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Report to the Scientific Director

RADIOLOGICAL SAFETY

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ABSTRACT

This report contains a description of the mission, organization and activities of Task Unit 6, Task Group 7.1, Joint Task Force SEVEN, during Operation Hardtack. Task Unit 6 was charged with the responsibility of providing radiological safety support for the Scientific Task Group, TG 7.1. The various chapters are devoted to a discussion of the activities engaged in by the Task Unit and the organization necessary to provide adequate radiological safety support for a weapons test operation of the magnitude of Operation Hardtack. Radiological survey results of the atolls following firing of the various devices are presented. Special problems arising during the operation are discussed.

ACKNOWLEDGMENTS

Task Unit 6 (TU-6) wishes to acknowledge the cooperation and support of the following organizations. Their combined efforts were largely responsible for the success of the radiological safety operations during Operation Hardtack.

Health Division, Los Alamos Scientific Laboratory (LASL)
J-Division, LASL
T-Division, LASL
Supply and Property Department, LASL
Albuquerque Operations Office, Atomic Energy Commission (AEC)
Holmes and Narver, Inc. (H&N), Los Angeles, Calif.
Office of the Chief Chemical Officer, Washington, D. C.
U. S. Army First Radiological Safety Support Unit, Chemical Corps Training Command, Ft. McClellan, Ala. (First RSSU)
International Business Machines Corporation (IBM), Albuquerque, New Mexico, and Birmingham, Ala.

In addition, the following individuals are to be credited with making significant contributions that materially assisted TU-6 during all phases of the operation:

Thomas L. Shipman, Health Division, LASL
Duncan Curry, Jr., J-Division, LASL
William R. Kennedy, Health Division, LASL
Leo G. Chelius, Health Division, LASL
Dean D. Meyer, Health Division, LASL
William E. Nolan, Health Physics Group, University of California Radiation Laboratory (UCRL)
Major Fred E. Rosell, Jr., U. S. Army
Simon Shlaer, Health Division, LASL

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Chapter 1

ORGANIZATION

1.1 TU-6 Mission

The mission of TU-6 was as follows:

a. Perform all ground and aerial monitoring services associated with the scientific mission except those in conjunction with aircraft and airborne collection of scientific data; assist TG 7.5 radiological safety (rad-safe) organization during the operational phase.

b. Provide laboratory and technical assistance to all task groups.

c. Provide all official personnel dosimetry services for Joint Task Force SEVEN (JTF-7).

d. Issue and maintain monitoring instruments and protective clothing as required.

e. Supply decontamination facilities for personnel, vehicles, and equipment.

1.2 TU-6 Organization

The operational concepts, calling for firing capabilities at both Bikini and Eniwetok atolls, demanded a Task Unit organization that provided two separate and independent rad-safe groups. Accordingly, separate organizations were established at Bikini and Eniwetok with over-all control being maintained by the Commander of TU-6 (CTU-6). The organization at each atoll was similar, varying only with the number of personnel assigned to the various sections. Each organization contained the following sections, as shown in the organization chart in Fig. 1.1:

a. Dosimetry and Records Section for maintaining personnel dosimetry records.

b. Plotting and Briefing Section for conducting all radiological surveys

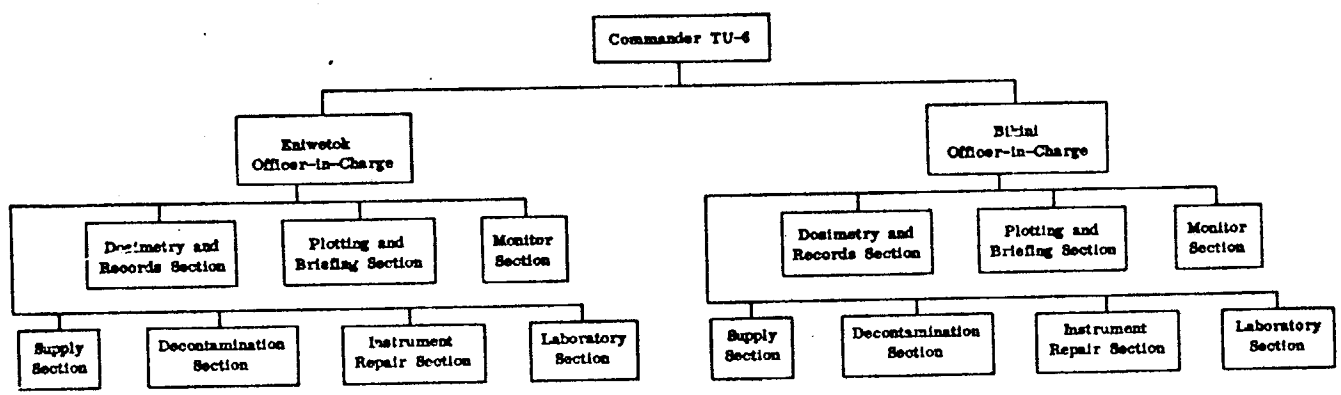

Fig. 1.1—Organization chart, TU-6, TG 7.1.

and briefing all personnel going into radiological exclusion areas (radex).

c. Monitor Section for providing all monitoring services and manning check points.

d. Supply Section for providing rad-safe supplies and laundry services (facilities furnished by TG 7.5).

e. Decontamination Section for operating facilities for personnel and equipment decontamination.

f. Instrument Repair Section for maintaining rad-safe instruments.

g. Laboratory Section for determining the amount of radioactivity in soil, water, air, and food samples.

At the start of the operation the Eniwetok organization strength was 55; that at Bikini, 45. The total was later reduced to 78. All supply problems were handled through J-4, located at Eniwetok. The master files of photodosimetry records were maintained at Eniwetok and the film badges issued to members of TG 7.2, TG 7.3, TG 7.4, and Hq., JTF 7, were processed by the Eniwetok Dosimetry and Records Section.

Responsibility for radiological safety for TG 7.5 personnel was not a function of TU-6 during Hardtack, in cont[illegible] with past operations. However, H&N rad-safe personnel were utilized within the TU-6 organization and rad-safe support for both TG 7.1 and TG 7.5 was provided by the Task Unit.

1.3 Procurement of Personnel

Personnel for manning TU-6 were obtained from the Army, Navy, and Air Force. The majority was obtained from the First RSSU, a Chemical Corps unit stationed at Ft. McClellan, Alabama. The following is a breakdown of the total personnel utilized by TU-6:

a. Army -- 95 officers and enlisted men.
b. Navy -- 8 officers and enlisted men.
c. Air Force -- 12 officers and enlisted men.
d. LASL -- 4 civilian health physicists as advisors.
e. UCRL -- 3 civilian health physicists as advisors.

1.4 Training of Personnel

Training of TU-6 personnel was carried out in several places. The majority of the First RSSU personnel received training at Ft. McClellan, Alabama, the unit providing its own training staff. Approximately 40 members of the First RSSU participated as trainees in Operation Plumbbob at the Nevada Test Site with the Reynolds Electric and Engineering Co. rad-safe group. Instrument repair personnel received extensive training at the Navy facility at Treasure Island, San Francisco, Calif., and at LASL. The four Navy hospital corpsmen who provided the bulk of the laboratory services were trained by LASL Health Division personnel. Dosimetry and Records personnel received extensive training in the use of IBM equipment at Ft. McClellan, Ala. This training was conducted by the Birmingham, Ala., office of IBM.

Scientific project personnel in TG 7.1 and contractor personnel in TG 7.5 were requested to provide their own monitors for recovery and construction missions. A four day school was operated at Parry and Enyu islands specifically to train such monitors. The school was in session for approximately seven weeks. Personnel from TG 7.3 and TG 7.4 were also trained at the school.

Chapter 2

ENIWETOK OPERATIONS

2.1 Facilities and Services

In support of the operations at Eniwetok Atoll, check points controlling entry and exit from contaminated areas were established under the direction of the Operation Section of the Rad-Safe Center as required. Main check points utilized at all times were located at the air dispatcher's office and the marine landing. As the situation demanded, other check points were established at the personnel pier and on islands in the atoll other than Parry. All persons entering or returning from a radex area were processed through these check points. An area was considered a full radex area if the contamination exceeded 100 mr/hr and full protective clothing was required for entry into it. Limited radex areas were established as necessary where the contamination was in excess of 10 mr/hr but less than 100 mr/hr. In these areas the clothing requirements were dictated by the situation and the job to be performed. In those cases in which alpha contamination presented a problem, no hard and fast rule concerning full radex areas was established. Generally speaking, a contamination level of 1,000 counts per minute on the Eberline PAC 3G alpha meter indicated that full protective clothing should be used; however, the type of work to be done in the contaminated area was of considerable importance in establishing clothing requirements.

2.1.1—Personnel decontamination facilities were located across the street from the Rad-Safe Building, as they were during Operation Redwing. The facilities consisted of clean and "hot" change areas and showers. A total of approximately 6,200 individuals were processed through the Eniwetok check points from 1 May to 20 August 1958. Of these, 860 were processed through the personnel decontamination station. Laundry services necessary to maintain the protective clothing were provided by H&N under the direction of the Supply Section of the Rad-Safe Center.

For the Quince and Fig events it was necessary to establish a personnel decontamination station on Runit. The traffic through this decontamination station was very heavy and clothing requirements were such that it was necessary to move the laundry barge from Bikini to handle the laundry load. Since the primary problem was one of alpha contamination, a large part of the clothing had to be disposed of because it was found too difficult to reduce the contamination to acceptable levels. Respirators and full face masks were cleaned for re-use but booties, surgeon caps, gloves, and coveralls had to be disposed of in many cases.

2.1.2—The equipment decontamination station on Parry Island processed a total of 800 items, including 56 vehicles and 9 helicopters. Numerous pieces of small equipment were cleaned up for the various projects and for H&N. Normal procedure called for all heavy equipment returning from shot islands to be monitored on removal from boats and directed to the decontamination station if necessary. Versene and citric acid were the common decontaminating agents employed, and a steam generator was used to provide hot solutions for the necessary washing. When equipment was not needed immediately it was held in a "hot" parking lot for varying lengths of time before decontamination in order to reduce contamination levels by radioactive decay of the contaminants.

2.1.3—*The Operations Section* of the Rad-Safe Center was responsible for the conduct of all radiological surveys on the atoll, the majority of which were made by H-19 helicopters. H-21 helicopters were not used for survey purposes since the possibility of excessive crew dosage was always present due to the configuration of the aircraft. In contrast to the H-19, where the pilot's compartment was located above the engine, the H-21 provided no shielding at all for the flight crew since the pilot's compartment was simply a plastic bubble on the nose of the plane.

Normal operations included a pre-entry survey at H+1 to H+4 hr, a detailed survey of the entire atoll at H+6 to H+8 hr, and detailed surveys on the mornings of D+1, D+2, and D+3 days. Additional surveys were made as required. The basic instrument used in the aerial surveys was the AN/PDR-39 survey meter modified to read up to 500 r/hr. The logarithmic scale instrument built by Jordan Electronics, Inc., that proved so successful on Operation Redwing could not be made to operate properly and so it was never used. When necessary, data were radioed back to the Rad-Safe Center from the survey helicopter by means of the helicopter radio net. Plotting and briefing stations were maintained at the Rad-Safe Center and the J-3 office. Ground surveys of islands in the atoll were conducted when required.

The helicopter survey technique called for the pilot either to land the aircraft at the desired spot so that a ground reading could be obtained or to make a slow pass over the desired spot at an elevation of 25 feet. Readings taken at 25 feet were multiplied by a factor of 2 in order to obtain a reasonable approximation of the true ground reading. The factor of 2 was experimentally determined and checked at various times during the operation. Experience indicated further that any reading taken from an altitude of 50 feet or higher was extremely difficult to correct to true ground values due to the asymmetry in the radiation fields and the topography of the various islands.

2.1.4—Monitors for recovery parties were provided by TU-6 when necessary. Demand was quite small except for the Quince and Fig events when 28 TU-6 monitors were used. In general, however, projects provided their own monitors as members of the recovery party. Monitors were responsible to the party leaders, who were expected to accept a monitor's advice and plan their operations accordingly.

2.1.5—Laboratory facilities at Eniwetok for radiochemistry work were obtained from the U. S. Army Signal Corps. The AN/MDQ-1 radiochemistry laboratory trailer was parked near the Rad-Safe Building and used for all sample preparation and counting. Approximately 450 water, food, and soil samples were processed and counted. Primary interest was centered in gross beta-gamma activity or total alpha activity. No detailed radiochemistry studies were required or attempted. In addition, numerous air filter samples were counted for alpha activity following the Quince event.

2.2 Shots and Survey Results

In the course of the operation, contamination from any one shot did not materially interfere with preparations for subsequent events. This was due in large part to the fact that most of the devices were fired on barges several hundred yards off shore rather than on the surface of an island or on towers. In comparison with Operation Redwing, on-site contamination during Hardtack was remarkably light. Fall-out from the Fir event on Bikini contributed approximately 1,200 to 1,500 mr total dose to those living at Eniwetok Atoll but this did not interfere with any Eniwetok operations. Close rad-safe control over accumulated dosages was effective in countering the dosage received from the Fir fall-out. Very little decontamination of land areas was required since the contamination levels at critical stations were generally quite low. The alpha contamination resulting from the Quince event required very close control and considerable decontamination effort at the zero site in order that preparation for the Fig event could proceed.

Table 2.1 gives a summary of the various events at Eniwetok Atoll. The H+4 hr survey results are indexed by figure number in Table 2.1.

TABLE 2.1 – FIRING SCHEDULE, ENIWETOK ATOLL

Shot	Date (M.I.)	Location	H+4 Hr Survey
Cactus	6 May 58	Runit (surface)	Figure 2.1
Butternut	12 May 58	Runit (barge)	Figure 2.2
Koa	13 May 58	Teiteiripucchi (surface, tank)	Figure 2.3
Wahoo	16 May 58	Ocean (500 ft deep)	None made
Holly	21 May 58	Runit (barge)	Figure 2.4
Yellowwood	26 May 58	Engebi (barge)	Figure 2.5
Magnolia	27 May 58	Runit (barge)	Figure 2.6
Tobacco	30 May 58	Engebi (barge)	Figure 2.7
Rose	3 June 58	Runit (barge)	Figure 2.8
Umbrella	9 June 58	Lagoon (150 ft deep)	None made
Walnut	15 June 58	Engebi (barge)	Figure 2.9
Linden	18 June 58	Runit (barge)	Figure 2.10
Elder	28 June 58	Engebi (barge)	Figure 2.11
Oak	29 June 58	NW Reef (barge)	Figure 2.12
Sequoia	2 July 58	Runit (barge)	Figure 2.13
Dogwood	6 July 58	Engebi (barge)	Figure 2.14
Scaevola	14 July 58	Runit (barge)	None made
Pisonia	18 July 58	Runit (barge)	Figure 2.15
Olive	23 July 58	Engebi (barge)	Figure 2.16
Pine	26 July 58	Engebi (barge)	Figure 2.17
Quince	6 Aug 58	Runit (surface)	None made
Fig	18 Aug 58	Runit (surface)	None made

It is to be noted from the various survey results that the photo tower on Mack received considerable fall-out from the several events at Runit. The combination of barge zero sites coupled with the normal wind conditions apparently resulted in continual contamination of the photo tower. This was in marked contrast to previous operations. The photo tower, to all intents and purposes, was of no use during the Hardtack events.

