quite a sight.

By the time we left the Mugford, carefully dodging a mine floating nearby, it was 1100 and we boarded a LCPL and went to the Haven. It seemed good to clean up and rest up in our air-conditioned palace. The Haven, a hospital ship, had been chosen as HQ for the Radiological Safety Section because of the air-conditioners which would protect our Geiger counters in the humid tropics.

I was not aboard any more ships until later in the week when I made a trip around the target fleet picking up film badges. From this trip and from bull sessions with the boys who had monitored on the various other ships, I learned a great deal of the damage that was inflicted by this, the first sea test of the atomic bomb. The fleet had been crippled badly. True, no capital ship had been sunk. However two assault transports and two destroyers had been sunk and approximately five capital ships and one battle cruiser had been put out of action so that they would have been easy prey for planes, guns, or torpedoes. The Independence, a heavy carrier, had been reduced to a twisted, ruined hulk. A great deal of minor damage was done also. Frames were wrenched, decks and bulkheads twisted and warped, and turrets sprung. Asbestos was blown from the steam pipes in the boiler rooms of many ships preventing operation. The stacks on the Pensacola and Salt Lake City were badly knocked over as were masts on many ships.

Had men been aboard the ships, most would have been destroyed. Some would have survived a few days and died of flash burns and of radioactivity. Some would have survived, chiefly those well below decks, but the manpower to operate the ship as a fighting unit would have been decimated.

Great pains were taken in many ways to check the effect of the blast and of the radiation. Gauges and instruments were placed on all ships and on the islands. Destroyers and planes were dispatched to follow and track the radioactive cloud, noting concentration and dispersal. Cameras were placed in towers on the islands, and sound and pressure wave recorders, oceanographic instruments and every conceivable test made. The results of the test have not as yet been completely evaluated. However the damage and radioactivity were all that was predicted or expected by the men whose calculations were based on experience and technical reasoning. Both were considerably more than I had expected of the air blast. The sight of indented steel plates on the side of

a vessel 1-1/2 miles away from center astonished me. Certain laymen have been disappointed in the test due to overpredictions of the damage by amateur phenomenologists and by underobserving the damage by men who did not board the ships. Anyone who has seen first hand the terrific damage, and has seen the needle of the Geiger counter swing up and off scale two days after the blast knows that an atom bomb isn't healthy. Particles of overtolerance radiation are even now (Able plus 7) being dug out of the deck of the Prinz Eugen (German battle cruiser) where they have imbedded themselves. They were caused by the condensation of vaporized steel from the super structure of the destroyer Carlisle or Anderson. I worked with divers who were examining and photographing the sunken hulks of these two ships. These divers were men with 15-20 years experience of salvage diving and all agreed that they had never seen such total destruction as these ships showed. The No. 2 gun turret of the can Anderson never was found. The hull was so crushed that a diver could step from the ocean floor to the deck. I have seen the photographs bearing out these statements and the total destruction was apparent even to me.

All in all, the test went off very well. Teams operated as teams, communications were not too jammed, and the schedule was followed almost exactly. Great initiative was shown by all and the fact that no injuries were sustained, and no one received an overdose of radiation is a triumph in itself. For me it has been a great and memorable experience. I shall always remember with pride the important part I played in the well being of the 42,000 men at Bikini, and in the stepping forward of science.

F. L. Cunningham
Bikini Atoll
July 9, 1946

BAKER DAY

On the morning of July 24, Baker Minus One, we were all prepared for the underwater test. I had my gear packed, instruments calibrated, film badges drawn, etc. Our instruments consisted of a Victoreen No. 263, range 0-.5 R/day, a Victoreen No. 247, range 0-200 R/day, and a dosimiter, a pocket-sized electroscope which could be read at any time to give the amount accumulated since the last charging. The two Victoreens were both Geiger-Muller type counters, having three ranges built into the meter. The 263 had earphones as well as a meter, while the 247 had meter only. The 247 is a very rugged, nearly waterproof instrument weighing about 15 lbs. It was very dependable but was not sensitive to small amounts of radiation. The 263 was a small 3 lb. instrument fitting into the pocket of army fatigue trousers.

