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Operations - Crossroads

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OBSERVATIONS ON THE SECOND CROSSROADS OPERATION

by

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Nine persons from Clinton Laboratories left Oak Ridge the evening of July 10, 1946 for the second Crossroads Operations Test, hereafter referred to as Test Baker. We went to Washington, D. C., by train and left Washington by Army Transport Command plane the morning of July 12. We stopped over for about an hour at Topeka, Kansas, and arrived at Fairfield-Suisun, California, at 8:30 PM Pacific time. We spent the night at Berkely and had the good fortune to discuss the first Crossroads Test with Drs. Snyder and Prosser from the University of Chicago and Dr. Pierce, from Rochester. They gave us some interesting information, but, most important of all, they told us that we probably would find many things wrong with the instruments and methods used in conducting Test Baker. They suggested that we might be happier by our experiences if we did not object too strongly to things as we found them. Shonka and Rose had objected violently to the operation of the instruments and methods of making measurements and had not succeeded in impressing the Army and Navy too favorably. The nine of us from Oak Ridge resolved that we would make our objections in as diplomatic manner as possible and strive to bring about the changes we thought desirable rather than gain any satisfaction from constant complaints to those in authority.

We left the morning of July 14, and after twelve hours arrived at Hawaii. We spent a few hours at Hickham Field and then had a four hour flight to Johnson Island. An hour was spent here, followed by an eight hour flight to Kwajalein. Here we took a small boat to Ebeye where we took a sea plane for Bikini. Up until this point all of our flights had been by the C-54, four-engine land plane. We arrived at Bikini and the U.S.S. Haven on the morning of July 16. The men in our group were assigned as follows:

Morgan - monitor - drone patrol boats.
Beal - monitor - Destroyer 781.
Sullivan - water counting.
Small - monitor - Destroyer 722.
Conveyou - monitor - downwind destroyer.
Boettner - monitor - Destroyer 722.
Chaka - monitor - P.C.E. 23.
Saiakti - monitor - Destroyer 720.
Nelson - monitor - L.C.[illegible].

A practice operation was held on July 18, a week before the test. The test was held at 8:30 AM, July 25. I will not attempt to describe the beauty and awfulness of the explosion, but those who had seen the other explosions seem to feel that this was the most spectacular of them all. The observation ships on which we were scattered stood by at distances from eight to fifteen miles from the explosion site. I might summarize what was

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seen during the time of the explosion by stating that there was a great deal of interesting physics displayed in this, the world's greatest waterfall. I hope that each of us will have the opportunity to see and study slow motion pictures of what happened there during a few seconds time.

Samples of water collected by the drone boats were very radioactive, and the indications are that a submerged animal could have received a lethal radiation exposure in the water during the first 24 hours immediately following the explosion. All the target ships were drenched with radioactive water and bits of coral. The radioactive level was so high that persons boarding these target ships could have received lethal radiation exposures, had they remained aboard for several days. The hulls of the ships became increasingly active because of selective absorption of barnacles, algae and other plant life on the sides of the ships.

The day after the explosion I had the good fortune to meet Colonel Gallerdinier, who displayed the delightful characteristic of willingness to admit that he knew very little about radioactivity and was extremely anxious to find out everything he could about the subject. Fortunately, he was the second person in charge under Colonel Warren and was responsible for planning and carrying out most of the monitoring operations. From this time on members of the Clinton Laboratories group were called in frequently for consultations and advice. Our calculations were used in determining tolerance levels for the water, air and contaminated surfaces. Our advice was sought concerning methods of preventing the spread of contamination and removing such contamination from various objects. I was called on to organize a special group whose responsibility was to make measurements of special hazards, to sort out sediments responsible for selective absorption, to measure alpha activity, to measure suspended airborne activity and to make final measurements for the clearance of ships before they left the lagoon.