The two underwater shots introduced complications in obtaining the desired contamination information. On the Wahoo shot the monitoring was done from a Navy seagoing tug (ATF). Surface contamination was somewhat high so the time delay in reaching the target ships was considerable. The tug was also used for obtaining a water sample for radiochemistry yield determination. This operation proved quite successful in that a useful sample was obtained without contaminating the ship significantly and with no more than 1 r total dose received by anyone engaged in the sampling operation. For the Umbrella event landing craft (LCM) from the H&N boat pool were used for the monitoring operation with considerable success. Surface contamination was quite low (highest reading observed was 5 r/hr), and within 90 min following detonation all target ships had been monitored and recovery operations were proceeding. A Navy seagoing tug was once again used for water sampling without trouble. The tug obtained the water sample at approximately H+45 min.

Monitoring operations on the underwater shots did not include an actual boarding of the target ships. Primary concern was to determine the general radiation intensities in the vicinity of the targets and immediately alongside the targets. Recovery parties were allowed to proceed, based on the TU-6 information, with the party monitor providing the necessary information concerning the situation aboard ship. The water-borne operations proved, in general, to be successful; operations were limited in some cases due to the effort made to prevent excessive contamination of participating Navy ships and boats.

The Quince and Fig shots produced contamination only on the shot island. Quince resulted in considerable alpha contamination. After Fig, heavy local contamination (fission products) existed as far as 200 feet from the zero point. A combination of residual alpha contamination from Quince and the high levels resulting from Fig required that a check point and a personnel decontamination station be set up on Runit. Approximately 1,600 people were processed through this check point during the Fig recovery operations.

The water circulation patterns in the lagoon provided fairly rapid dissipation of the contaminated water that remained after the barge shots, and almost all the water zero sites could be re-entered within 24 hr without hazard to the boat crews. Although water-borne recovery operations for Pinex and detector foils were held up after some events, no more than a 24 hr delay was ever experienced.

Use of the barge zero points required that underwater radiation measuring instruments be available for use by divers working on signal cables and mooring devices. Six meters manufactured by the Isotopes Specialties Co., Burbank, Calif., were used. The meters were designed to withstand pressures encountered at depths of 100 feet. These meters were hand-carried by divers using self-contained underwater breathing apparatus and proved to be highly successful. Diving monitors using the instruments reported that the meters were easy to handle and to read while under water.

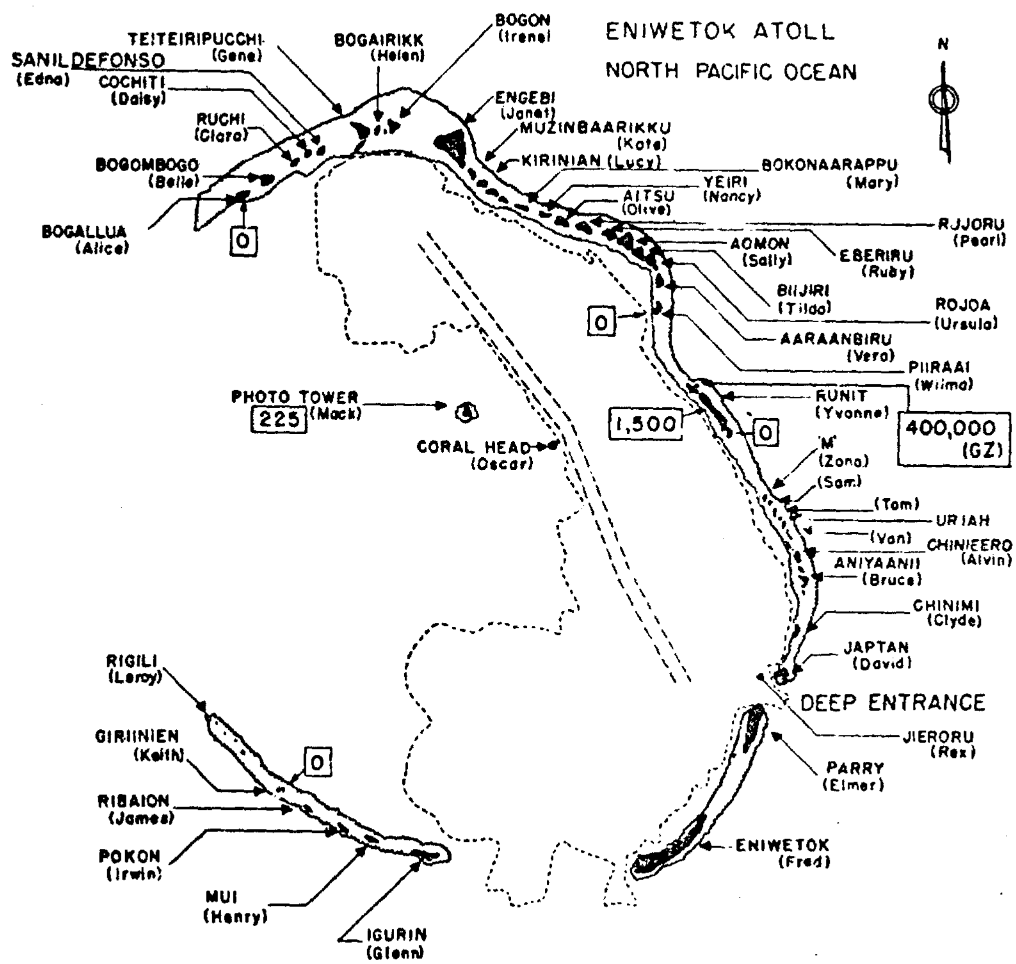

Fig. 2.1—Cactus radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Runit.

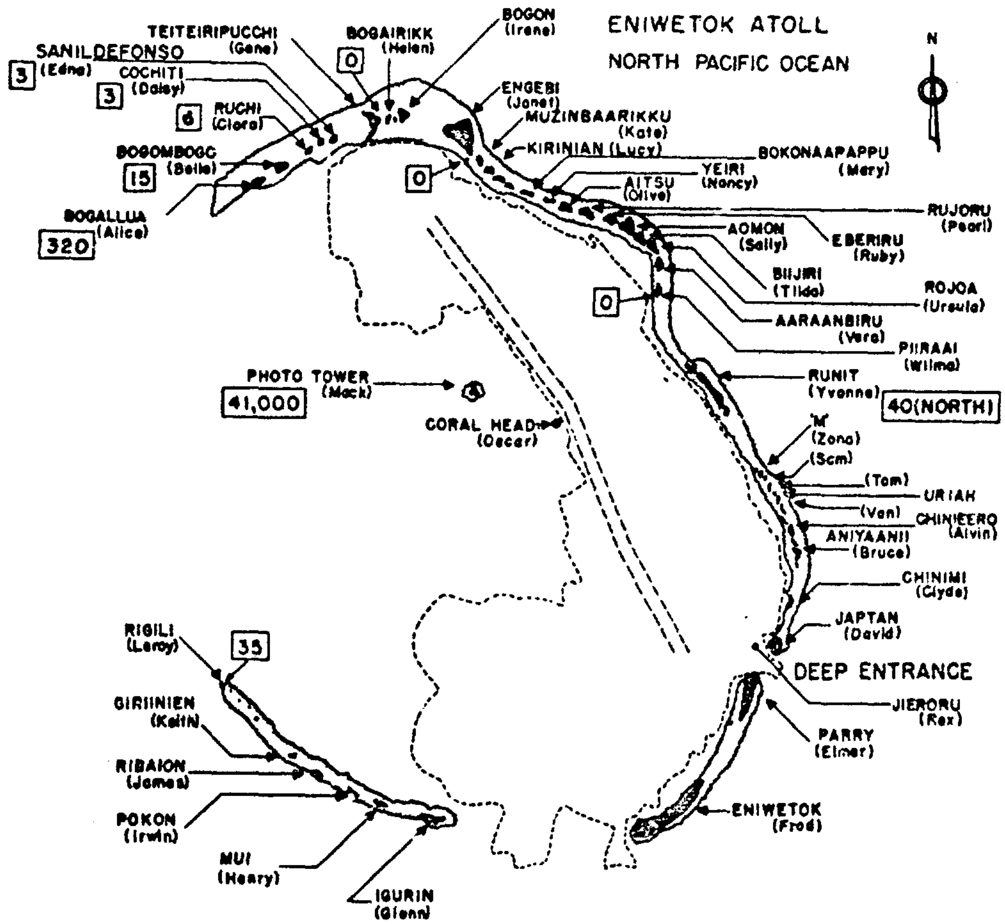

Fig. 2.2—Butternut radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

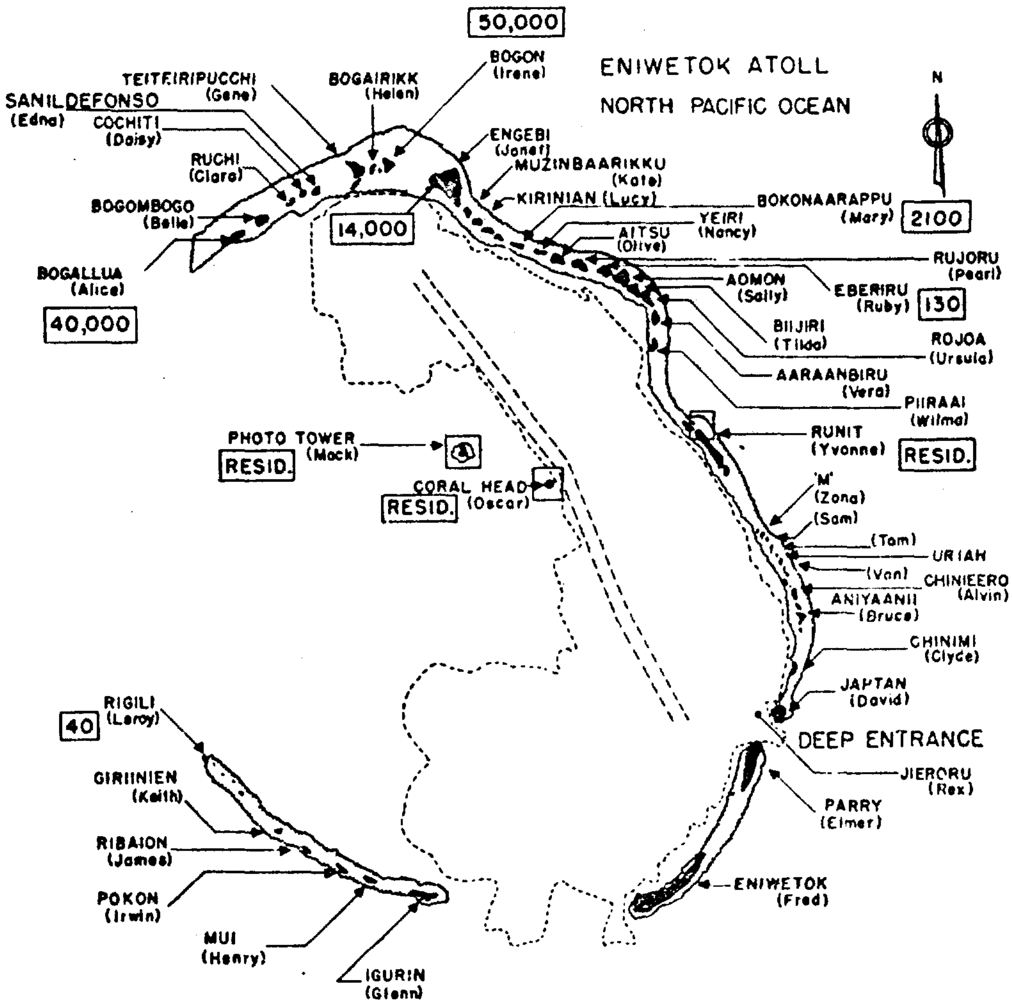

Fig. 2.3—Koa radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Teiteiripucchi.