About 0900 the bugle blew. This time we were not tense and excited as before, although each of us knew that for us this was the big job and that no one knew the magnitude of the radiation we would encounter. We knew that we would be busy for weeks after this test measuring the terrific amounts of radiation set up.

I had the same assignment as before, Initial Boarding Team 8, with the same members except my new fellow monitor was Dr. Mosely, another Army man. We gathered our gear, for a stay of three days we were told, and left the Haven for the Wharton where we joined the rest of the team and put off for the Shakamaxon again, the same ship I was on over Test Able.

We put out to sea about 1300. We rolled quite a bit but this time I didn't get sick. We all had a beer to celebrate the momentous day and turned in early that night. The next morning we all gathered on the top gun mount at 0850. How hour had been set for 0905 and this was verified by radio. This test we were to observe with the naked eye from a distance of about 11 miles. The superstructures of the ships and the islands of Enyu and Bikini were plainly visible. The time was being called off, ten second to go, five seconds, Four, three, two, one, and a bright orange flash rose up from the sea and was immediately swallowed up by a rising column of water of huge proportions. This towering geyser rose to a height of several miles, and nearly half a mile wide before it cascaded back into the lagoon enveloping the whole atoll in a

cloud of steam and mist, all permeated with the lethal fission products from the bomb's explosion, which had been physically trapped. As this slowly settled and cleared away, the islands and the fleet emerged into view. The battle wagon Arkansas was immediately missed as was the LSM 60, the ship from which the bomb had been suspended. I later found many of the fragments of this ship which had been disintegrated and the pieces nearly molten before they fell back into the lagoon and onto the ships. The pieces I found were on the New York, Pennsylvania, and the Independence. We were the first aboard the Independence and the second team aboard the New York and the Pennsylvania.

We, in the salvage fleet, were steaming back and forth and entered the lagoon cautiously about 1100. By 1400 we had worked our way slowly, depending on our instruments, to the outer fringe of target vessels and boarded the Fillmore, a PA or assault transport. This ship was cleared radiologically and otherwise, and we moved on through the fleet to the LCI 329. The Saratoga, our first priority ship was seen to be in trouble as we had entered. Her huge distinctive stack was gone and she was settling low in the water. By now she was very low, the flight deck almost touching the water. We boarded the LCI and found it very radioactive, about 2-4 times tolerance. We then moved toward the Sara to get pictures and observe more closely but the terrific radioactivity in the water prevented it. We lay off on the edge of the radioactive water and watched the noble Sara die. The after end of the flight deck was by now under water, and she started blowing by the stern. Then slowly, majestically, the bow rose and slid slowly under the surface of the lagoon. A proud veteran, "The Fighting Lady," had just died a stately death and we were all awed as we watched.

By now the highly radioactive water had spread out to where we were and we were forced to withdraw to Enyu Island and anchor there. The Capt. and the rest of the team left for the Wharton and Dr. Mosely and myself remained aboard. We remained there for over a week. A week filled with inaction, as the water around the target fleet was contaminated so badly as to prevent boats from going in except for quick surveys and even then they could not penetrate to the center of the fleet. The destroyer Hughes was towed to Enyu and beached as it was in a sinking condition. Another PA was likewise beached. On about Baker plus five, we received a mission. It was to anchor the sub Skate which had been so badly mauled in the first test. We towed it over near the reef

to the appointed spot, and dropped an anchor and a buoy. We then came alongside the Skate and I went aboard with several sailors who were to fasten the cable to the Skate with shackles. The ship was very hot, giving the highest readings of any I had yet obtained, being of the order of 100 to 200 times tolerance. This meant that men could stay aboard only a short time. The crews were changed frequently and the work was hastened as much as possible. As radiation can be perceived by none of the senses, the sailors did not realize the amount they had received or the necessity of thorough showers immediately. This was quickly demonstrated to them by letting them listen to the overtolerance readings of their clothes, shoes, and even bare chests where they had come in contact with the contaminated vessel. As most of them wore only shorts, as I and everyone else did, they were covered with particles, chiefly relatively harmless beta activity although the ship itself was active, the above amounts in the hard, penetrating gamma radiation. We anchored, just off the Skate, and I took a ride over to the Haven, a three hour round trip across the choppy lagoon in the motor whaleboat. In the course of the trip you become drenched to the skin and the salt really cakes on. At the Haven, I got my mail, checked my instruments, got my orders, and got some clean clothes, and a stock of candy, etc. Upon returning, I started reading my airmail edition of Time magazine, and came upon a picture of the twisted hulk of the Skate. I looked up from the picture to the real Skate, lying about 100 yards away, and directly in front of me and compared the two.

