

Trinity

The Day the World Changed

Trinity Atomic Test Site, NM
July 15-16, 1945
(Version 5/27/14)

Los Alamos scientists concluded that the physics and operation of the Uranium "gun" assembly nuclear weapon, (called Little-Boy), was so straight forward and well understood that a field test would not be necessary. However, such was not the case for the Plutonium Implosion" assembly weapon (called Fat-Man), which involved new, never before employed technologies, for which a field test was deemed mandatory.

By late 1944 development and the expectation of delivery of the required Plutonium had reached the point where it was timely to start the planning and preparation for a field test. One of the first tasks was choosing a suitable test location. Several were available, for example the Wendover, Dugway Proving Grounds, just east of the Nevada/Utah boarder, west of Salt Lake City. However, it had the disadvantage of being about 800 miles, or nearly two days driving time, from Los Alamos.

The task of locating a proving ground closer to Los Alamos, was assigned to Kenneth Bainbridge, a Harvard experimental physicist. In the face of war time secrecy and National shortages he had to establish a complex physics laboratory in a desert wilderness. It was to be a laboratory capable of conducting the most difficult and challenging physics experiment ever attempted-- a daunting task indeed!

Bainbridge discovered that there was a suitable site, relatively close to Los Alamos. It was the northern portion of the Alamogordo US Army Air force bombing practice range in south central New Mexico. The bombing range commander had agreed to relinquish that portion of the range for the purpose. After extensive search, Bainbridge chose that area for the test, the test code named "Trinity."

How the forthcoming test came by the name "Trinity" is unclear. General Groves is reported to have said it was Oppenheimer's choice. However, when Oppie was asked about it in later years, he replied that he didn't remember why he had chosen that name! It is my understanding that he specifically denied that the name had been inspired by the English Renaissance Metaphysical Poet John Donne, as has some have surmised.

The Trinity site was an isolated unpopulated region about 15 by 25 miles in extent, 200 miles south of Los Alamos; and 3½ to 4 hours driving time. The area was known as "Jornda del Murdo" (Journey of Death). A name a name harking back to a tragedy which occurred there in early Spanish Mission days-- a name hauntingly prescient of the results of the use of the weapon, whose prototype was to be tested there.

The test site was beautiful, pristine high desert country, which before WWII, the Bureau of Land Management (BLM) had leased out for grazing, the lease holder of the trinity site land had been a Mr. McDonald. However, those grazing leases had been canceled when the Alamogordo, New Mexico, bombing range was established early in the war. The former ranch, the McDonald Ranch, facilities were still in place, and turned out to be of great use in the test operations. There was a substantial ranch headquarters building, "the McDonald House," barns, storage buildings, water wells, water storage tanks and stock watering tanks, a windmill and power driven water pumps, etc. Those stock tanks made refreshing last resort, places for a cool dip after a long days work in the desert sun.

The Trinity area was populated with yucca, mesquite, centipedes, rattle snakes and was home to a herd of prong horn antelope. I was fascinated by the areas wild, haunting, and mysterious beauty; for example, how sometimes on moon-lit nights, stalks of distant yuccas plants became outlined in the silvery moon light, and took on the look of strange long-necked -creatures from an alien land.

The Jorada was a shallow basin with higher lands to the north and south, and bounded on the east by the dry rugged Oscura Mountains. A primitive road led eastward through the Oscuras' "Mocking Bird Gap." However, that road was seldom traveled and was not guarded. At least I don't think it was guarded, because I drove through it several times, while out exploring after work, without encountering gate or guards.

The Trinity Test July 15-16, 1945

During the days when the Los Alamos Laboratory was striving to create a nuclear weapon to end the War, a common slogan among those of us involved was, "Krakatau or Bust." Krakatau referred to the August 27, 1883, explosive eruption of the Indonesian volcano Krakatau, located in the Sonda strait between Sumatra and Java. The energy release of that eruption was estimated to have been 100,000 tons, TNT equivalent, the largest explosive energy release known to have occurred at the time Trinity test.

After several years of arduous effort, the fateful time for testing the first nuclear weapon had at last arrived. It was the culmination of three years of intense and fascinating work. Most of us there at the Trinity test site believed that the results of the forthcoming test had the potential for bringing an abrupt end to four years of bloody warfare, thereby saving millions of both American and our Allies lives as well as Japanese lives.

Everyone involved in the Trinity test was tense with excitement. Even today, some 65 years later, I still have burned indelibly in memory, my experiences of that test. The time set for the beginning of the event was 12 P.M., July 15, 1945. The actual count down for the test firing would start as soon after midnight, as all preparatory procedures were completed, and all

conditions were judged optimal for the firing. Firing time was referred to as Zero time, or (T=0).

No one was absolutely sure what would happen at "zero time." Suggested possibilities ranged from nothing, i.e., a fizzle, to the ignition of the Earth's atmospheric nitrogen and the resultant destruction of the earth. (This possibility was put forward by Dr. Edward Teller, but it was quickly "poo pooed" by the cool, irrefutable, analyses of the great theatrical physicist and Noblest, Dr. Hans Bethe, who happened to be the world's acknowledged expert on thermonuclear ignition of nitrogen. In fact, he won the Nobel Physics prize in 1967 for his theory on that subject, and on how the Sun converts nitrogen and other similar weight elements into helium to produce thermo-nuclear energy.