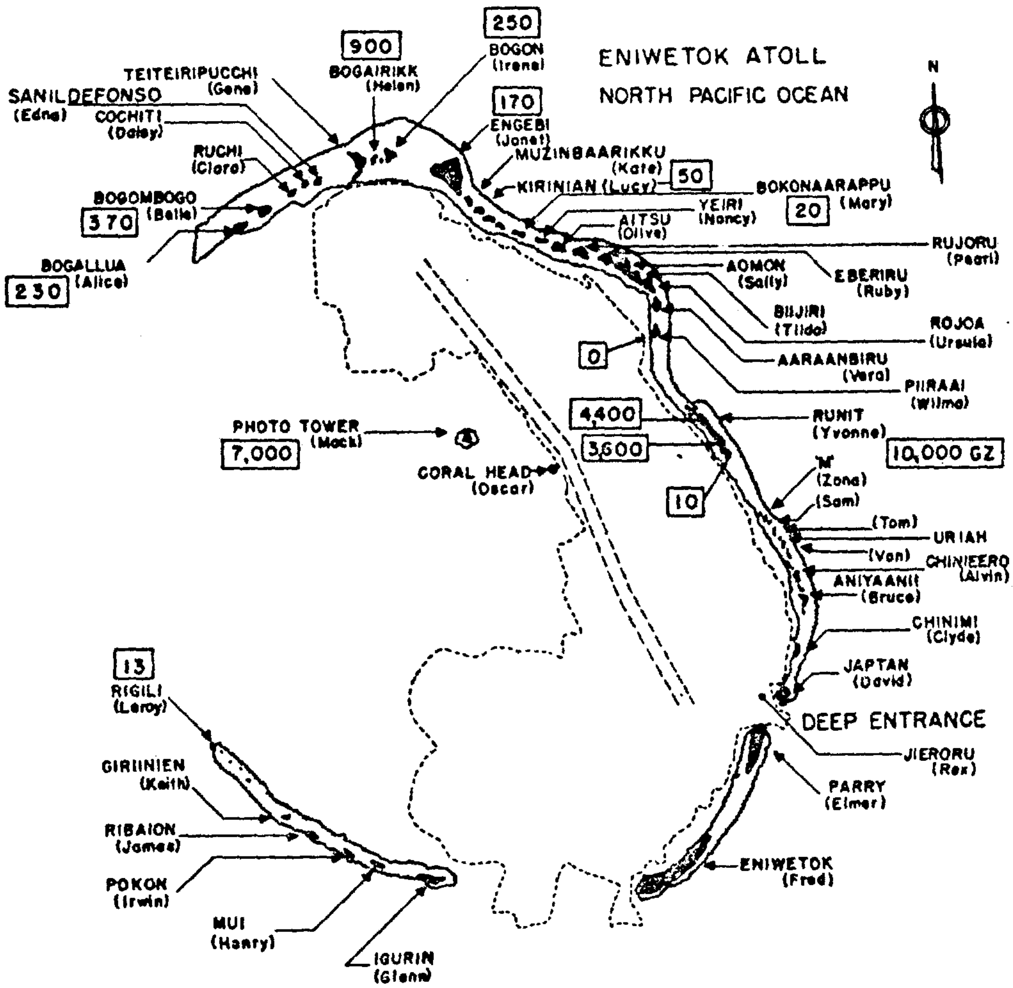

Fig. 2.4—Holly radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

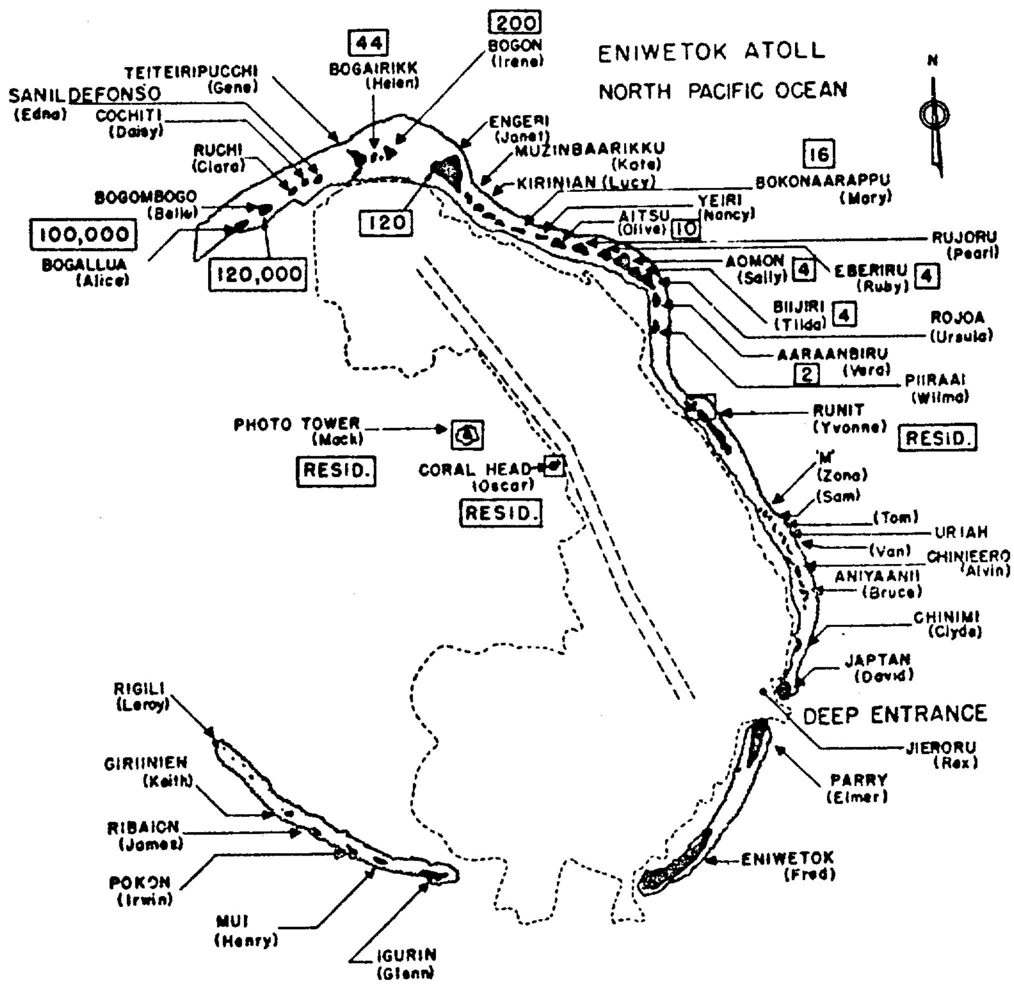

Fig. 2.5—Yellowwood radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

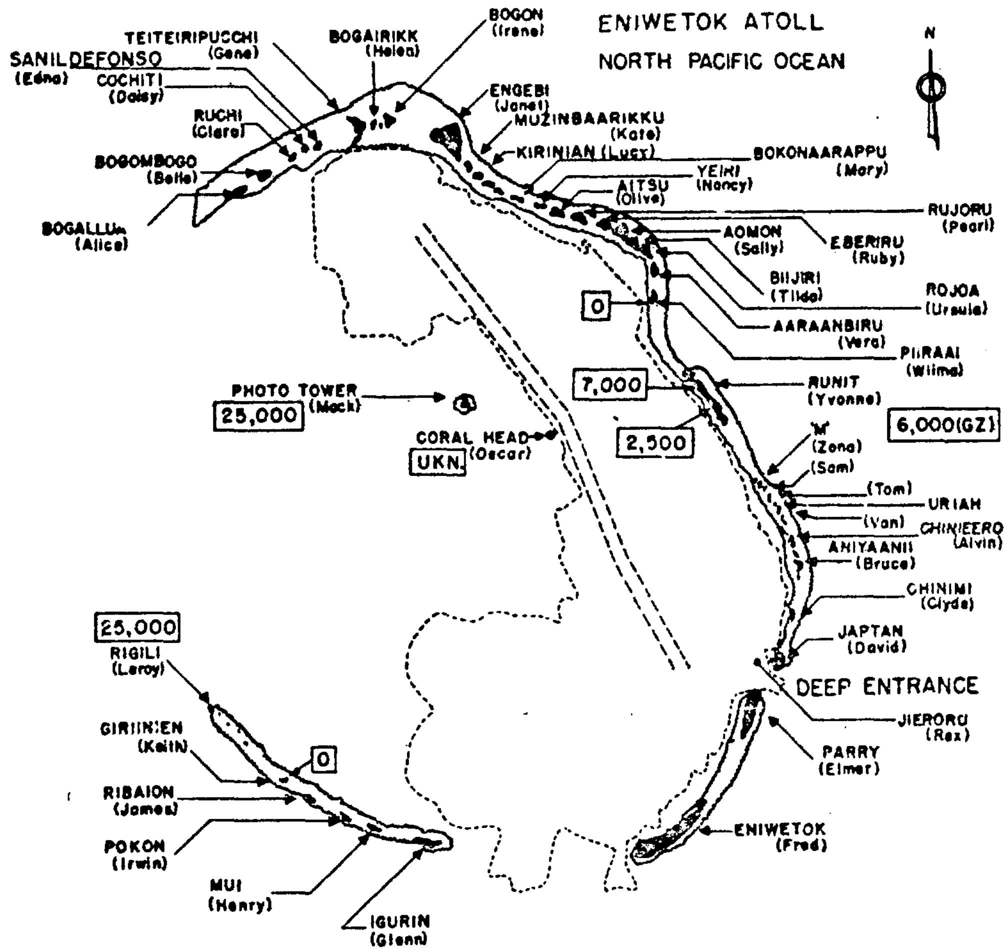

Fig. 2.6—Magnolia radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

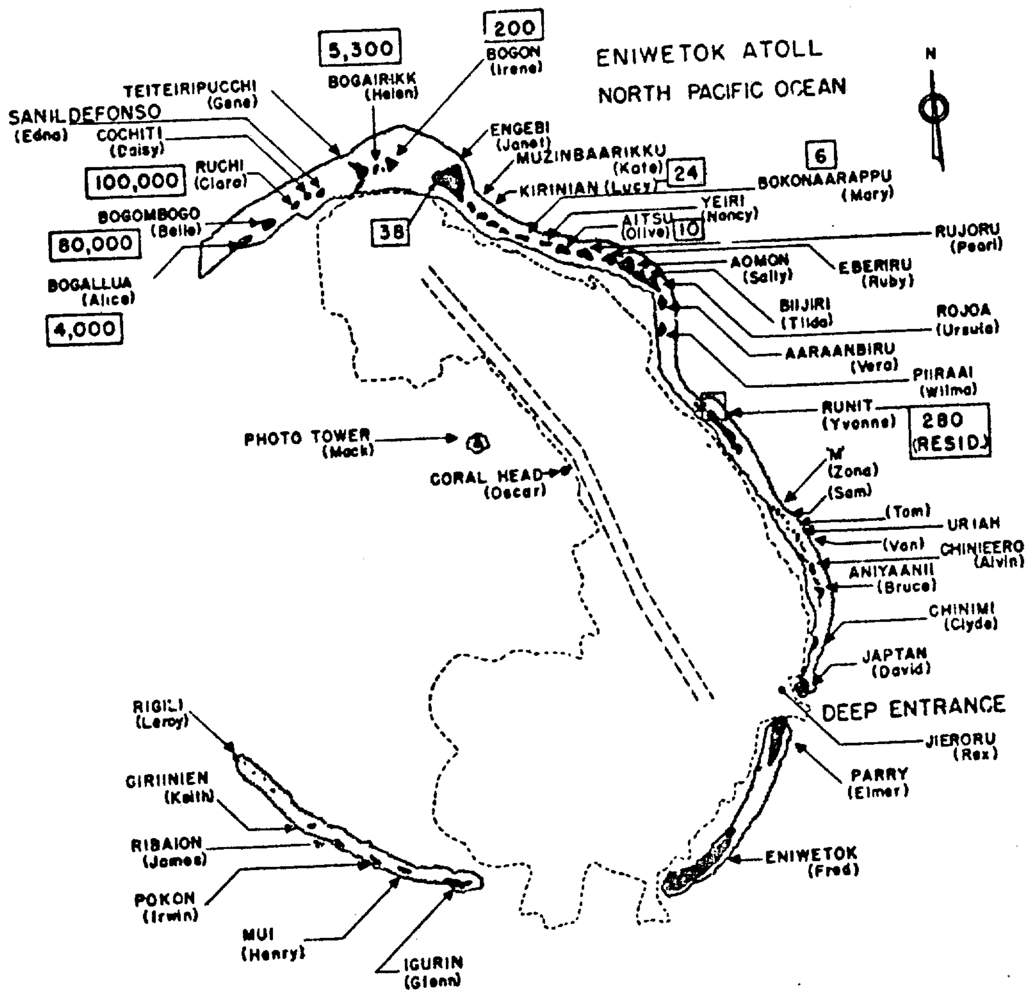

Fig. 2.7—Tobacco radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

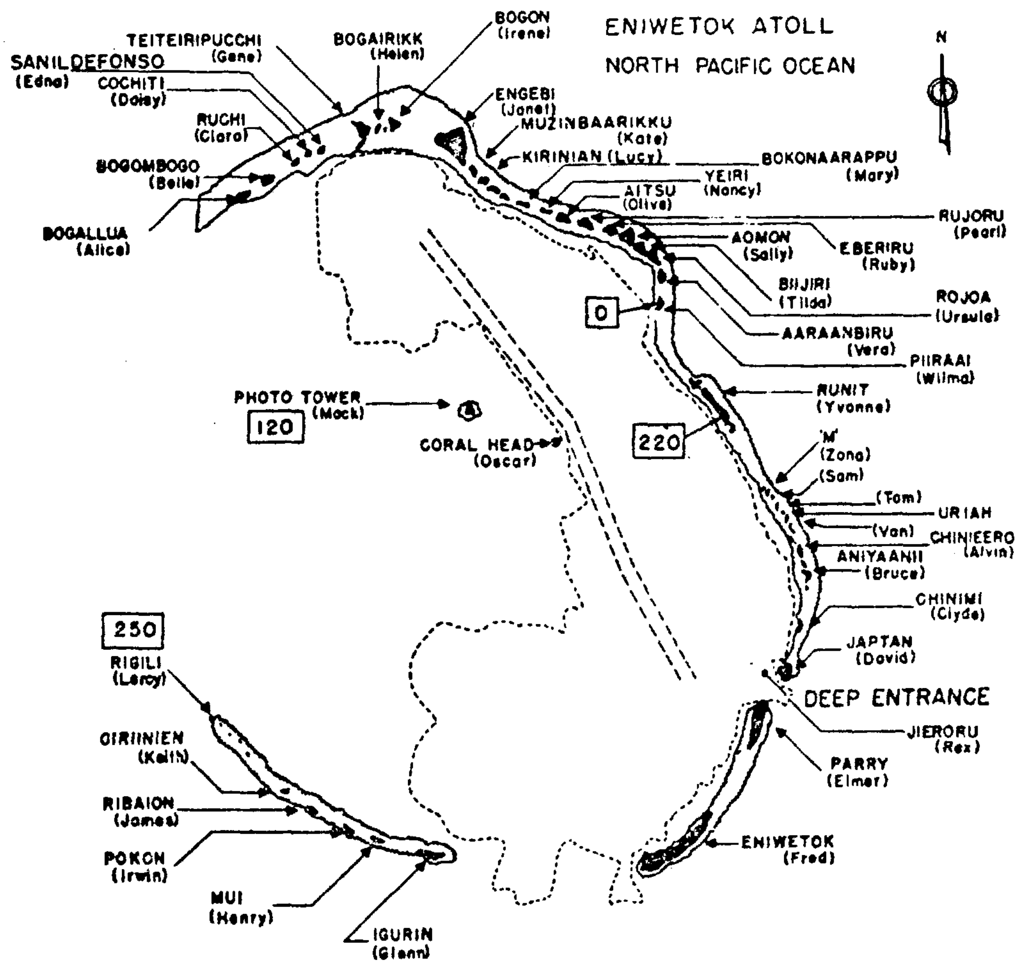

