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18 July 1945

RESTRICTED DATA
ATOMIC ENERGY ACT — 1954

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MEMORANDUM FOR THE SECRETARY OF WAR.

SUBJECT: The Test.

1. This is not a concise, formal military report but an attempt to recite what I would have told you if you had been here on my return from New Mexico.

2. At 0530, 16 July 1945, in a remote section of the Alamogordo Air Base, New Mexico, the first full scale test was made of the implosion type atomic fission bomb. For the first time in history there was a nuclear explosion. And what an explosion!

The bomb was not dropped from an airplane but was exploded on a platform on top of a 100-foot high steel tower.

3. The test was successful beyond the most optimistic expectations of anyone. Based on the data which it has been possible to work up to date, I estimate the energy generated to be in excess of the equivalent of 15,000 to 20,000 tons of TNT; and this is a conservative estimate. Data based on measurements which we have not yet been able to reconcile would make the energy release several times the conservative figure. There were tremendous blast effects.

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For a brief period there was a lighting effect within a radius of 20 miles equal to several suns in midday; a huge ball of fire was formed which lasted for several seconds. This ball mushroomed and rose to a height of over ten thousand feet before it dimmed. The light from the explosion was seen clearly at Albuquerque, Santa Fe, Silver City, El Paso and other points generally to about 100 miles away. The sound was heard to the same distance in a few instances but generally to about 100 miles. Only a few windows were broken although one was some 125 miles away. A massive cloud was formed which surged and billowed upward with transcendent power, reaching the stratosphere at an elevation of 41,000 feet, 36,000 feet above the ground, in about five minutes, breaking without interruption through a temperature inversion at 17,000 feet which most of the scientists thought would stop it. Two supplementary explosions occurred in the cloud shortly after the main explosion. The cloud contained several thousand tons of dust picked up from the ground and a considerable amount of iron in the gaseous form. Our present thought is that this iron ignited when it mixed with the oxygen in the air to cause these supplementary explosions. Huge concentrations of highly radioactive materials resulted from the fission and were contained in this cloud.

4. A crater from which all vegetation had vanished, with a diameter of 1200 feet and a slight slope toward the center, was formed. In the center was a shallow bowl 130 feet in diameter and 6 feet in depth. The material within the crater was deeply pulverized dirt. The material within the outer circle is greenish and can be distinctly seen from as much as 5 miles away. The steel from the tower was evaporated. 1500 feet away there was a four-inch iron pipe 16 feet high set in concrete and strongly guyed. It disappeared completely.

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5. One-half mile from the explosion there was a massive steel test cylinder weighing 220 tons. The base of the cylinder was solidly encased in concrete. Surrounding the cylinder was a strong steel tower 70 feet high, firmly anchored to concrete foundations. This tower is comparable to a steel building bay that would be found in typical 15 or 20 story skyscraper or in warehouse construction. Forty tons of steel were used to fabricate the tower which was 70 feet high, the height of a six story building. The cross bracing was much stronger than that normally used in ordinary steel construction. The absence of the solid walls of a building gave the blast a much less effective surface to push against. The blast tore the tower from its foundations, twisted it, ripped it apart and left it flat on the ground. The effects on the tower indicate that, at that distance, unshielded permanent steel and masonry buildings would have been destroyed. I no longer consider the Pentagon a safe shelter from such a bomb. Enclosed are a sketch showing the tower before the explosion and a telephotograph showing what it looked like afterwards. None of us had expected it to be damaged.

6. The cloud traveled to a great height first in the form of a ball, then mushroomed, then changed into a long trailing chimney-shaped column and finally was sent in several directions by the variable winds at the different elevations. It deposited its dust and radioactive materials over a wide area. It was followed and monitored by medical doctors and scientists with instruments to check its radioactive effects. While here and there the activity on the ground was fairly high, at no place did it reach a concentration which required evacuation of the population. Radio-

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active material in small quantities was located as much as 120 miles away. The measurements are being continued in order to have adequate data with which to protect the Government's interests in case of future claims. For a few hours I was none too comfortable about the situation.

7. For distances as much as 200 miles away, observers were stationed to check on blast effects, property damage, radioactivity and reactions of the population. While complete reports have not yet been received, I now know that no persons were injured nor was there any real property damage outside our Government area. As soon as all the voluminous data can be checked and correlated, full technical studies will be possible.

8. Our long range weather predictions had indicated that we could expect weather favorable for our tests beginning on the morning of the 17th and continuing for four days. This was almost a certainty if we were to believe our long range forecasters. The prediction for the morning of the 16th was not so certain but there was about an 80% chance of the conditions being suitable. During the night there were thunder storms with lightning flashes all over the area. The test had been originally set for 0400 hours and all the night through, because of the bad weather, there were urgings from many of the scientists to postpone the test. Such a delay might well have had crippling results due to mechanical difficulties in our complicated test set-up. Fortunately, we disregarded the urgings. We held firm and waited the night through hoping for suitable weather. We had to delay an hour and a half, to 0530, before we could fire. This was 30 minutes before sunrise.