Teller's conjecture concerning ignition of atmospheric nitrogen, even though unrealistic, added to the drama and tension of the occasion. It was reported that after Teller's conjecture, Dr. Enrico Fermi "jocularly" offered, to take bets on whether or not the atmospheric nitrogen would ignite.

I remember having had a hasty breakfast and picking up a few army field-rations on the morning of the test, just in case there wouldn't be a chance to return to base camp for an evening meal before the shot. After breakfast, Fritz, "my wonder dog," and I, boarded our military carry-all and took off for the 17-mile drive up to the North Instrument Shelter. Fritz, of course, didn't understand what was going on, but seemed, somehow, to sense and share in the prevailing excitement!

A late night firing time was chosen for several reasons, one of which was, that at that time of day, fewer people, in the surrounding areas were likely to be awake, and to possibly to see and wonder about a brilliant flash of light in the night sky. Another reason was, that in high desert country, such as that of the Trinity area, where local weather was often driven by "thermal's," i.e., rising columns of warm air, from ground that had been heated by the sun. This type of weather activity, was minimal during the hours from midnight to dawn, as a result, that period generally had the lightest winds and the most stable weather; hence the radioactive fallout area, would be minimal at that time of day. But even so, it was not expected that the fallout would be entirely confined to the Trinity test area.

The day's activities consisted mostly of system checks and practice count downs, including simulated test device arming, etc. Toward the end of the daylight hours, a much appreciated "stand down" was announced to allow time for the test crew to return to base for an evening meal, and a final pre-shot briefing.

This briefing included an emphasized precaution against looking directly toward ground zero at shot time, because doing so without eye protection, would cause severely damaged vision, if not total blindness! In this regard, I had prepared a special viewing fixture for myself, consisting of a 1-foot square, piece of 1/4 inch thick, "Masonite" composite board, in the center of which was a rectangular opening fitted with a double layer, of arc-welder's filter glass. As a test, I had tried looking directly at the sun through the fixture, and found that it appeared as only a dim globe of

light. Thus, I felt confident that my eyes would be adequately protected for looking directly at the bomb's fire ball, immediately its initial flash, and I planned to do just that!

I learned later from conversations and from the memoirs of other test percipients, that Prof. George Kistiakowsky and I, had apparently been the only test partisans who had taken the risk of standing exposed, and looking at fire ball, immediately after the detonation, at the distance of only 10,000 yards from Ground Zero, in fact, the only ones in the entire Trinity test area, who did so!

There were three observation/shelter stations, each 10,000 yards (5.6 mi) from ground zero. The only people who had the privilege, and faced the increased danger of being in the forward area at shot time, were those of us manning those three stations.

The largest contingent of forward area crew was to be at the South Shelter, since that was the Command and Control Center, and also an observation station. The next largest contingent was at the North Shelter, where I would be. I don't know how many people, if any, were at the West Shelter on shot night. Dr. Segre's group had a number of radiation-measuring experiments there, but as far as I know, none of them required the presence of personnel at shot time.

All the rest of the test crew who were not at the forward area stations, as well as all the base support staff would be observing the test from base camp area, 5 miles south of South Station. In addition a large group of Los Alamos VIP scientists, who were not part of the test crew, would be watching from an area about 20 miles northwest of ground Zero, known as Compana Hill. That area had a radio communication link with test control, to keep everyone there, apprised of what was going on at the Trinity test.

As I recall, there was about 10 or 12 of us at the North Shelter. I didn't think about it at the time, but we up there had by far the most dangerous post. We later jokingly referred to ourselves as "the expendables." The danger arose from the fact that prevailing winds were from the south, which meant that the fallout would be blown northward, toward our position. Hence, we could be in danger of being caught in the radioactive fallout area. Control hadn't warned us about that possibility; however they were aware of the possible problem, because they had ordered "that no one was to leave the north shelter area after the test, until everyone left together in convoy". The only reason for such a decree was to prevent someone from being inadvertently left behind, to be trapped in the fallout area. However, as it turned out that decree, itself, was the cause of our near disastrous fall-out exposure, as will be described later.

(Edited To here 9/21/14)

There was no suitable escape road leading northward from the North shelter, only a, slow going, primitive track, which was too rough to serve for outrunning the fallout cloud. Providently, there was also a primitive road leading westward, which could serve as our escape route. Because, west was at a right angle to the probable fallout area, we wouldn't have to out run the fallout, but just travel westward a relatively short distance to get clear of the danger!

After our evening meal we were back at our posts by about 8 pm. We at North shelter were in communication with South shelter control, by a loud speaker system, as well as by numerous signal lines, so we always knew what was happening at control. When midnight had been chosen as the time to start the final test sequence, the prediction had been for stable weather. But late in the night of that fateful day, the weather begun deteriorating and thunder storms developed, and lightning had begun flashing over the Oscuro Mountains, just to the east.

My brother William, who was working in Dr. Segre's group, was engaged in helping launch the "Barrage" balloons, which were to loft their groups' radiation detectors. He reported, the disquieting experience, of feeling sparks jumping through his heavy leather gloves, every time there was a flash of lightning in the Oscuro Mountains. He was engaged in feeding signal cables off spools of wire, so it could be attached to the balloons' mooring cable, as it was being reeled out. It was a situation reminiscent of and similar to Benjamin Franklin's experiment of flying a kite in a thunderstorm, only now there was a nuclear explosive device, nearby, up in a 100 ft high steel tower, waiting for an electrical firing signal to sent over a 10,000 ft. long above ground unshielded twisted pair cable.