Fig. 2.8—Rose radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

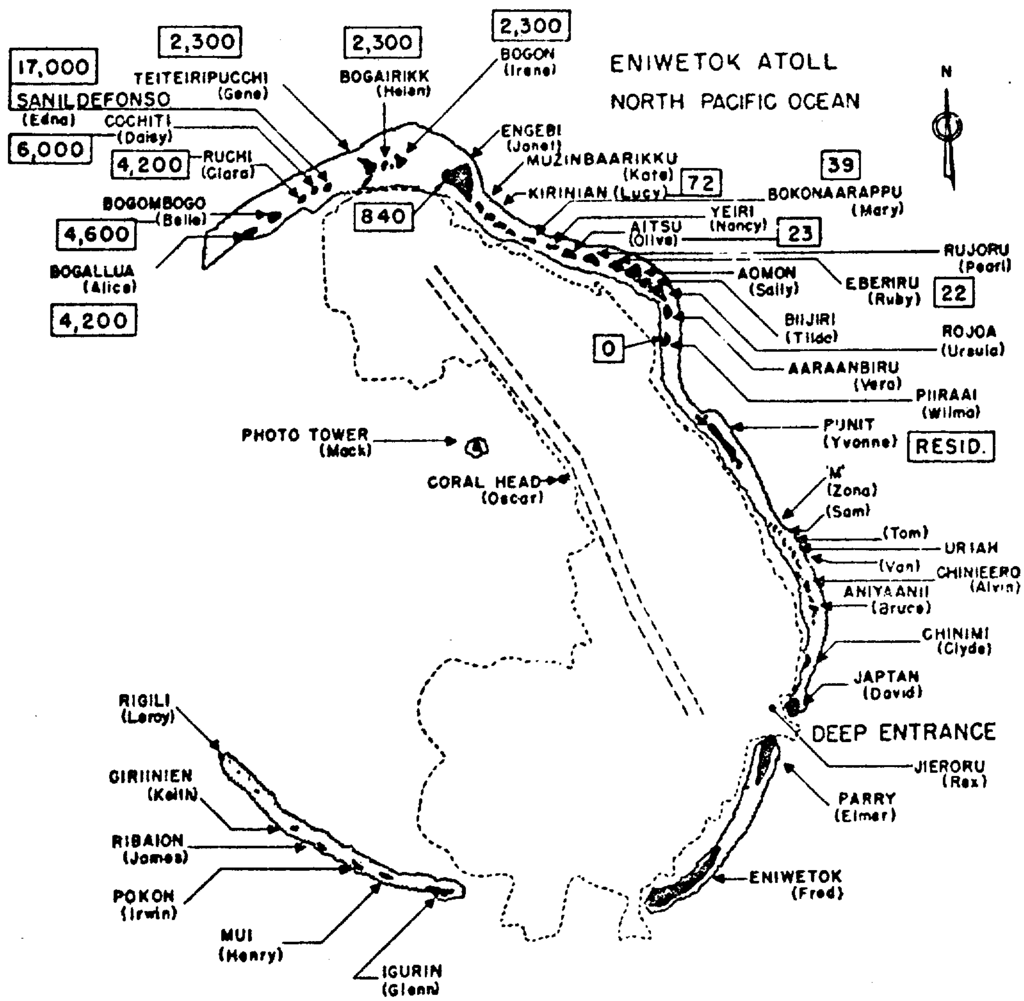

Fig. 2.9—Walnut radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

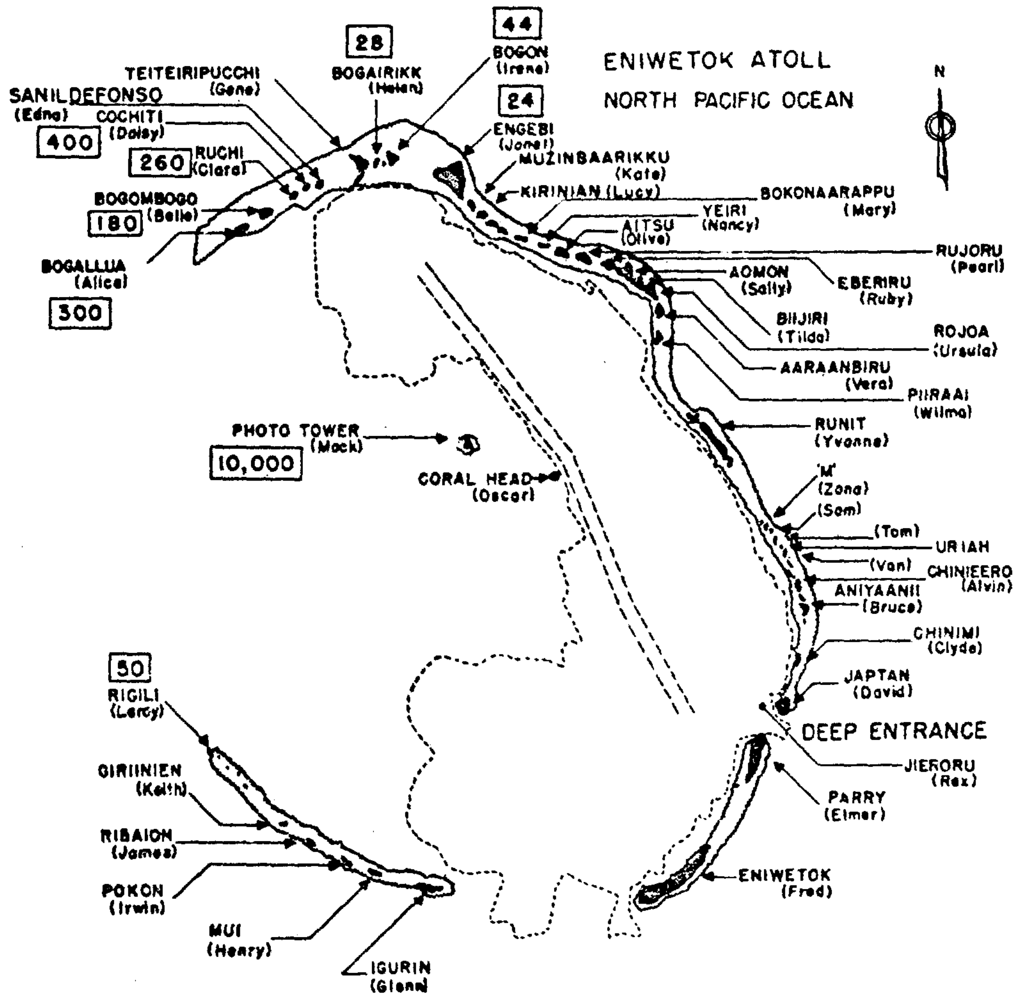

Fig. 2.10—Linden radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

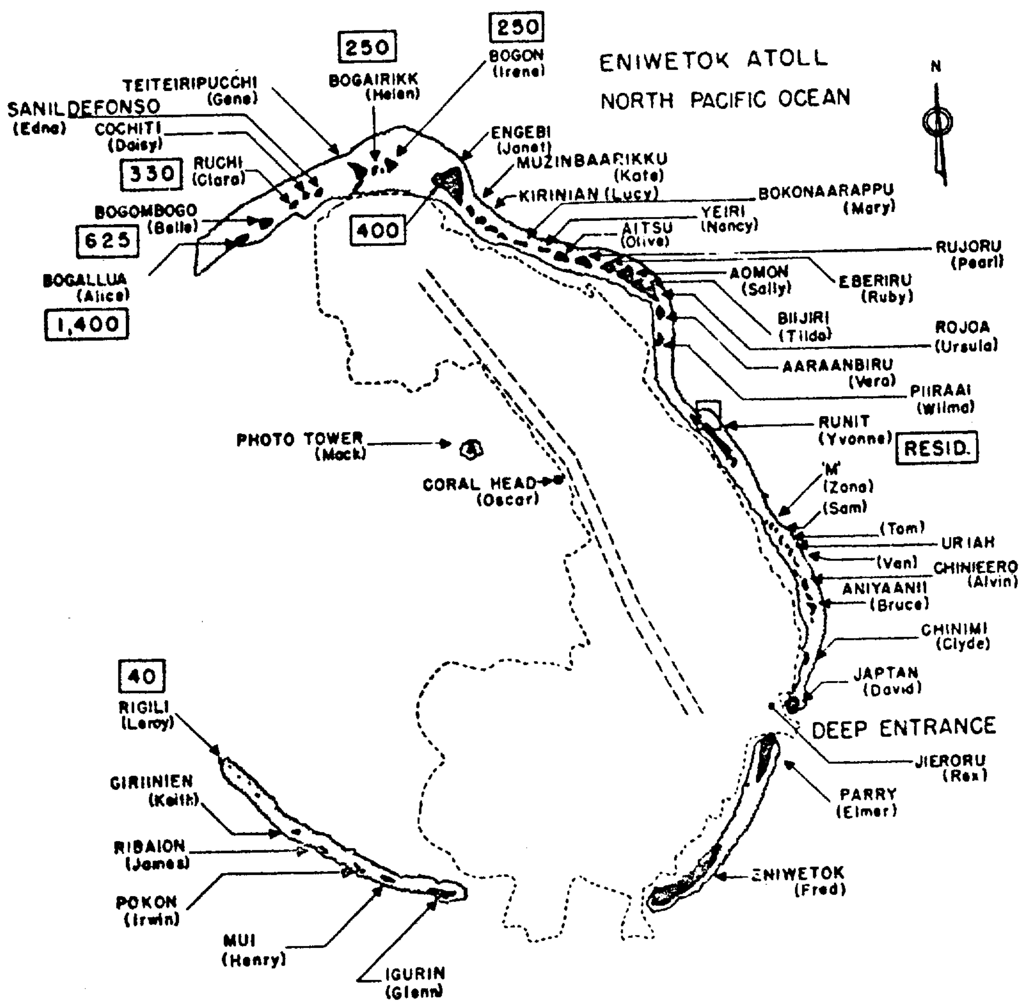

Fig. 2.11—Elder radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

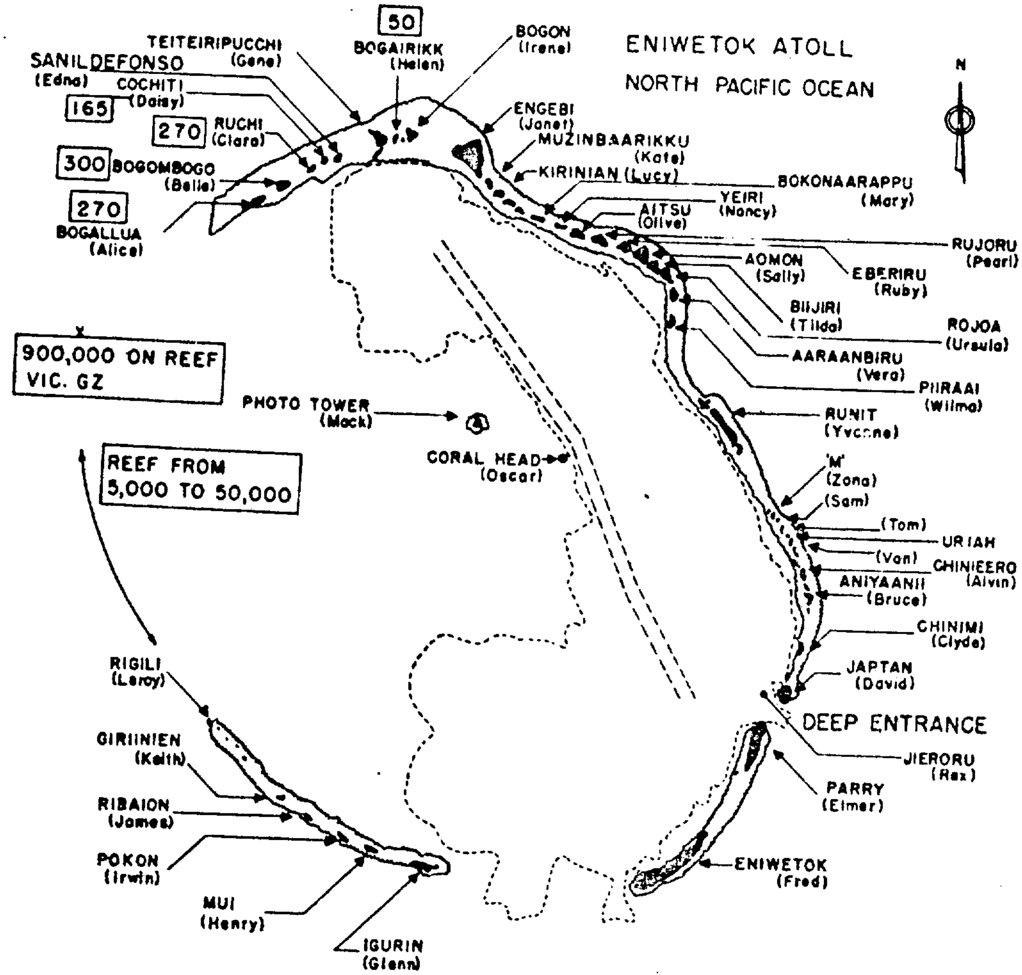

Fig. 2.12—Oak radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge on the NW reef.