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9. Because of bad weather, our two B-29 observation airplanes were unable to take off as scheduled from Kirtland Field at Albuquerque and when they finally did get off, they found it impossible to get over the target because of the heavy clouds and the thunder storms. Certain desired observations could not be made and while the people in the airplanes saw the explosion from a distance, they were not as close as they will be in action. We still have no reason to anticipate the loss of our plane in an actual operation although we cannot guarantee safety.

10. Just before 1100 the news stories from all over the state started to flow into the Albuquerque Associated Press. I then directed the issuance by the Commanding Officer, Alamogordo Air Base of a news release as shown on the inclosure. With the assistance of the Office of Censorship we were able to limit the news stories to the approved release supplemented in the local papers by brief stories from the many eyewitnesses not connected with our project. One of these was a blind woman who saw the light.

11. Brigadier General Thomas P. Farrell was at the control shelter located 10,000 yards south of the point of explosion. His impressions are given below:

"The scene inside the shelter was dramatic beyond words. In and around the shelter were some twenty-odd people concerned with last minute arrangements prior to firing the shot. Included were: Dr. Oppenheimer, the Director who had borne the great scientific burden of

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developing the weapon from the raw materials made in Tennessee and Washington and a dozen of his key assistants — Dr. Kistiakowsky, who developed the highly special explosives; Dr. Bainbridge, who supervised all the detailed arrangements for the test; Dr. Hubbard, the weather expert, and several others. Besides these, there were a handful of soldiers, two or three Army officers and one Naval officer. The shelter was cluttered with a great variety of instruments and radios.

"For some hectic two hours preceding the blast, General Groves stayed with the Director, walking with him and steadying his tense excitement. Every time the Director would be about to explode because of some untoward happening, General Groves would take him off and walk with him in the rain, counselling with him and reassuring him that everything would be all right. At twenty minutes before zero hour, General Groves left for his station at the base camp, first because it provided a better observation point and second, because of our rule that he and I must not be together in situations where there is an element of danger, which existed at both points.

"Just after General Groves left, announcements began to be broadcast of the interval remaining before the blast. They were sent by radio to the other groups participating in and observing the test. As the time interval grew smaller and changed from minutes to seconds, the tension increased by leaps and bounds. Everyone in that room knew the awful potentialities of the thing that they thought was about to happen. The scientists felt that their figuring must be right and

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that the bomb had to go off but there was in everyone's mind a strong measure of doubt. The feeling of many could be expressed by "Lord, I believe, help Thou mine unbelief." We were reaching into the unknown and we did not know what might come of it. It can be safely said that most of those present—Christian, Jew and Atheist—were praying and praying harder than they had ever prayed before. If the shot were successful, it was a justification of the several years of intensive effort of tens of thousands of people—statesmen, scientists, engineers, manufacturers, soldiers, and many others in every walk of life.

"In that brief instant in the remote New Mexico desert the tremendous effort of the brains and brawn of all these people came suddenly and startlingly to the fullest fruition. Dr. Oppenheimer, on whom had rested a very heavy burden, grew tenser as the last seconds ticked off. He scarcely breathed. He held on to a post to steady himself. For the last few seconds, he stared directly ahead and then when the announcer shouted "Now!" and there came this tremendous burst of light followed shortly thereafter by the deep growling roar of the explosion, his face relaxed into an expression of tremendous relief. Several of the observers standing back of the shelter to watch the lighting effects were knocked flat by the blast.

"The tension in the room let up and all started congratulating each other. Everyone sensed "This is it!" No matter what might happen now all knew that the impossible scientific job had been done. Atomic fission would no longer be hidden in the cloisters of the theoretical physicists' dreams. It was almost full grown at birth. It was a great

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new force to be used for good or for evil. There was a feeling in that shelter that those concerned with its nativity should dedicate their lives to the mission that it would always be used for good and never for evil.

"Dr. Kistiakowsky, the impulsive Russian, threw his arms around Dr. Oppenheimer and embraced him with shouts of glee. Others were equally enthusiastic. All the pent-up emotions were released in those few minutes and all seemed to sense immediately that the explosion had far exceeded the most optimistic expectations and wildest hopes of the scientists. All seemed to feel that they had been present at the birth of a new age--The Age of Atomic Energy--and felt their profound responsibility to help in guiding into right channels the tremendous forces which had been unlocked for the first time in history.

"As to the present war, there was a feeling that no matter what else might happen, we now had the means to insure its speedy conclusion and save thousands of American lives. As to the future, there had been brought into being something big and something new that would prove to be immeasurably more important than the discovery of electricity or any of the other great discoveries which have so affected our existence.