By now a brisk south wind, had started blowing and later during the evening, in addition to lightning there were sprinkles of rain. Despite all this, in the early morning hours of July 16, final dry-runs were started.

Another complicating factor in getting the test off, besides the weather, was that it had been planned to have a B-29 high altitude bomber, fly over ground zero, and to be at the same altitude (30,000 ft.) and distance from the bomb, it would be when the bomb dropped and exploded over Japan. The purpose of the bomber in that location at Trinity was to test the effect of the blast on the aircraft and its crew.

A practice shot count-down was begun and we heard the sound of a high overhead aircraft. Then it was announced that the practice count-down had been aborted, because the B-29 had not been on the correct flight path. A half hour or so later, another practice count-down and flight was announced, but it was also terminated —and for the same reason!

Since, there was by now limited time remaining to conducted the nuclear test that night, and that time was rapidly dwindling away, such being the case, "test control" decided to scrub the bomber participation and to proceed with the test

I remember later hearing speculations, that the bomber crews might not have been trying very hard to find the correct flight track because they feared what might happen to the aircraft and crew when that, never before tested nuclear device exploded!

But I think there was little if any justification for that speculation. There was no satellite GPS at that time, and to best of my knowledge, neither was there a radio beacon at ground Zero. Thus the B-29 navigator had had to rely on "dead reckoning" to bring the bomber within sight of the

test tower location light. That fact, coupled with the unsettled, weather conditions, must have made being on a precise track, extremely difficult, if not impossible.

For example, those of us who had been at the test site since the early spring of the Trinity test operation had experienced several night time bombings by highflying B-29 bombers, from Holloman, White Sands, Air force base, just to the south of Trinity. Fortunately they were only using 100 lb pound, sand and five pounds of black powder filled, practice bombs.

In those top secret, war time days, Trinity base didn't officially exist. So when the bombers spotted our base camps' lights, in what had originally been part of their bombing practice range, they apparently assumed that that was their "lighted" target. Most of those bombs landed in the base camp area, but fortunately none ever actually hit a building, but even so, if they had been high explosive bombs the camp would have been destroyed! I well remember the feeling of visceral terror, at being in my bunk at night and hearing the high over head drone of approaching bombers and knowing that I was lying there on, what they thought, was their targets' bulls-eye! We were figuratively being hoisted on the petard of our top secrecy status!

Some time, after the B-29 participation in the Trinity test operation had been called off, a heavy downpour of rain struck -- a virtual cloud burst. When that happened, I became discouraged and remember thinking, that that downpour would probably be "the last straw" and that they would now likely announce the postponement of the test, until some other day and hope for better weather next time.

However, to my joy and amazement, the shot was not called off. Then, when dawn had already begun to lighten the eastern horizon, miracle of miracles, we were thrilled by the announcement of the beginning of another countdown. This time it sounded as if Control was determined to complete the test tonight, and I felt a premonition, that this time, it was going to go to completion this time!

Up at the North Shelter, our vehicles were all look-a-like army carryalls, and we had them parked side-by-side, headed outward, ready for a hasty departure. My wonder dog, Fritz, spent most of shot night, blissfully sleeping on a seat of my carryall. From where the vehicles were parked the view toward ground zero was obstructed, so I knew Fritz would be safe from any inadvertent eye damage, if for example in the unlikely event that he should happen to be awake and looking around at shot time.

During daylight hours Fritz was ordinarily free to wander around and usually spent his time investigating local wildlife or following me around, including into the north shelter, where he was always welcomed and given a pat on the head by its occupants., -- to which he responded with a tail wag.

My test time post was inside the north shelter, which I would be sharing with six or eight other scientists. We each had our own tasks, and in addition, there were four or five other scientists

outside, whose duties would kept them there until T-10 seconds, then they would be free to go where they liked.

Two of those present at north shelter that night were Byrland Brixner and his assistant. Brixner was one of, if not "the" world's leading expert in super high speed scientific photography. His cameras were located, as I remember, at N9000 yards, i.e., 1000 yards closer to ground zero than we were at the North shelter, and those cameras had film, film that had to be retrieved after the shot! Because of Control's decision that everyone at North shelter should leave together in convoy, none of us would be able to leave, to get out of the potential fall-out, until the film from those cameras was retrieved.

My group, P4, had nine ground motion measuring seismographs (Geophones) located at 1000 yd. intervals, starting at N1000 yards from ground zero and ending at N10,000 yards. The output signals of these seismographs were recorded on two, 6-channel strip-chart galvanometers located inside the north shelter. Nine of those galvanometer channels were for ground motion data and the remaining three channels recorded system condition information.

My shot night task was to make sure that our strip-chart recorders, had been indeed started by the T-10 second signal from Control, and if not, I was to start them manually, by pushing their start buttons and then to make sure that all the galvanometer pens had ink and were actually writing.

As the countdown continued without interruption, tension mounted, minutes by minute, and finally second by second. As I recall, at minus 15 minutes, the loud and clear sonorous, voice of Professor Samuel Allison, came over the PA system: "Minus 15 minutes and counting, all systems go." There were similar announcements, at minus 10 minutes and then at minus 5 minutes, the announcements began coming every minute. The minus one minute announcement was followed by the electrifying information that "All firing capacitors were fully charged and ready."