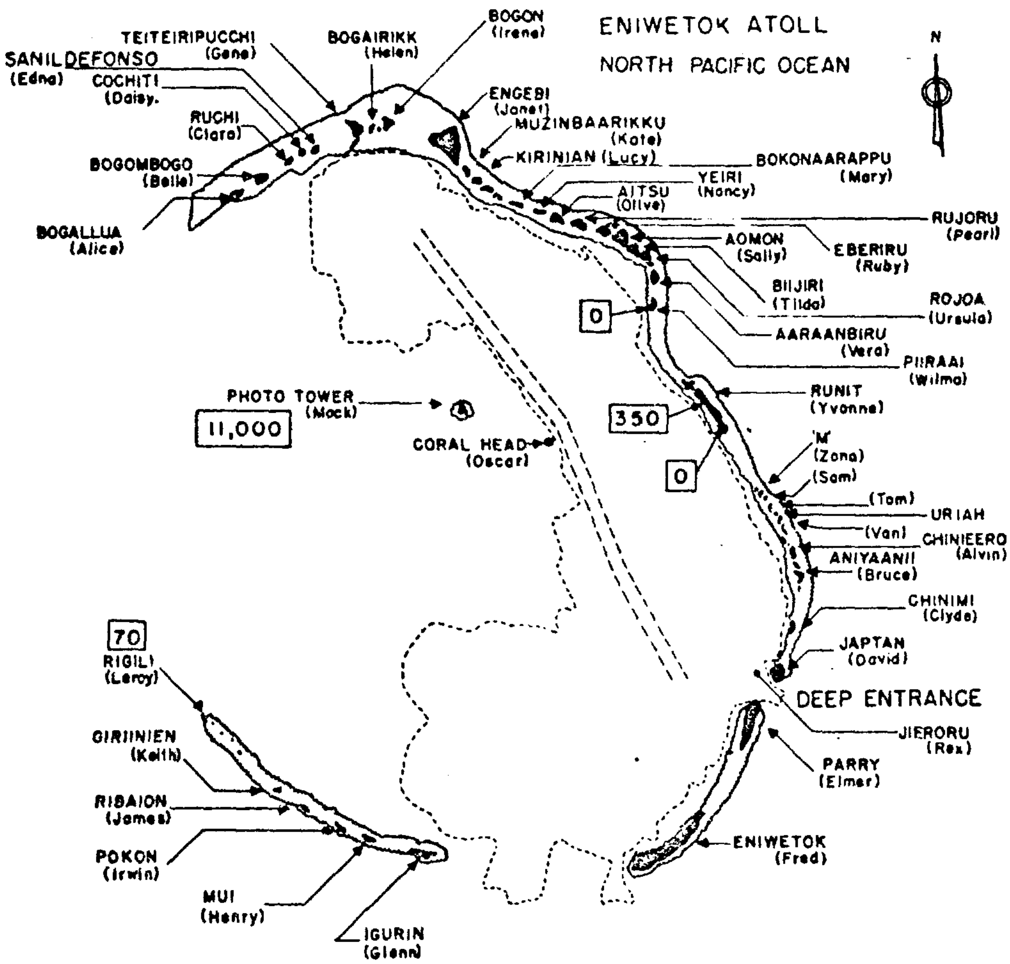

Fig. 2.13—Sequoia radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

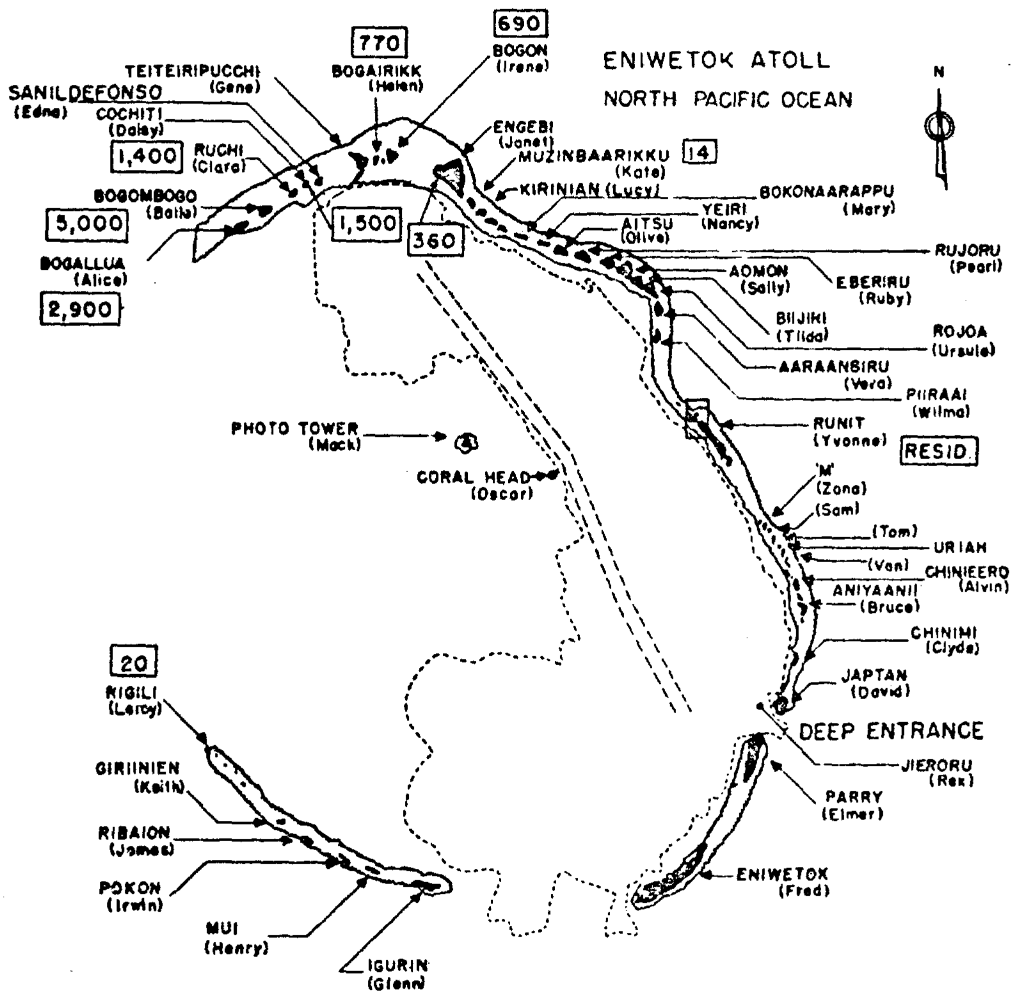

Fig. 2.14—Dogwood radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

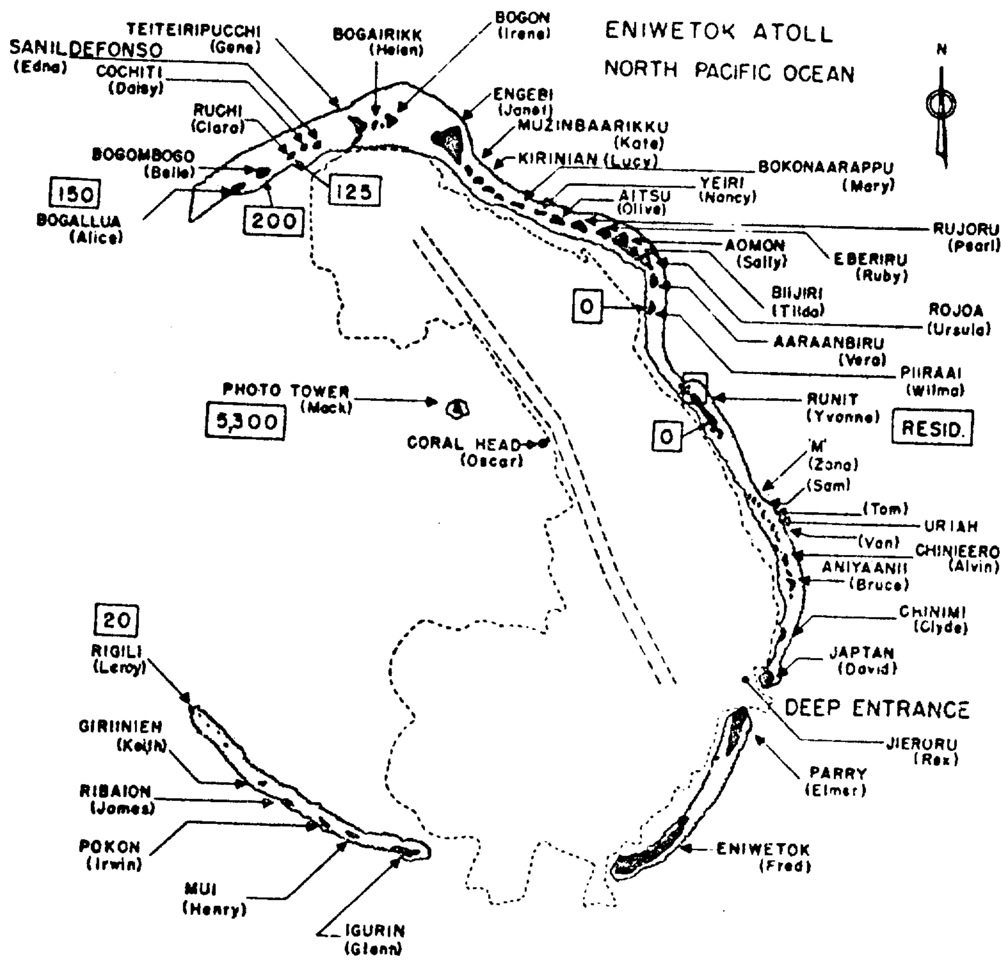

Fig. 2.15—Pisonia radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Runit.

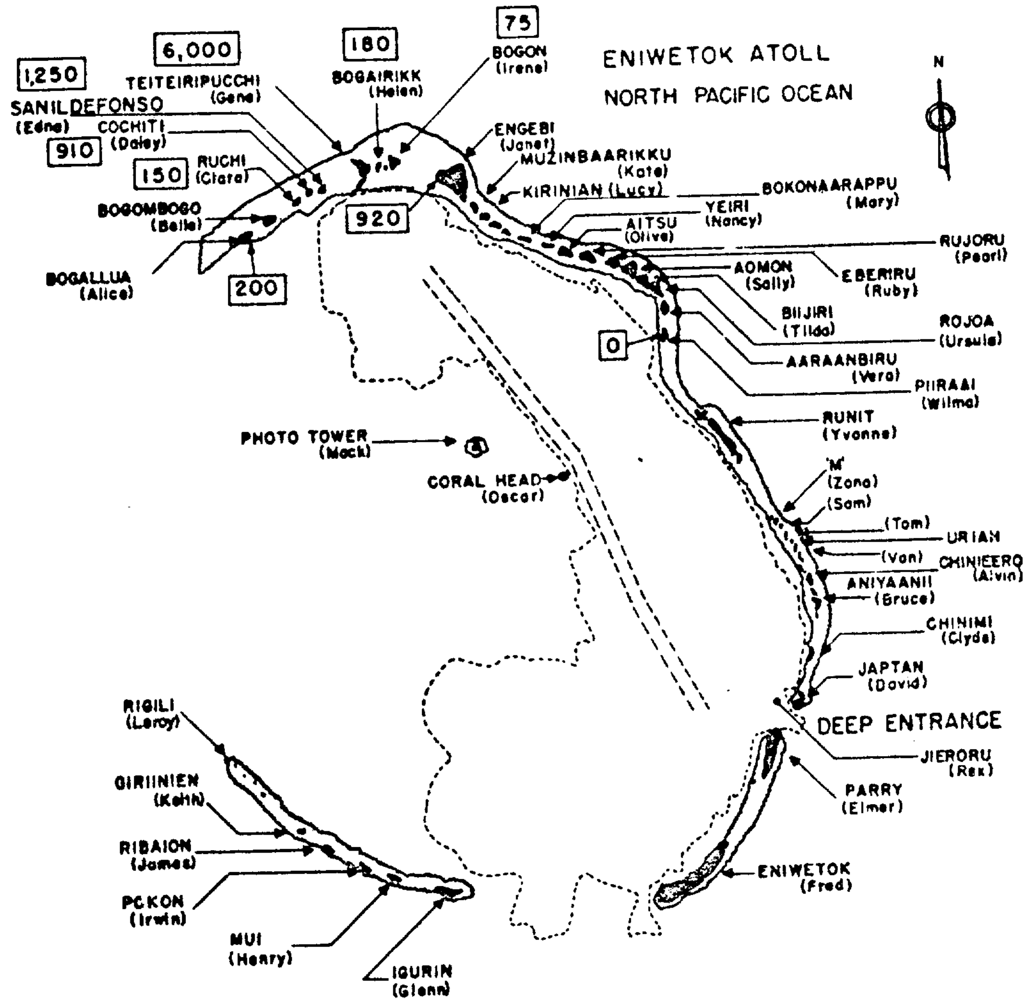

Fig. 2.16—Olive radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

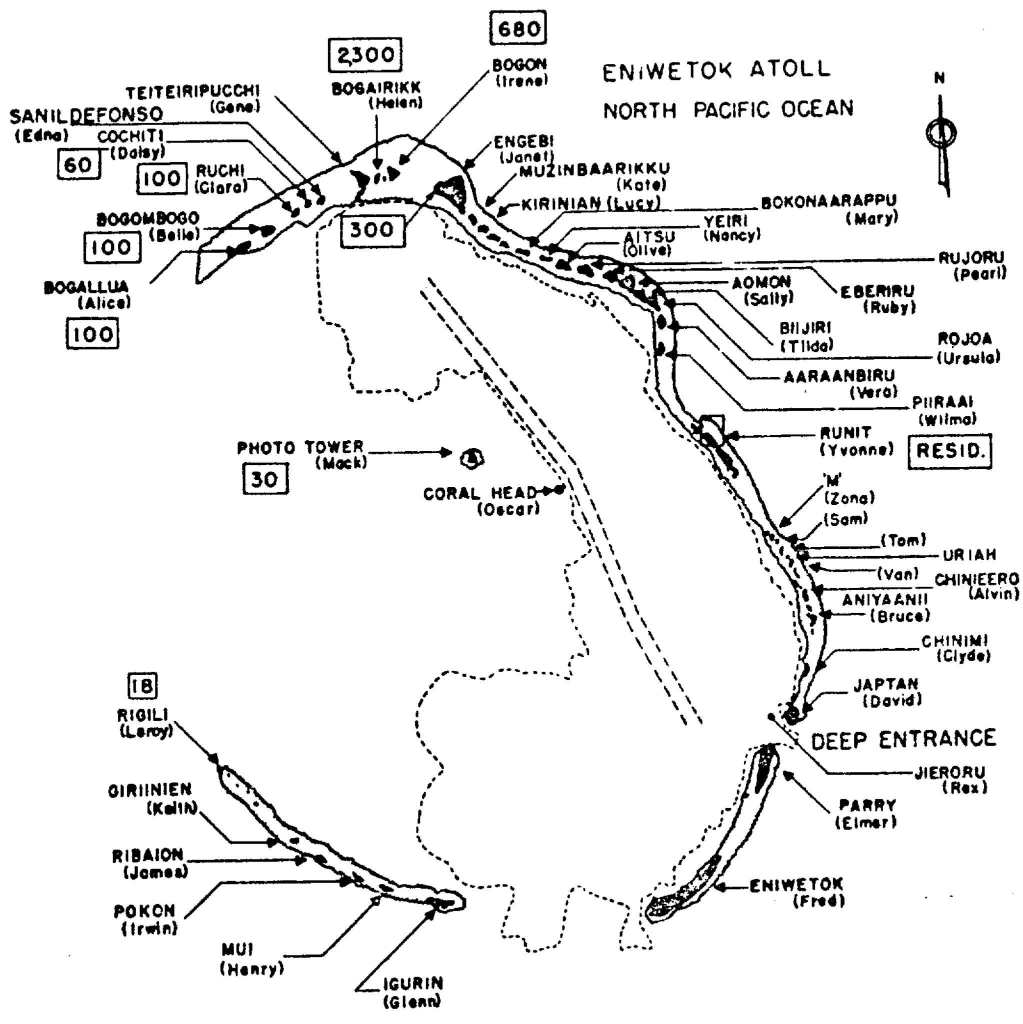

Fig. 2.17—Pine radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot was fired on a barge off Engebi.