"The effects could well be called unprecedented, magnificent, beautiful, stupendous and terrifying. No man-made phenomenon of such tremendous power had ever occurred before. The lighting effects beggared description. The whole country was lighted by a searing light

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with the intensity many times that of the midday sun. It was golden, purple, violet, gray and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described but must be seen to be imagined. It was that beauty the great poets dream about but describe most poorly and inadequately. Thirty seconds after the explosion came first, the air blast pressing hard against the people and things, to be followed almost immediately by the strong, sustained, awesome roar which warned of doomsday and made us feel that we puny things were blasphemous to dare tamper with the forces heretofore reserved to The Almighty. Words are inadequate tools for the job of acquainting those not present with the physical, mental and psychological effects. It had to be witnessed to be realized."

12. My impressions of the nights high points follow:

After about an hours sleep I got up at 0100 and from that time on until about five I was with Dr. Oppenheimer constantly. Naturally he was nervous, although his mind was working at its usual extraordinary efficiency. I devoted my entire attention to shielding him from the excited and generally faulty advice of his assistants who were more than disturbed by their excitement and the uncertain weather conditions. By 0330 we decided that we could probably fire at 0530. By 0400 the rain had stopped but the sky was heavily overcast. Our decision became firmer as time went on. During most of these hours the two of us journeyed from the control house out into the darkness to look

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at the stars and to assure each other that the one or two visible stars were becoming brighter. At 0910 I left Dr. Oppenheimer and returned to the main observation point which was 17,000 yards from the point of explosion. In accordance with our orders I found all personnel not otherwise occupied massed on a bit of high ground.

At about two minutes of the scheduled firing time all persons lay face down with their feet pointing towards the explosion. As the remaining time was called from the loud speaker from the 10,000 yard control station there was complete silence. Dr. Conant said he had never imagined seconds could be so long. Most of the individuals in accordance with orders shielded their eyes in one way or another. There was then this burst of light of a brilliance beyond any comparison. We all rolled over and looked through dark glasses at the ball of fire. About forty seconds later came the shock wave followed by the sound, neither of which seemed startling after our complete astonishment at the extraordinary lighting intensity. Dr. Conant reached over and we shook hands in mutual congratulations. Dr. Bush, who was on the other side of me, did likewise. The feeling of the entire assembly was similar to that described by General Ferrall, with even the uninitiated feeling profound awe. Drs. Conant and Bush and myself were struck by an even stronger feeling that the faith of those who had been responsible for the initiation and the carrying on of this Herculean project had been justified. I personally thought of Blondin crossing Niagara Falls on his tight rope, only to me this tight rope had lasted for almost

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three years and of my repeated confident-appearing assurances that such a thing was possible and that we would do it.

13. A large group of observers were stationed at a point about 27 miles north of the point of explosion. Attached is a memorandum written shortly after the explosion by Dr. E. C. Lawrence which may be of interest.

14. While General Farrell was waiting about midnight for a commercial airplane to Washington at Albuquerque--120 miles away from the site--he overheard several airport employees discussing their reaction to the blast. One said that he was out on the parking apron; it was quite dark; then the whole southern sky was lighted as though by a bright sun; the light lasted several seconds. Another remarked that if a few exploding bombs could have such an effect, it must be terrible to have them drop on a city.

15. My liaison officer at the Alamogordo Air Base, 60 miles away, made the following report:

"There was a blinding flash of light that lighted the entire northwestern sky. In the center of the flash, there appeared to be a huge billow of smoke. The original flash lasted approximately 10 to 15 seconds. As the first flash died down, there arose in the approximate center of where the original flash had occurred an enormous ball of what appeared to be fire and closely resembled a rising sun that was three-fourths above a mountain. The ball of fire lasted approximately 15 seconds, then died down and the sky resumed an almost normal appearance.

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"Almost immediately, a third, but much smaller, flash and billow of smoke of a whiteish-orange color appeared in the sky, again lighting the sky for approximately 4 seconds. At the time of the original flash, the field was lighted well enough so that a newspaper could easily have been read. The second and third flashes were of much lesser intensity.

"We were in a glass-enclosed control tower some 70 feet above the ground and felt no concussion or air compression. There was no noticeable earth tremor although reports overheard at the Field during the following 24 hours indicated that some believed that they had both heard the explosion and felt some earth tremor."

16. I have not written a separate report for General Marshall as I feel you will want to show this to him. I have informed the necessary people here of our results. Lord Halifax after discussion with Mr. Harrison and myself stated that he was not sending a full report to his government at this time. I informed him that I was sending this to you and that you might wish to show it to the proper British representatives.

17. We are all fully conscious that our real goal is still before us. The battle test is what counts in the war with Japan.

18. May I express my deep personal appreciation for your congratulatory cable to us and for the support and confidence which I have received from you ever since I have had this work under my charge.

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19. I know that Colonel Kyle will guard these papers with his customary extraordinary care.

L. R. GROVES,
Major General, USA.

4 Inclosures:
Sketch
Picture
News Release
Statement by E. O. Lawrence

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