At minus one minute, 5 second announcements began. At minus 15 seconds, second by second counting began. I wouldn't have dreamed that seconds could have seemed so long; "minus 15, 14, 13, 12, 11, minus 10." At minus 10 all the control board lights "came on" and a multitude of recording instruments started, just as they were supposed to do, including my two galvanometer strip-chart recorders, and all the, galvanometer pens were writing!

At that point, my duties inside the shelter were finished, so I dashed for the shelter door, because I wanted to get outside to see the blast. It so happened that those people who had been outside, were now also free, and wanted to be in the shelter, so there was a momentary traffic jam at the doorway. But in plenty of time they all got in, and I got out!

When I was outside and everyone else inside⁽¹⁾, I turned my back toward ground zero and looked toward the distant Oscura Mountains. Meanwhile, I heard Sam Allison voice loud on the loud speaker, intoning the remaining seconds, "Minus 3, 2, 1, **Zero.**"

With "Zero" ringing in my ears, my by now, dark-adapted vision, was momentarily blinded by the most brilliant flash of light, ever seen on earth, blinded by the back-scattered light, from the suddenly brightly illuminated, 20 mile distant Oscura Mountains.

After a few seconds, when my vision had recovered, those mountains appeared much brighter and whiter, than they did in the noon day sun. Meanwhile, I felt the radiated heat soaking though the, heavy high desert night time, clothing on my back. After a few moments of what, under the circumstances, seemed a weird silence, I heard, the now aroused and alarmed Fritz's, howling from my carryall.

At that point, I raised my light-shield and turned and looked directly toward ground zero. It was an awesome sight, the likes of which I had never before, nor have I since. Unlike the dim globe of the sun, on which I had tested the shield, I saw a brilliant, seething white hot ball of rapidly expanding light, now maybe 10 or 20 times the apparent diameter of the sun.

The tips of my ungloved, exposed fingers holding the shield, as well as that, of the area of my throat, exposed below the shield, were beginning to feel uncomfortably hot from the radiated light. However, after a bit, the heat rise slowed, stopped, and then began gradually fading, as the fire ball continued to expand, cool and rise. The fireball itself grew and grew to an awesome size, forming a brilliant, continually expanding and rising sphere of light, seemingly menacing proportions, a sphere that expanded and rose until it gradually forming a mushroom shaped cloud.

After several more seconds, I thought it was now safe to view the fireball directly, without a filter. Segre's barrage balloons, which had been down toward ground zero, and easily visible, were now gone; only puffs of smoke, marked where they had been. Those "puffs of smoke," each had a line of smoke reaching to the ground, lines of smoke, marking where the former mooring cables had been. Everything had been vaporized and nothing was left, but the smoke!

It was spellbinding watching the explosions shock wave racing outward and upward ahead of the rapidly expanding "fire ball, the shock wave was visible because, as it reached and then passed through the various stratigraphic air layer interfaces, it first formed first a point of mist, a point which then changed into a rapidly expanding ring of mist. This happened at each of the several stratigraphic air layers. I remember seeing at least three rings, each formed thousands of feet higher than the one below. That was the first and only time I ever observed that fascinating phenomenon.

Meanwhile, as the fireball continued to rise, cool, and become less brilliant, another compelling phenomenon became apparent, it was that of was an eerie, "blue glow," of the ionized air, that surrounded the fireball. That glow had to have been very bright, to have been visible against the still bright, though now cooling fireball. The blue glow told of, and emphasized, the deadly radiation peril of the that rising, seething mass of the fireball. No one present at Trinity that

night could ever forget that sinister blue glow.

It had now it been about thirty seconds since the detonation, and as yet I had heard no sound from it. Then, by the early dawn's light, plus the lingering light from the fireball, I actually saw the sound wave approaching. It was clearly visible as a fast approaching line of dust, as well as by the shaking of the desert tundra, as it passed by. That is the only time in my life that I ever saw an approaching sound wave, and oh!, what a shock wave it was! I had, braced myself and was ready, but when it hit, it nearly knocked me off my feet. I not only heard, but also felt the shock of that sound wave. Again that was the first, and the only time I have I ever experienced such a sensation. The best descriptive simile, that I been, able to think of, was what of, is what I imagined it would feel like, to be hit by a big base drum, and feel the drum's skin, shatter over my head.

After that initial shock, the sound was like the world's loudest clap of thunder; thunder that reverberated and echoed back and forth between the surrounding mountain ranges. It seemed to go on and on, for minute after minute. After that sound had finally faded away locally, I could still hear it echoing and re-echoing in the distance.

Meanwhile, that seething mass of fireball continued to rise ever higher, up and up, until I began to wonder when it was going to stop. I estimated its height from the apparent angle to its top, as seen from my location, according to which, it had reached at least 30,000 feet and was still rising.

Since the wind was from the South, the fireball cloud and its associated fallout, was drifting northward toward our north instrument shelter. It was apparent that such was the case, because the mushroom cloud was now askew and leaning more and more in our direction.

The situation now was that, Brixner now had to drive from the North Shelter, the 1,000 yards, (a little over a half mile), down toward ground Zero, open his super high speed cameras, extract the photographic film, and then drive back to the North shelter (about a one a mile round trip) before any of us could leave, to escape the looming now almost over-head, fallout cloud.

After the fireball had cooled, and the sound had finally died away, Brixner and his assistant ran over to the line of, look alike carryalls, and in the semi-darkness inadvertently got into mine, instead of their own, without noticing Fritz, who by now had again settled down and was sleeping curled up on the back seat. They were already started and rolling, when Fritz awoke and announced his presence by barking and that's when I had heard Brixner shout , "Oh, Shut-up Fritz"—and Fritz knowing Brixner, did so.