Chapter 3

BIKINI OPERATIONS

3.1 Facilities and Services

Operations similar to those at Eniwetok were carried out at Bikini. Control points were established as required, primary points being the marine landing and the helicopter pad. In addition, for afloat operations, a Rad-Safe Center was established aboard the USS Boxer. This center included plotting and briefing facilities, a personnel decontamination station, and emergency supplies, primarily instruments. These facilities were never used since the camp at Enyu was always re-usable. In addition to the facilities aboard the Boxer, an H&N barge was fitted out with a complete Rad-Safe Center, including laundry equipment. This barge was to be used only in the event that afloat operations were required. Only the laundry equipment was used during the Bikini phase; all rad-safe clothing was laundered aboard the barge. The barge was moved to Eniwetok for the Quince and Fig events in order that the laundry could be utilized.

3.1.1—Personnel decontamination facilities, which were a duplicate of those on Eniwetok, were established on Enyu adjacent to the Rad-Safe Building. Approximately 1,200 people were processed through the facility.

3.1.2—The equipment decontamination station, also a duplicate of Eniwetok facilities, was located adjacent to the Rad-Safe Building. One hundred and five vehicles and pieces of heavy construction equipment were decontaminated as well as numerous pieces of project and H&N equipment. Four aircraft required decontamination.

3.1.3—As at Eniwetok, the Operations Section of the Rad-Safe Center was responsible for all surveys. In general, these surveys were conducted by helicopter. Ground surveys by vehicle were carried out when required. Regular surveys were conducted on a schedule similar to that at Eniwetok. On shots that required evacuation of the atoll, the pre-entry aerial surveys were launched from the Boxer at sea. In these cases the survey party first proceeded to Enyu to clear the island and the ship anchorage for re-entry and then proceeded with the remainder of the survey. In general, two survey crews carried out the survey simultaneously, one covering the southern half of the atoll, the other covering the northern half.

3.1.4—Monitors for recovery or construction parties were provided as required. The demand was quite small. As at Eniwetok, projects provided their own monitors.

3.1.5—The radiochemistry trailer was located in the TG 7.1 Administrative Compound. The Laboratory Section handled 318 water, soil, and food samples. Water samples were taken from the water supplies of the various ships and from the Enyu swimming area. The swimming beach was closed for 1 day following the Fir event due to radioactive contamination.

3.2 Shots and Survey Results

Very little interference with preparations for firing the various devices was caused by excessive contamination. On two occasions placement of a shot barge was delayed for 24 hr due to the radiation levels. Some delay in recovering diagnostic film from the photo tower on Chieerete was experienced. Surface decontamination by filling and grading of the western end of Eninman was required to reduce contamination resulting from the Hickory event. The road on Romurikku was scraped and graded to aid recoveries following the Maple event.

Table 3.1 gives a summary of the various events at Bikini Atoll. The H+4 hr survey results are indexed by figure number in Table 3.1.

Not shown by the H+4 hr survey results is the fact that radiation readings on the west end of Eninman were quite dependent on tides. Several recovery operations had to be scheduled with high tide in order to take advantage of the lowest radiation levels. This particularly affected a number of the stations that were very close to the high tide line. It is to be noted that high readings were never uniformly recorded at any particular tide stage. This was of particular concern before the Hickory event since considerable effort by construction crews to build a sea wall on the west end of the island was required.

Contaminated water resulting from the barge shots fired in the northern part of the atoll usually moved out fairly rapidly. Generally speaking, reentry into the water zero site could be made within 24 hr. As mentioned previously, positioning of subsequent shot barges was delayed on two occasions for 24 hr due to radiation levels, but this was in part a result of surface contamination that prohibited the engineering survey crews from occupying

TABLE 3.1–FIRING SCHEDULE, BIKINI ATOLL

Shot	Date	Location	H+4 Hr Survey
Fir	12 May 58	Namu (barge)	Figure 3.1
Nutmeg	22 May 58	Eninman (barge)	Figure 3.2
Sycamore	31 May 58	Namu (barge)	Figure 3.3
Maple	11 June 58	Romurikku (barge)	Figure 3.4
Aspen	15 June 58	Namu (barge)	Figure 3.5
Redwood	28 June 58	Romurikku (barge)	Figure 3.6
Hickory	29 June 58	Eninman (barge)	Figure 3.7
Cedar	3 July 58	Namu (barge)	Figure 3.8
Poplar	12 July 58	Namu (barge)	Figure 3.9
Juniper	22 July 58	Eninman (barge)	Figure 3.10

their stations. The crater on the west end of Eninman cleared out very slowly in comparison with the Namu area due to the water currents and circulation in general.

Very little fall-out was experienced on Enyu. Fall-out from the Fir shot was slight, giving a peak intensity of 12 mr/hr. Water samples taken from rain showers after the Maple and Poplar events showed moderate activity, but the rains did not significantly increase the background level at Enyu.

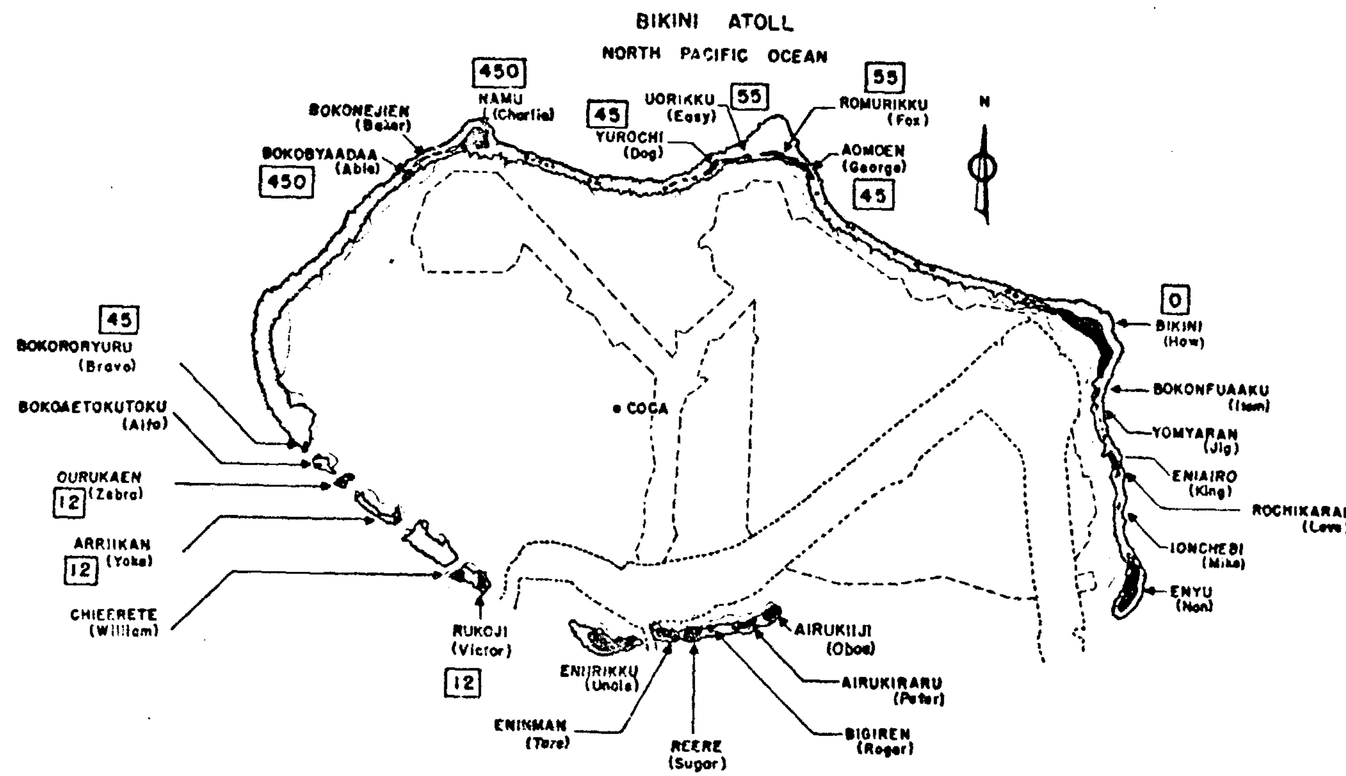

Fig. 3.1—Fir radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Namu.

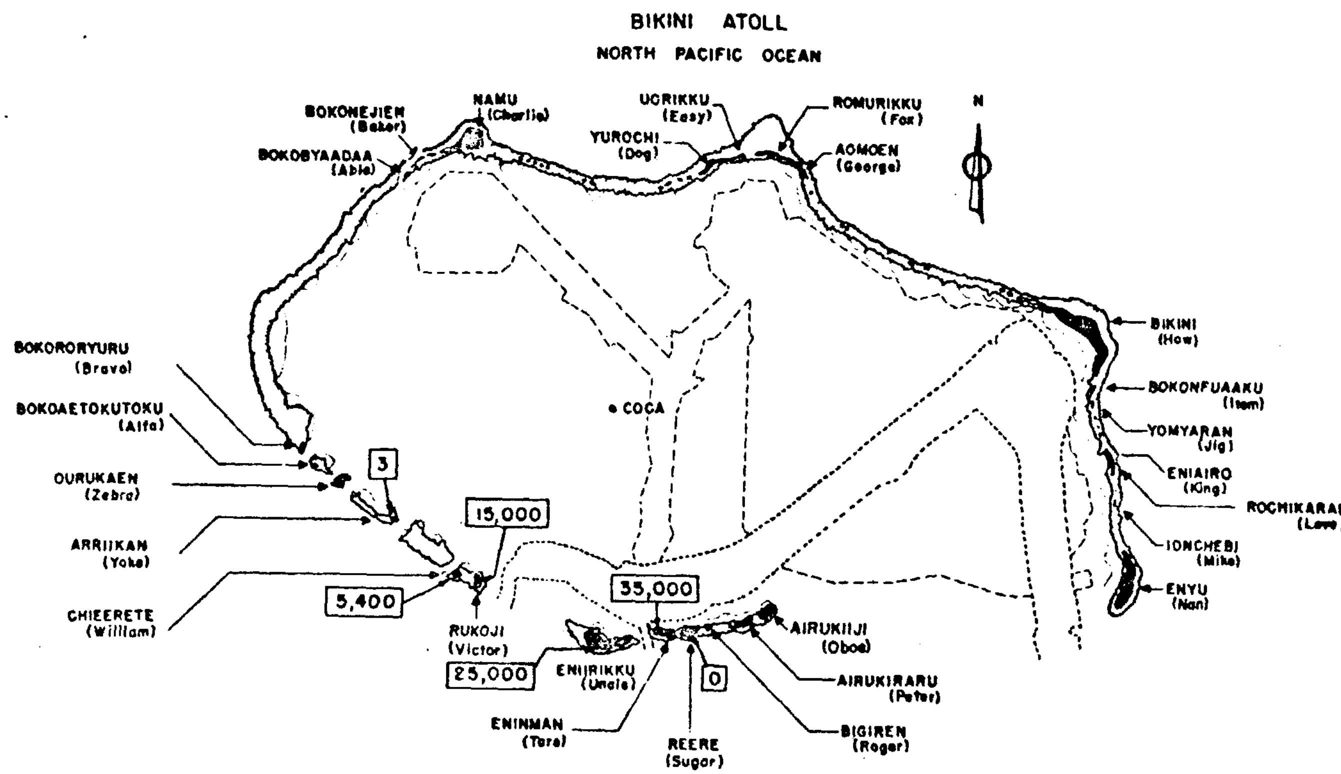

Fig. 3.2—Nutmeg radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Eninman.

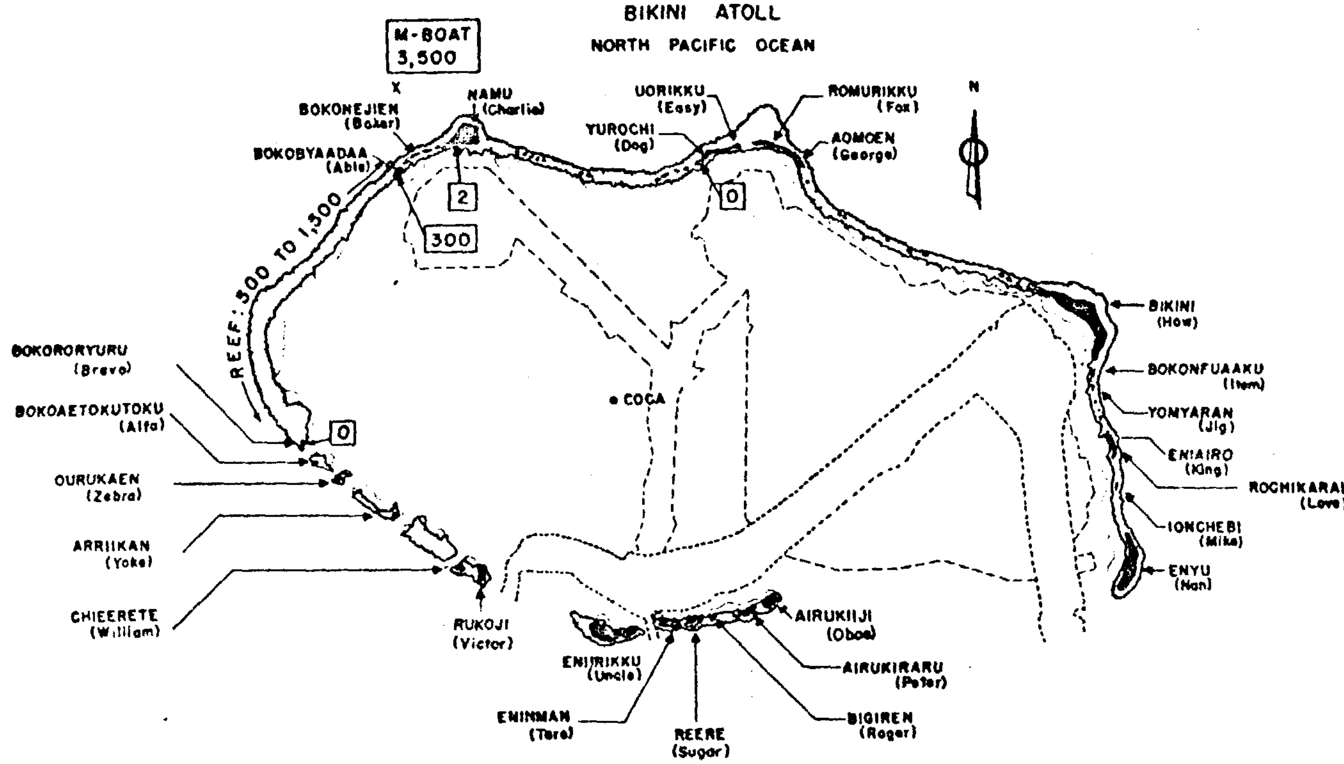

Fig. 3.3—Sycamore radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Namu.