The next day I returned to the Haven and there began a job as special BSM monitor. This consisted of going out on any stray assignments that might come up. The man in charge of this, a Naval Lt., was a friend of mine and as a result I received many of the interesting, and choice assignments. Over the next ten days I was aboard most of the major vessels of the fleet. For two days I was advising an Army Col. upon the state of most of the Army gear, which was considerable on board the ships. This was very interesting work as I got aboard a great many ships. All of these ships had to be boarded from small Cris-Craft built LCPL's which rolled and rose and fell on the lagoon's chop. The ships all had steel Jacob's ladders welded onto the hull which we had to catch and then climb. This was no small feat when carrying instruments in the choppy lagoon. The Independence, when first I boarded her, had to be boarded by climbing a freely swinging net suspended from the overhang at the bow. On about Baker plus ten, I again boarded her with Capt. Dodson

and made a complete survey. We were the first to board her after test Baker. She was still terrifically radioactive and we could only stay a short time. Photographs were taken of the damage done to planes on her deck, and the Captain and I hauled down Prep flag and replaced it with Baker to indicate that someone had been aboard but that she was still dangerous. It was while on board her that I found several fragments of the LSM 60 and left them right where I found them as they ran around 1000 times tolerance. I had encountered spots of this much radiation before on several vessels in porous materials which had absorbed the sea water which had fallen on them carrying its deadly load. Rusty spots on the decks, which were frequent on LST's, landing craft LCT's and LCI's, were particularly bad spots. One LST I monitored with Commander Cundiff, I can remember particularly as being loaded. During this time I also made a tour of all of the landing craft in the fleet and thus get a very good impression of the spread, and of the pattern of the intense portion of the deadly rays.

By now, Baker plus 15, we were all becoming a bit anxious to return so that we would be back in time for school in the fall. It was on August 11 that Col. Warren, head of the Radiological Safety Section, called us together and gave a report. It was that the test was over. Ships would no longer be boarded except on orders from the Admiral. Most ships were contaminated beyond further use. They would all be sunk with the exception of a few saved for experimental purposes. Most of us were to sail the 16th of August for Oakland on the Henrico, a transport, and the Haven would remain as a lab base for the monitors and other scientific personnel who remained.

Experiments in removing the layer of fission products which covered all exposed vessels had been made with little success. Caustic, acids and various detergents and other chemicals had been sprayed and hosed onto the ships. Men had scrubbed the decks of some. However, after the first loose layer was removed, the succeeding attempts helped little if any. By now the gamma radiation had decayed on most ships to the point it was not particularly dangerous. However, the ships were covered and the lagoon water was permeated with alpha and beta emitting particles with long half-lives and would be for years to come. Therefore, the ships were not habitable, as this soft radiation while not hard enough to penetrate the skin could get into the body orally and through cuts and do damage.

Thus ended Operation Crossroads. As I write this on the USS Henrico, Hawaii and home bound, I look back on the past weeks as the most momentous in my life. The always terrifying aspect of atomic warfare has become even more terrifying to me upon close familiarity with the deadly killer. The possibilities of an underwater blast in any of our harbors or lake ports, will surely condemn that city to total evacuation for decades and possibly centuries. The possible destruction, for useful purposes at least, of vast parts of our industry is no longer remote. The picture which can be painted is a frightening one. In my eyes at least, the world's only salvation lies in international unity and accord. This, at the present state of international relations, seems to be far in the future. I thank God that America has the strength which will prevent, at least for many years to come, others from initiating such a war. Also that we have the scientific personnel which the experience and training to take what preventative and protective measures are possible.

Operation Crossroads is completed successfully.

F. L. Cunningham
Aboard the USS Henrico
Enroute Bikini Atoll to Pearl Harbor
August 19, 1946