There was now enough light, to clearly see my carryall, racing ahead of it's cloud of dust, down toward the camera station, which, as I recall, was near the North 9,000 yard station, and about a quarter mile away.

There were radiation monitoring stations were located at 1,000 yard intervals all the way down to ground zero. The output from those monitors, could be heard on loud speakers at the north shelter. Radiation was manifest by a click each time an ionizing particle passed through a detector. At first, there was just random, occasional clicking, from cosmic rays and other natural background radiations. As the radiation levels increased, those clicks would become more and more frequent, building up to a roar, and as the radiation level rose farther, that roar increased in both volume and pitch. Eventually, when the detector reached its saturation level, its roar abruptly stopped, leaving a "sinister silence" in it's wake!

The 1,000 yard detector must have been disabled by the blast, because it never worked at all. Fortunately all the other stations were working. The 2,000 yard from ground zero station's radiation level had, by now reached its saturation level. We were all feeling an almost overwhelming tension, because of having to wait for Brixner's return. Remember we had to leave in a convoy! Meanwhile, the monitors were telling us, that the fallout was looming ever closer.

By the time Brixner and his assistant had reached his camera, the next monitor nearest ground zero, North 3,000 had started its crescendo march to saturation. Just after the film cassettes had been retrieved from the high-speed cameras, and the carryall had started back, the monitor next down range from the camera station, N8000, had begun its crescendo saturation march.

We were now all watching Brixner's progress with ever growing concern, and like a crowd of excited sports fans, began shouting "Go! Brix Go!", "Go! Brix Go!" When the film crew finally did get back, the station at North 9000 that they had just left had started its crescendo saturation death march. This meant that the radiation fall-out was now, just 1000 yards away from us.

Everyone was now in their carryalls, with engines running and waiting, I was in Brixner's carryall and was ready to follow, when he passed. But Brixner, apparently not knowing about the imminence of the fallout, didn't drive by, but unexpectedly stopped, and we hurriedly switched vehicles, and then we all took off together, driving west, as fast as road conditions permitted. Meanwhile, Fritz unable to contain his joy at our reunion, was licking my face and wagging his tail so exuberantly, that I was forced to say, "Stop it, Fritz; I have to drive!" However, at that moment, his expressive reaction, reflected my own feeling of wonder and exultation. We had gotten away just in the nick of time, and had received no significant radioactive fallout exposure, as was later shown by our personal radiation monitors and film badges.

When we arrived back at base camp, everyone was seemed to be "walking on air" and a pervasive feeling of wonder, vindication and euphoria abounded. My brother William, who had viewed the shot from base camp, later told me that the MP guard crew had been visibly impressed with what they had seen. was now Apparently they were soldiers who had volunteered for hazardous duty, and had been expecting some sort of overseas combat assignment, but instead found themselves, here in the New Mexico desert, riding herd on a bunch of nutty looking scientists. Now they realized that they had been part of something really big, something that could end the war. Their attitude was now

completely different toward everyone and instead of being aloof and formal as they had been, they were now all smiles, and friendly.

I don't clearly remember the details of everything that happened the next few days, except that of an overwhelming sense of relief and gratification. A review of the chronology of the world's events of the next 28 days, it might help put the situation in perspective. (See chronology below.)

Re: My decision to be outside the North shelter at shot time, when everyone else wanted to be inside.

I have been asked how come I dared to be outside the shelter at Trinity at shot time, rather than inside the protection of the shelter like almost everyone else. That question deserves an answer other than, because I was foolhardy and stupid. I had given the matter a lot of thought ahead of time, and had come to the conclusion that being outside involved an acceptable risk and that I would be safe in all eventualities, short of the ignition of the atmosphere, and if that happened, it would be the "end of the world!" and being in a shelter or not would have been, irreverent. I will try and outline my thinking, without going into the physics of the situation, too deeply.

The answer to the question of the danger, involved the distance from ground zero, which was 10,000 yards, or 5.6 miles. That distance was great enough to protect from shrapnel or fragments from the bomb. In any case it was expected that everything in the vicinity of the explosion would be vaporized. And if that should not be the case and there were flying fragments, the $1/R^2$ relationship would apply. The $1/R^2$ relationship meant that the chance of being hit by a fragment of the test device, would be on the order of 1 chance in 4 billion, i.e., about the same probability as that of being hit by a meteorite from outer space.

The other thing to consider, was radiation. There are two kinds of radiation: particle radiation and electromagnetic radiation. Particle radiation could have been, alpha particles, protons, or electrons. Considering known range energy/relationships of these particles in air, it was clear, considering the likely energy of the particles emitted, that their range would be many orders of magnitude less than the 5.6 mile distance from ground zero, hence they would not be a problem.

Electromagnetic Radiation: The emitted radiation would be either gamma rays, x-rays, ultra-violet light, visible light or infra-red radiation (radiated heat). Of these the only radiation having sufficient range to reach the north or south shelters would be visible light and infra-red radiation. I was sure that my eye shield fixture and heavy clothing would be more than adequate to take care of these radiations.

At any-rate, I decided that it would be OK to take a chance of being outside the shelter, so that's where I was! Apparently, I got away with it, because I suffered no immediate ill effects or long

term damage. It's now about 70 years later and I'm still here and doing well and apparently Prof. Kistiakowsky, who was the only person who took the chance of being outside at the South Shelter, suffered no ill effects from the blast, either.