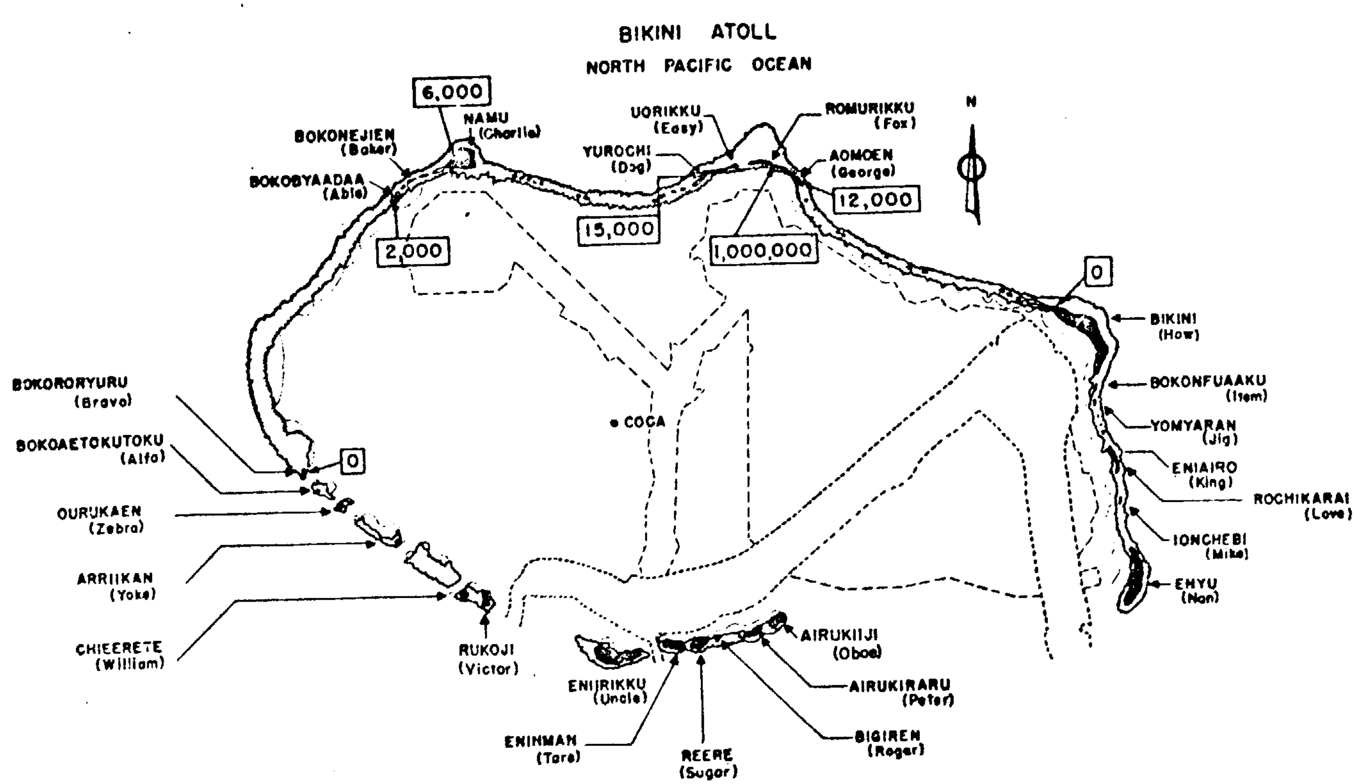

Fig. 3.4—Maple radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Romurikku.

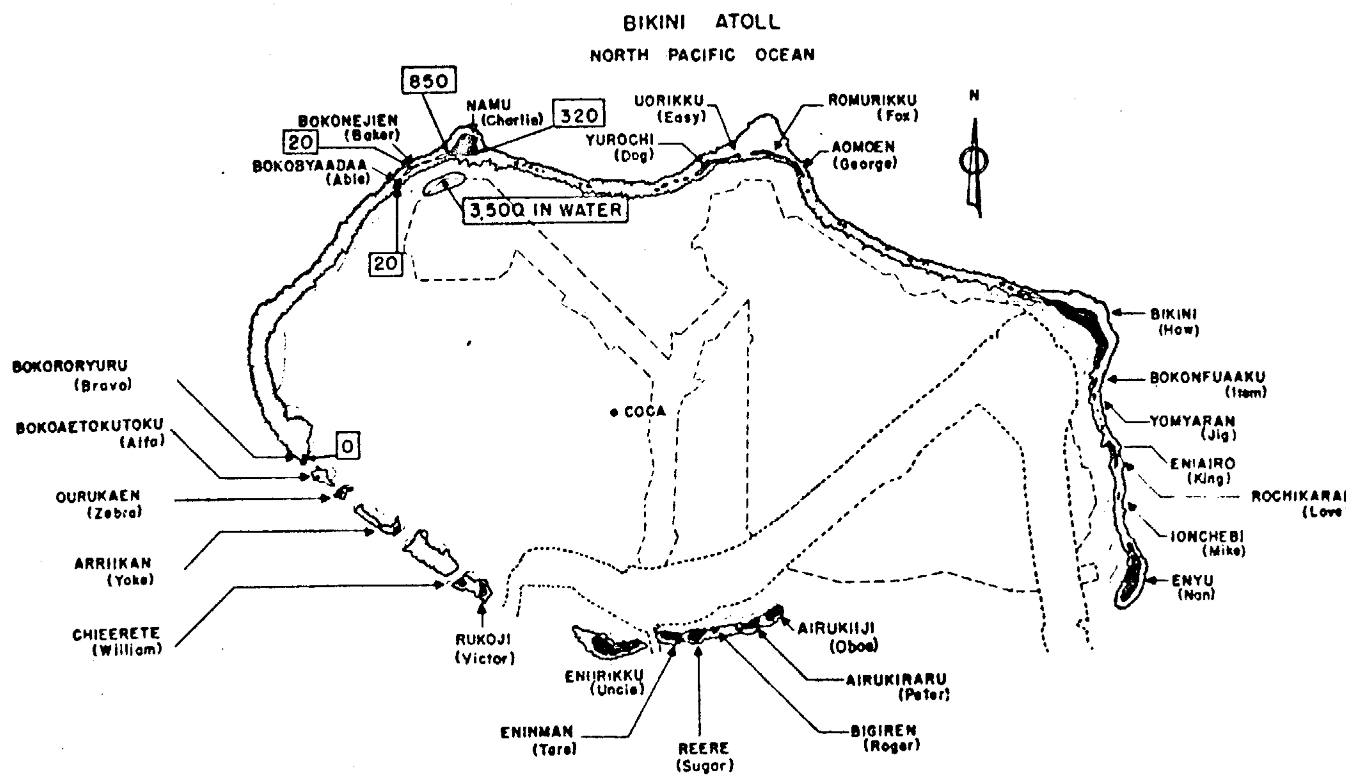

Fig. 3.5—Aspen radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Namu.

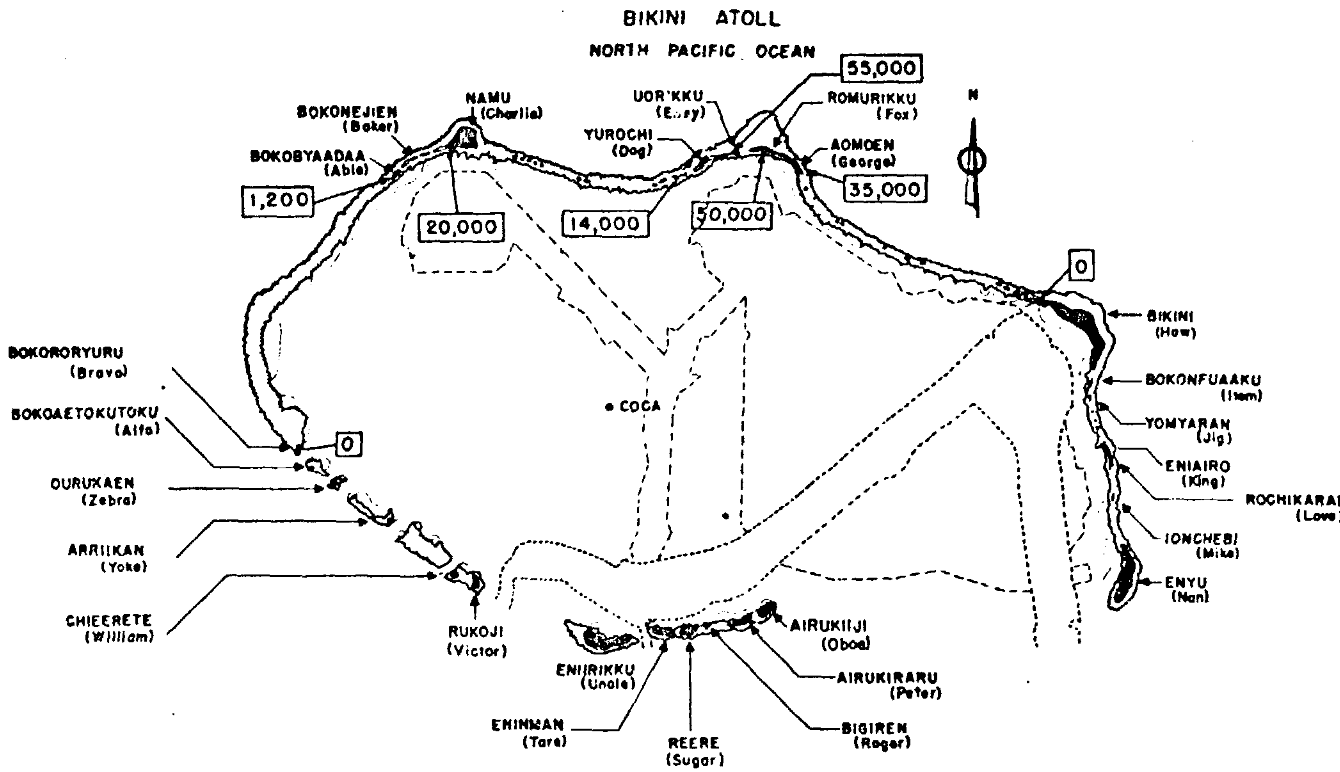

Fig. 3.6—Redwood radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Romurikku.

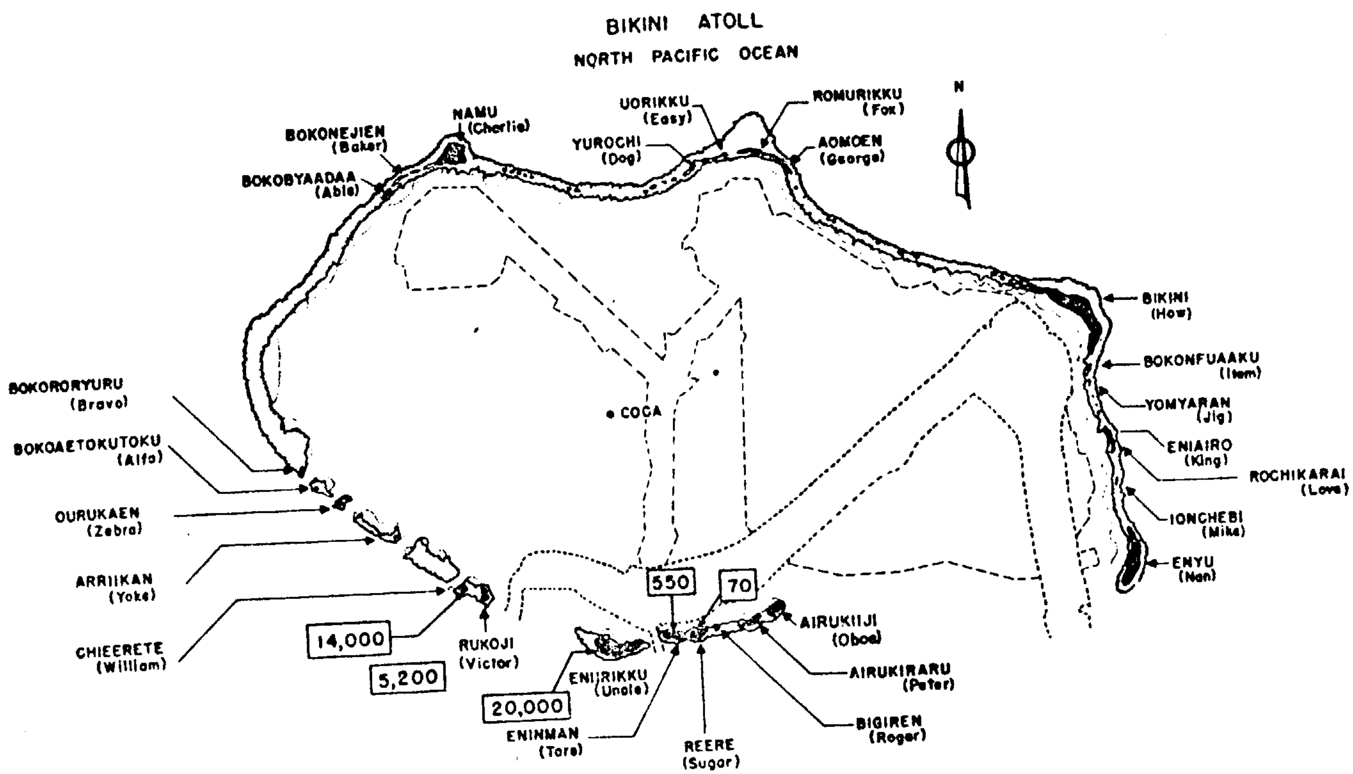

Fig. 3.7—Hickory radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Eninman.