Until this time, it had been assumed that beta and alpha particles presented no hazards worthy of consideration. Fortunately, we found no alpha activity of any consequence. However, we found many objects responsible for the selective absorption of fission products which gave a beta-gamma ratio from ten to one hundred. Some of these objects were rust, paint, cloth, wood, human skin, plant life and fomite (this inadvertently had been used in some of the target ships in an attempt to decontaminate them). Objects were found with radiation levels at the surface greater than 100 r/hr (this was as high as we could estimate on our instruments). All the extremely hot objects we found favored the beta activity by a factor of ten or more. The hottest parts of the ships of the observation fleet were the sides of the ship and the fresh water evaporating systems. All the salt water pipes passing through the ships were good sources of gamma radiation because of the selective absorption of the rust inside the pipes. Many of the sleeping berths on the sides of the ships and near these pipes were evacuated.

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We left Bikini on August 6 and at this time only a few of the target ships had been boarded for short periods of time. To my knowledge only one of the target ships, a destroyer several miles from the zero position, had its crew back aboard and this only for twelve hour shifts. I am not permitted in this discussion to disclose any information which I might consider of a secret nature, but I believe the newspapers have listed the damage done. As I recall, the ships sunk or beached to prevent sinking are as follows: Arkansas, Saratoga, Nagata, Hughes, Fallon, three submarines, two small troop ships, one drydock ship, one oil-tender and several small ships of a few thousand tons displacement each.

To the best of my knowledge, no one received any radiation damage during and after Test Baker. Colonel Warren had agreed to follow our suggestion of making the monitors and the proper instruments available at the United States ports when the instruments from Test Baker are disassembled and when the hulls of the ships are scraped free of marine life. He agrees that large quantities of radioactive material are fixated in the marine life at the bottom of the lagoon and this will probably make the fish from this neighborhood undesirable for food of the natives for many months to come.

The instruments used had much to be desired, but everything considered, turned out to be rather good. The principal instrument used by the inexperienced monitors was called an X-263. It is a low-voltage GM meter produced by Victoreen and using a GM tube produced by the University of Chicago. It is very light and handy and has an integrating meter for indicating the level of radiation. I believe our group did a rather good job at pointing out to the other monitors, in a diplomatic way, the limitations of any GM meter. To us it serves only as an indicator of the presence of radiation. It is sensitive to temperature and humidity variations. It is usually photosensitive, energy dependent, and reads zero for high levels of radiation. In spite of its shortcomings it is extremely useful to detect low levels of radiation. The next most used instrument was a very large and heavy one called the "247". It, likewise, was produced by Victoreen and was not very serviceable. We took some of our instruments along with us. The Walkie Talkie and Walkie Puppy would not work outside the air-conditioned ships and so were of little value. The Precipitron, Filter Queen and Cutie Pie were very serviceable. The Landsverk-Gollum Survey meter, in my opinion, was by far and large the best instrument available. It is light, convenient to carry and energy independent; the flashing timer worked perfectly; it is independent of temperature, humidity and photo-electric effects. In addition, it has a thin window so that it can be used for measuring low energy beta activity.

Two days before Test Baker we placed some of our special films on floats and located them on the various target ships. These floats contained the regular neutron film and fission track film with small bits of thorium, covered with cadmium, placed adjacent to them. Unfortunately, at the present writing, only two of these films have been recovered. If more of these films are obtained we hope to make a fair estimate of the intensity of the delayed neutron activity from the water column.

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The activity of the water had a half life that was very nearly equal to the time since the explosion (e.g. after 100 hours the half life was 100 hours). This "law" was followed rather closely for the first week. After the first day it was a bit upset by the presence of about 20% Na^{24} activity. Of course where there was selective absorption the effective half life was greater than the lapse time during this period.

Repeatedly the Army and Navy expressed the opinion that one of the principle objectives of the operation was to train their personnel in problems relating to radioactivity. Perhaps this fact accounts for why I had a Navy commander and an Army colonel reporting to me. With this objective, they made a good start. Drs. Sullivan and I lectured to the monitors and the numerous questions that followed indicated a great interest in this subject.

All members of the Clinton Laboratories monitoring group have returned by air except Cowgoon and McLean. They will arrive by ship toward the last of August.

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