I'm quite sure that I was the one person outside at the north shelter at shot time and to best of my knowledge Professor George Kistiakowsky was the only person outside at the South Shelter/Command and Control station.

Post Trinity Test Chronology: Ending of World War II

The Trinity plutonium nuclear device test explosion occurred at 5:29:45 AM, July 16, 1945 MST with the explosive force of approximately 200,000 tons of H.E. Equivalent.

The same day, July 16, 1945, at approximately 12 PM, the USS Light Cruiser Indianapolis, sailed from Port Chicago, CA, with the nuclear components of Uranium bomb, "Little Boy" as her only cargo. The Indianapolis was available for the assignment because she happened to be at the nearby Vallejo Naval shipyard after being repaired, from damage kemo kosey attacks, received during the invasion of Okinawa. Apparently it had been decided that the Uranium (gun assembly) bomb would not be deployed until the Plutonium (implosion assembly) weapon was also ready.

July 26, 1945, the Indianapolis, after refueling at Pearl Harbor, completed a record speed run, delivering the Uranium bomb parts to the American Air-force Base on Tinian Island. After her record breaking speed run the Indianapolis was order to report to Subic Bay in the Philippines for new assignment. Where upon, her Captain requested a destroyer escort, but Tinian Command refused his request on the grounds that it was not needed, because there "were no Japanese Subs reported in the waters between Tinian and the Philippines." Tinian Command also neglected to inform Navel authorities in the Philippines that the Indianapolis was coming and of her expected time of arrival.

(Approximately 4 days later)

July 30, 1945, the Indianapolis was sunk by Japanese submarine torpedo and 75% of her crew was as lost. Only about 300 of 1200 survived. When torpedoed, the force of the explosion plus pressure of the in-rushing water, augmented by her speed through the water had collapsed several of her forward bulkheads and she sank so rapidly that only a few life boats were able to be launched before she went under. About 300 of her crew went down with the ship. The remaining 880 members of her crew faced dehydration and shark attacks, while floating in the sea with few lifeboats and almost no food or water. The survivors of the sinking where finally spotted four days later, by a long range PBY surveillance aircraft on a routine patrol. When rescue finally did arrive

many of those hapless men had been cruelly taken by sharks.

Years later, the story of the Indianapolis disaster, inspired movie producer Steven Spielberg's "blockbuster" shark terror movie "Jaws."

The USS Indianapolis, holds a place in history due to the circumstances of her sinking, which led to the greatest loss of life in a single vessels' sinking, in the history of the U.S. Navy. (Ref. Wikipedia, free encyclopedia).

I felt compelled to include this account of Indianapolis's loss, because I, along with everyone else who contributed significantly to the Manhattan Project, especially those of us involved in the Trinity Operation, are indelibly, though unintentionally, linked to her sinking and the tragic loss of her gallant crew.

After Words:

Everyone at Trinity that fateful summer of 1945, worked long hard hours, usually six days a week and there was little opportunity for relaxation and entertainment, except that occasionally on Saturday evenings, a movie screen would be setup under the stars, in an open area, outside the mess hall, and a 16mm movie, would be shown to an audience seated on benches carried out from the nearby mess hall. It so happened that that evenings movie was the 1939 classic "Beau Geste", starring Gary Cooper, Ray Milland, Robert Preston and Brian Donlevy. Just before the movie got started, our, at the time, "acting" base camp commander, Captain Diablo, interrupted proceedings, with the gratuitous admonition: "Be sure to return your benches to the mess hall after the movie," concluding "And If you don't you'll damn well wish that you had, I promise you" and he then departed!

The main setting of the Movie was the French Foreign Legion's, Fort Zinderneuf in the Moroccan desert. As the story unfolded the audience became increasingly bemused by the similarity of the conditions at Fort Zinderneuf and those of Trinity, both being harsh desert outposts, and both also had an arrogant abusive "acting" officer in charge. The movie's Fort Zindereuf was under the interim command of an abusive Sergeant Markoff (Brian Dolevy) and we had our own "Sergeant Markoff" in the person of our "acting" camp commander Captain Diablo.

It turned out that in the movie, Sergeant Markoff repeatedly uttered the same phrase and in the same malicious manner, as had just used by Captain Diablo, in his pre-movie, bench return admonition to us. Because of that, every time in the movie, Sergeant Markoff uttered, "And if you don't you'll be sorry, and will damn well wish you had." The movie audience would burst out in raucous laughter and catcalls. Actually, Captain Diablo had no authority over we civilians, but behaved as if he thought he had!

A Chilling an Unexpected Encounter, circa 1955

The Trinity test site was in an area known as the Jorada del Muerto, which in English means "Journey of Death," and is all BLM (Bureau of Land Management) land. When the area was chosen for a bombing practice range and then later the Trinity test, apparently Capt. Diablo was officer, in charge of evicting all the ranchers and their cattle. A task which he had apparently relished and executed with contemptuous efficiency, and in so doing created a whole new class of embittered Diablo haters. A fact of which I became frighteningly aware years later, as a result an unexpected and alarming encounter with one of those evicted ranchers, a Mr. McDonald.