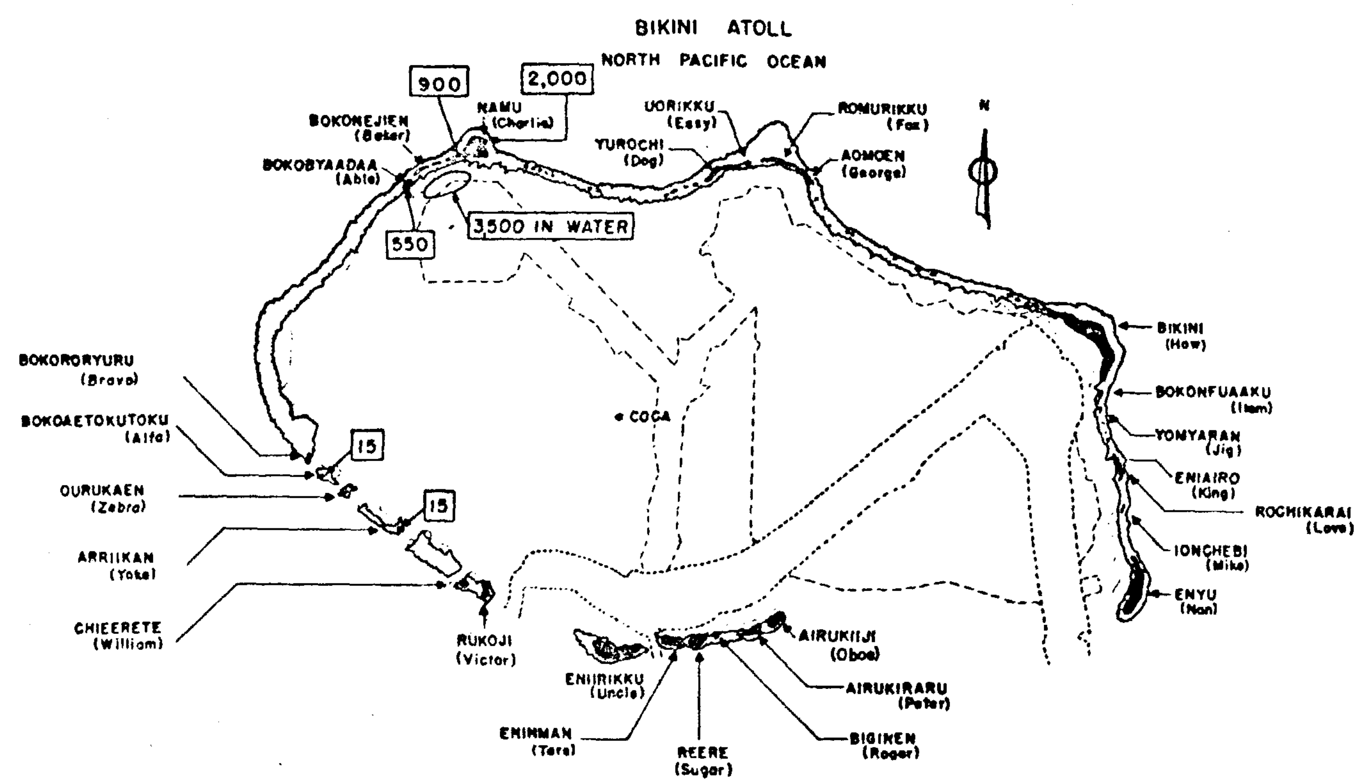

Fig. 3.8—Cedar radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Namu.

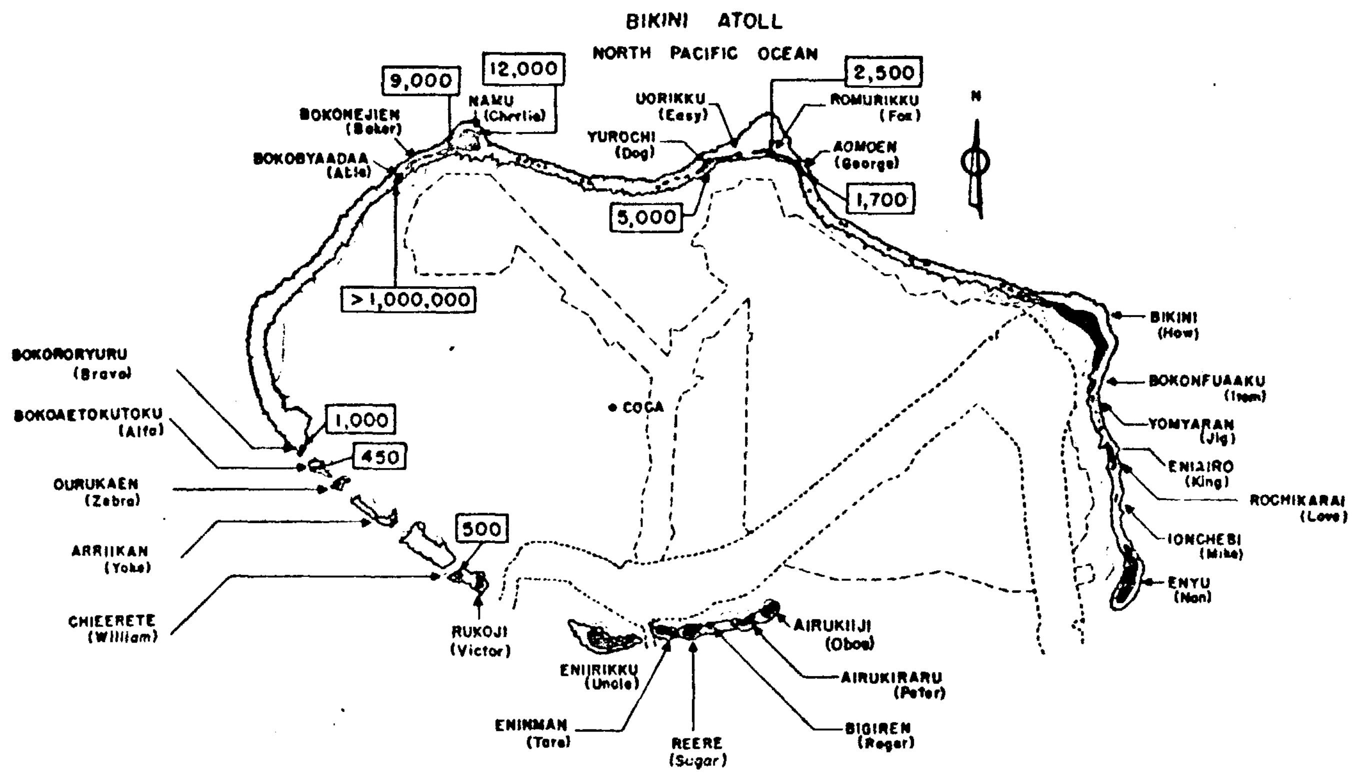

Fig. 3.9—Poplar radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Namu.

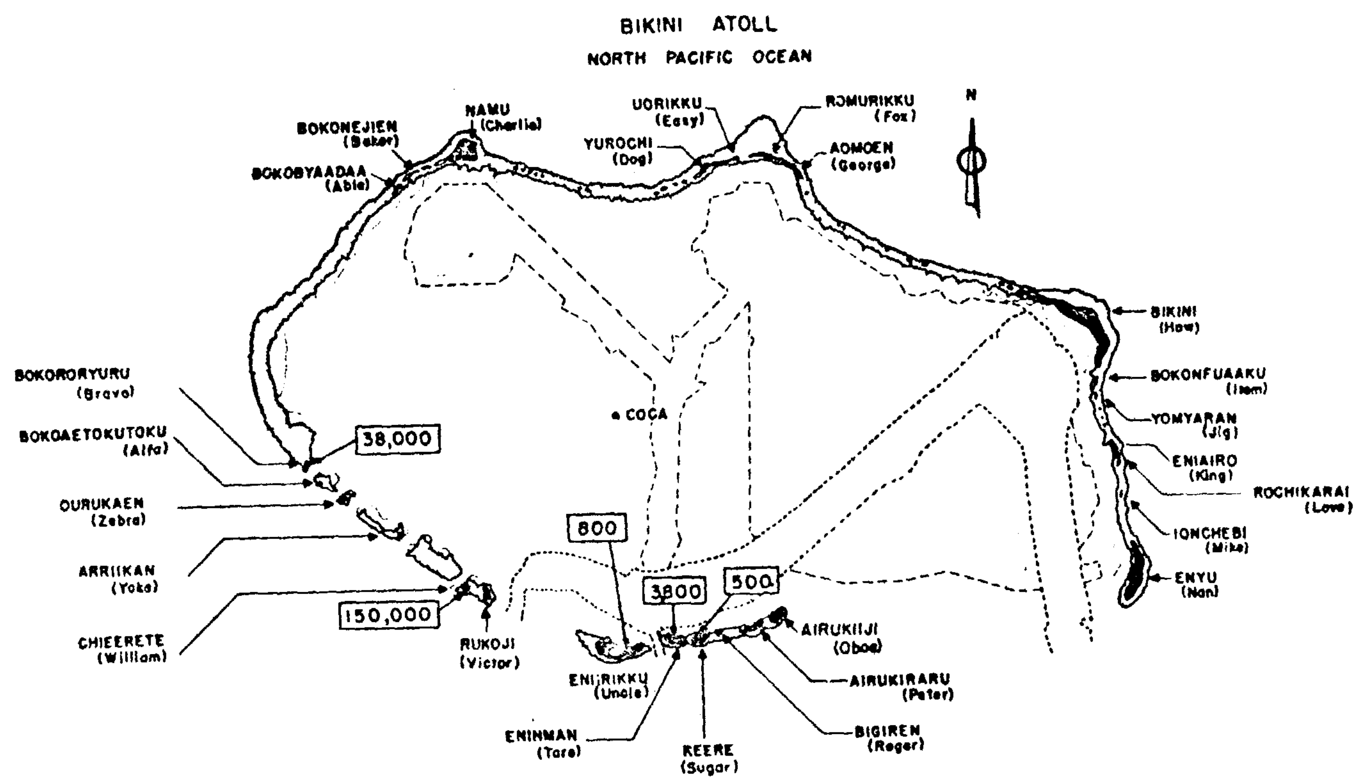

Fig. 3.10—Juniper radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was a barge off Eninman.

Chapter 4

JOHNSTON ISLAND OPERATIONS

4.1 Facilities and Services

TU-6 participation at Johnston Island was limited to providing emergency health physics crews for use during any possible contingency that might arise during launching. In addition, these people assisted the scientific personnel during recovery operations and monitored and supervised the packing and shipping of nose cones and other recovered samples.

The emergency party totaling 11 people, was stationed at Honolulu, T. H. Just prior to an event at Johnston Island six of them were sent to Johnston to take care of any rad-safe problem that might arise, and arrangements were made through the JTF-7 Liaison Office at Hickam Air Force Base, Honolulu, to move the other five there if necessary.

Personnel of the emergency team were provided by LASL, UCRL, and TU-6 at Eniwetok Proving Ground. In selecting its members, primary consideration was given to people with considerable field experience with alpha contaminants as this was considered most important.

The facilities and equipment of the Rad-Safe Center aboard the USS Boxer were utilized by members of the team. Twenty AN/PDR-39 and 12 PAC 3G survey meters were available on the Boxer in addition to the various items of protective clothing.

Chapter 5

PERSONNEL DOSIMETRY

5.1 Dosimetry Devices

5.1.1—The film badge program was designed to provide a dosage-indicating device to all personnel in JTF-7 in order that complete dosage information might be maintained on everyone entering the Eniwetok Proving Ground (EPG) during the operation. Beginning 1 April 1958, film badges were issued to all individuals upon their arrival at EPG with instructions that this badge would be worn at all times and would be turned in on recall by TU-6 upon exit from any contaminated area or upon departure from the EPG. The badge consisted of the DuPont 559 film packet (502 and 834 film components) dipped in ceresin wax and then packaged in a rigid polyvinyl chloride case. The purpose of the wax dip and the polyvinyl was to make the film packet impervious to moisture in order that it might be worn for several months if necessary without deterioration. As the operation progressed, test badges were withdrawn from individuals and processed to check the over-all efficiency of the packaging. Badges were in use as long as six months with no significant failure observed.

During the operation 62,000 badges were issued, processed, and the information recorded. Records were maintained on approximately 18,000 individuals.

5.1.2—Pocket dosimeters, Bendix model 611, 0 to 5 r range, were also used as a means of obtaining quick information as to dosage received by an individual while in a contaminated area.

5.2 Film Processing and Record Posting

5.2.1—To simplify the recording of information, each man was assigned an eight digit identification number that coded individual personal data. The first four digits identified the individual's Task Group, Task Unit, and permanent home station or laboratory. The last four digits were used as an individual ID number within Task Units. To facilitate the issuance of film badges all personnel in Hq., JTF-7, TG 7.1, TG 7.5, and certain units of other Task Groups (such as aerial sampling crews of TG 7.4) were issued "charge-a-plates." These plates, similar to those used in commercial charge account operations, showed the individual's full name and eight digit ID number. Use of the charge-a-plates eliminated filling out cards by hand, thus speeding up the issuance of badges tremendously. After issuing a badge, all the information was manually punched into IBM cards, which were used with the IBM 704 EDPM, and the information was stored on magnetic tapes.

5.2.2—All film processing was done by hand using the standard techniques employed at LASL. The film was read with the Eberline Film Badge Evaluation and Recording System, FS-3, in conjunction with an IBM 526 Summary Punch. The FS-3 was developed by the Eberline Instrument Corp., Santa Fe, N. M., in close cooperation with TU-6. The punched IBM cards from the FS-3 were then used to post the records on the IBM 704. This new method of operation proved very satisfactory in that it reduced the number of personnel employed in Dosimetry and Records from 40 during Operation Redwing to a maximum of 16 during Hardtack and considerably reduced the human errors encountered during prior manual operations.

5.2.3—Identical film processing stations were established at Eniwetok and Bikini atolls for the issuing, receiving, and processing of film badges. All records of these transactions performed at Bikini were forwarded by IBM Data Transceiver to Eniwetok where a consolidation of information from both atolls was made and stored on tapes with the IBM 704. This method of computation and record posting was quite convenient since the preparation of daily exposure reports and accumulative dosage cards was accomplished simultaneously with the posting of the new information to the 704 tapes for storage. New total dosage information compiled by the 704 was then transmitted back to Bikini by data transceiver, where a duplicate file was maintained for daily use. Compilation and printing of the complete exposure reports at the end of the operation was accomplished by introducing a previously prepared code to the 704. This code extracted the desired information from the storage tapes and directed the printing of the various rosters on the IBM printer. This method eliminated completely the many hours of typing previously required in preparation of these reports.

5.2.4—During the operation it was found that the majority of the errors occurring in the dosimetry program resulted from the improper assignment of the eight digit identification numbers. Other errors resulted from improper manual key-punching of badge issue cards by operators of the 526 Summary Punch. In addition, the operators manually punched film badge numbers into the IBM cards after the FS-3 had automatically punched the dosage information into the card. The film number read-out system currently being developed by Eberline for use on the FS-3 will eliminate these key punch errors in the future.

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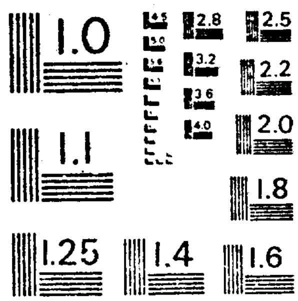

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