Ten years after the end of WWII, one of my friends and fellow physics student Raymond Grincheck at the University of New Mexico in Albuquerque expressed an interest in visiting Trinity, which was only a couple of hours drive to the south. Since, I also wanted to see what Trinity was like, after so many years, hence we decided to drive down and have a look. The road into the area, as during the War, was unmarked, but was now open and unguarded. Since I knew the way, we had no trouble finding our way in. The area appeared empty and devoid of human activity. "Jumbo" still lay on its side where it had fallen when its support structure was destroyed by the Trinity blast, 10 years earlier. The then as yet unfenced, 100 yard diameter circle of green glass (blast fuzed sand), centered on ground "Zero" was still admitting beta rays, (electrons). However, the multitudinous twisted pair, copper signal lines, which had run from "ground zero" to the instrument bunkers at North and South 10,000 yards, had all been taken away by copper scavengers. The south (control) bunker, was still intact, but was now in neglected disarray. The McDonald ranch headquarters building, the former living room of which had been converted into a clean room and used for the final assembly of the nuclear weapon components, was still there and unlocked and much as it had been during the Trinity test.

We decided to drive the 5 miles from south control bunker, on down to base camp, to find a place to spend the, now fast approaching, night. Most of the base camp buildings and facilities were now gone, except for a windmill and stock tank and a couple of the now weathered and forlorn looking barracks buildings. The area was not posted and no one seemed to be around. Since a cold wind had sprung up and we needed shelter, I tried the door of one of the barrack buildings and was pleased to find it unlocked. Actually, I think it happened to be my old Trinity day's dorm, and somehow, it felt like home and Fritz, my wonder-dog, seemed to recognize it also and wagged his tail approvingly. After brushing away the bird and bat droppings on the floor, we rolled out our sleeping bags. Being now well sheltered, we lit our lantern and heated water on my little one burner backpack "Primus" stove, made coffee and started warming up our supper, while listening to the ghostly wailing of the wind in that old buildings roof ventilators.

All and all, we were feeling rather snug and were looking forward to a comfortable evening, reminiscing about the day and then a quiet sleep. But, after a bit Fritz began growling and then suddenly the entrance door burst open and we found ourselves looking down the double barrels of a shotgun, held by an irate looking old rancher. He glared at us and said, "What the hell do you boys think you're doing here, this is private property and you're trespassing!"

Startled and frightened, we apologized and explained that we had thought it was government property and since it wasn't posted, we had just moved in for the night, to get in out of wind and hastily added that we would pack up leave immediately and asked him to please put down the shotgun. He lowered his gun and on learning that we were not hostile and willing to leave, he became less belligerent and leaned the gun against the wall. After a bit he said, since it was a bad night out, that if we wanted, we could wait until morning to leave. We thanked him and said we would be on our way early in the morning.

However, he then didn't leave us alone, as we hoped and had expected so that he would have, so that we could get on with our meal. But he hung around and kept talking. It soon became apparent, that he was really lonely and was happy to have company. We offered him coffee, which he accepted and food, which he declined.

He became more and more effusively friendly and invited us to come back to visit anytime. I was surprised and pleased when he introduced himself as Mr. McDonald, the Mr. McDonald of the McDonald Ranch. When I mentioned that I had been part of wartime Trinity test crew, his face lighted with interest and first thing he asked me was, if I had known a Captain Diablo. When I answered that I knew a lot about him, but didn't know him personally and that he was not my friend, at which he launched into litany of invectives, the likes of which I had never heard before or since. He concluded, by remarking that if he ever saw that "God Damned Son of a Bitch, Diablo" over his rifle sights, he doubted he would be able stop his finger from squeezing the trigger.

As mentioned above Captain Diablo had been in charge of evicting the ranchers from their BLM leased lands when the Holliman Air-Force practice bombing range had been established early in the War. The Tinity site had originally been part of that range. Apparently Captain Diablo had been very high handed in dealing with the ranchers and hadn't allowed them enough time for the removal all their cattle and private property. As I remember that was the gist of Mr. McDonalds' grievance with Diablo, plus the fact that in order to receive Governmental compensation for their losses, their claims had to be certified by the officer in charge. Who in this case was Captain Diablo, and he had refused to certify any claims, even though valid and just.

To the best of my knowledge all the events and facts of the above accounts are true and accurate. However, since this account is all based on, my memory of events, facts and conversations from more than half century ago, I apologize in advance or any, even though valid and just.

The Ton TNT Calibration Shot: (The Panicky MP)

As planning for the test of the Plutonium Bomb, (i.e. the "Fat-Man"), progressed, because of its complexity and the use of new and never before used technologies, it was decided that a practice/calibration explosion of ordinary high-explosives (H.E.) would be required. The purpose of this test would be to practice and to check complex timing sequences, and to calibrate the instruments which measured energy release (yield) and other parameters which were independent of the nuclear radiation effects (For example the seismographs, thermal radiation, hyper-velocity of sound and blast gauges, etc.).

Because of Fat-man's expected yield, and the height above ground, the scale requirements for the H.E. test shot called for 100 tons of TNT, to be detonated 30 feet above the ground. Its interesting to note, that this TNT test explosion its-self, would be the worlds largest ever, intentional detonated ordinary H.E. Explosion. The elevated platform for holding the TNT was located 800 feet from "ground zero", so as to leave "ground zero" itself undisturbed for the coming nuclear test.

The TNT came in boxes of about 50 lbs. each. I don't know for sure but, I think the TNT may have been shipped to Trinity, by rail. The "Pope" railroad siding (Southern Pacific R.R. ?) was only about 20 miles west of Trinity. The Army Engineers were in charge of handling the TNT, which was a big job in its-self. The 100 tons of TNT formed a cube, 20ft. on a side. This cube was supported on a sturdy 20ft. high wood platform. The center of the TNT cube was thus 30 feet above ground, i.e., 10 ft to the cube center plus the 20ft height of the platform above the ground!. Staircases led from the top of the cube to the platform and then, to the ground below.

One time when Fritz and I and a couple of other members of our group, were on our way back to Trinity, after spending a weekend at home in Los Alamos. We had turned off the State highway, and were driving on the unpaved Trinity access road, when we overtook an Army 6x6 flatbed truck, lumbering and bouncing down the road ahead of us. I was driving at the time and pulling up behind the 6x6, and honked our horn to pass. The driver didn't respond but stayed in center of the road, thus making it impossible for us to pass. He knew we were behind him, and apparently had no intention of letting us pass. Annoyed, I dropped back out of his dust and followed along far enough behind him, so as to be out, of most of his road dust. The was quite

a rough road. and after a while he hit an extra big bump and one of the several, heavy looking, careless stowed, boxes, which had been bouncing around, on the truck's 'stake-bed', bounced off and hit the road behind the truck and just in front of us, it bounced and rolled along couple times and came to stop at the side of the road.

I sped-up and started blowing our horn and waving, and finally got the truck to stop. The driver looked over at us as we pulled up beside him asked "what's the matter?" I relied, "you just lost a box off your truck, it's about 100 yards back there lying at the side of the road." He seemed completely unconcerned and laconically replied, "Oh, that's OK, its' just TNT" and dropped his truck into gear and started on down the road, without stopping to retrieving the explosives. However, since our sedan had better acceleration, we did manage to get past him during the exchange.

As mentioned earlier, our physics group, P-4, was responsible for ground motion measurements. We were installing, a linear array of five Geophones (Seismographs) between Ground Zero and the North instrumentation bunker. As I recall our Geophones were located at 2,000, 4,000, 6,000, 8,000 and 10,000 yards from ground zero. The geophones were oil exploration instruments whose sensitivity and frequency response range we had modified for the predicted Trinity yield. The signals from these geophones were to be recorded in the North instrumentation bunker on a multi-channel strip-chart gravimeter recorder.

Since I was involved with the nitty-gritty of the geophone system, I had to drive past pass ground zero and the 100 tons of TNT test tower; every time I drove to or from Base camp and up to the north shelter, which was at least 4 times a day! As my wonder dog, Fritz and I drove by in our jeep, I was always fascinated by the spectacle of a MP guard, a guard wearing a battle helmet and with Garand rifle slung on his back, pacing a beat up there, 40 feet in the air, on top of the 20 ft. on a side TNT cube, which was sitting on it's 20 ft. high platform. It seemed like a dumb placement or the guard, because he couldn't challenge or check the credentials of those approaching the tower and couldn't have stopped anyone, short of shooting them. I never had reason to fear the guard, but because the TNT he was guarding, I always got a prickly feeling at the back of my neck when driving past, particularly when lightening was flashing around in the Trinity basin and thunder was echoing off the nearby Oscuras Mountains to the west, because the TNT was to be detonated, by an electric signal

In order to serve its calibration function, the TNT had to explode symmetrically outwards, from the center of the cube. To assure that the explosion, had been symmetric, a radioactive tracer was fluid was to be loaded into the TNT so that the symmetry of the explosion could be determined after the test explosion, by measuring the uniformity of distribution of the tracer's radioactivity.

The day or so before the TNT shot, Fritz and I, happened to be driving past the TNT cube, just as a group of radio-chemists were in the process of loading the radioactive tracer into the TNT cube. So we stopped to watch and happened to observe the following humorous incident. The MP guard was pacing his beat up on top of the cube as usual and the radio-chemists there gathered around a table down on the ground, about 50 feet from the tower supporting the TNT cube. They had a "gear pump" set up on a table and were pumping the tracer solution into uniform grid of pipes which had been built in the TNT cube, through a plastic hose. For some reason the pressure built-up too high in the plastic hose attached to the pump, and the hose popped off the pump and started wildly flailing around and spraying radioactive tracer solution in all directions.

The radioactive tracer, though not highly dangerous, it was not something, in which one wanted to get soaked !!. So the nearby radio chemists started running away from the pump, to escape the radio active liquid from the hose. The MP up here, on top TNT cube, saw the chemists running away, and must have assumed they were running because the TNT was about to explode!! Where upon, he dropped his rifle and started moving so, that his helmet flew off, he literally ran "out from under his helmet" and I have never seen 40 feet of stairs descended faster. He couldn't have reached the ground much faster by jumping.

However, he didn't stop at the ground and as he ran past my jeep, I wondered why he hadn't jumped in and yelled, "that thing is about to blow, let's get the hell out of here" but he didn't slow down or even seem to notice that we were there! When I last him, he appeared to be trying to set a running speed record! He was still headed west when I last saw him.

For me, as an uninvolved, accidental observer, this incident was unforgettable humorous high drama. To the best of my knowledge what happen there that day was only known to those present and those to whom we might have told about it. I doubt that those radio-chemists reported the incident to the guard's superiors.

Since Fritz and I were the only uninvolved observers, this may be the first and only time this tale has been told in print.

Ralph Nobles

Ralph Nobles, Ph.D.

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