ATOMIC ENERGY

THURSDAY, DECEMBER 6, 1945

UNITED STATES SENATE,
SPECIAL COMMITTEE ON ATOMIC ENERGY,
Washington, D. C.

The special committee met, pursuant to adjournment, at 10 a. m., in room 312, Senate Office Building, Senator Brien McMahon (chairman) presiding.

Present: Senators McMahon (chairman), Russell, Johnson, Millikin, Hickenlooper, and Hart.

Also present: Representative John R. Murdock; Edward U. Condon, scientific adviser; and James R. Newman, special assistant to the special committee.

The CHAIRMAN. The hearing will come to order. We will hear Dr. Morrison.

STATEMENT OF DR. PHILIP MORRISON, PHYSICIST, LOS ALAMOS LABORATORY

Dr. MORRISON. I have a prepared statement. I believe it is appropriate to indicate my qualifications before I begin.

After the completion of my graduate work at the University of California in Berkeley in 1940, I was for a short time instructor in physics at San Francisco State College and later at the University of Illinois. In December 1942 I began work at the metallurgical laboratory of the University of Chicago. In October 1944 I came to the Los Alamos laboratory. At Chicago, my work consisted of theoretical, experimental, and design work in connection with the plutonium-producing chain reactors. At Los Alamos, it was concerned with the active components of the bomb itself. Following the Trinity test in New Mexico, I went to the Marianas to assist in the final assembly work on the bomb. On September 6, I came to Japan to join General Farrell's party there. I returned to Los Alamos in October.

Senator MILLIKIN. Mr. Chairman, who is General Farrell?

Dr. MORRISON. General Farrell was General Groves' deputy; he was sent overseas to head the military party.

Many Americans have visited the cities, or the ruins, of Japan since the end of war in the Pacific. The reporters and the photographers have made clear for us all the appearance of the war-damaged towns, especially of the cities destroyed by the first atomic bombs, Hiroshima and Nagasaki. But there is more to be learned from those scenes than the newspapers have yet been able to tell. It was my job to visit the damaged cities of Japan, to speak with the people there, and to assist in the carrying out of certain technical studies. You have heard and

you will hear more expert testimony on the kinds and extent of the damage done by the atomic bomb. I am a nuclear physicist, not a specialist on this or that kind of damage; I wish I knew even less about damage than I do. It is my purpose to tell the committee as clearly as I can what the impressions of an American physicist are when he views the ruins and talks to the survivors of the bombing he and his coworkers spent so much time to make possible.

The atomic bomb is not merely a new weapon: it is a revolution in war. I saw the blackened ruins of Tokyo and Osaka, of Kobe and of Nagoya, and I know that a city cannot live under the fire raids of a thousand B–29's. The destruction of a great city in itself is not the new feature of the atomic bomb. To make clear why the atomic bomb is different one must talk first of the B–29.

We of the Los Alamos project who went overseas in July to prepare the bombs for delivery over the target were stationed on the small island of Tinian, near Saipan in the Marianas chain. Tinian is a miracle. Here, 6,000 miles from San Francisco, the United States armed forces have built the largest airport in the world. A great coral ridge was half-leveled to fill a rough plain, and to build 6 runways, each an excellent 10-lane highway, each almost 2 miles long. Beside these runways stood in long rows the great silvery airplanes. They were there not by the dozen but by the hundred. From the air this island, smaller than Manhattan, looked like a giant aircraft carrier, its deck loaded with bombers. I have flown many times in a B–29, and I doubt that there is a more complex and wonderful machine of any kind. And here, far from the factories in Seattle or Wichita, were several hundred of these million-dollar craft. Here were collected tens of thousands of specialists, trained in the operation and repair of the delicate mechanisms which cram the body of the plane. In the harbor every day rode tankers, laden with thousands of tons of aviation gasoline. A net of pipe lines supplied the airfields with fuel. The radio dial was busy with signals of every kind. And all these gigantic preparations had a grand and terrible outcome. At sunset some day the field would be loud with the roar of the motors. Down the great runways would roll the huge planes, seeming to move slowly because of their size, but far outspeeding the occasional racing jeep. One after another each runway would launch its planes. Once every 15 seconds another B–29 would become air-borne. For an hour and a half this would continue with precision and order. The sun would go below the sea, and the last planes could still be seen in the distance, with running lights still on. Often a plane would fail to make the takeoff, and go skimming horribly into the sea, or into the beach to burn like a huge torch. We came often to sit on the top of the coral ridge and watch the combat strike of the 313th wing in real awe. Most of the planes would return the next morning, standing in a long single line, like beads on a chain, from just overhead to the horizon. You could see 10 or 12 planes at a time, spaced a couple of miles apart. As fast as the near plane would land, another would appear at the edge of the sky. There were always the same number of planes in sight. The empty field would fill up, and in an hour or two all the planes would have come in.

Next day the reconnaissance photographs would come in. They showed a Japanese city, with whole square miles of it wrecked and torn by flame. The fire bombs dropped on wood and paper houses by the thousands of tons had done their work. A thousand B–29's, time and again, burned many square miles of a city in a single raid.

The atomic bomb was something else. There were no shiploads of incendiaries. Instead of all the ordnance men and their bomb dumps, there were about 25 people from Los Alamos, a few Quonset huts transformed into testing laboratories, and a barricaded building. The strike took off after midnight. The field was deserted. Only two or three planes were warming up. A few lights burned around a single hard-stand.

Senator MILLIKIN. What is a hard-stand?

Dr. MORRISON. It is a path on the airfield on which the airplane sits before taking off.

And one plane roared down the runway, took off, and set course for the cities of the enemy. The reconnaissance photos next told the same story. One plane, with one bomb, had destroyed many square miles of a city, destroyed them even more thoroughly and with even less chance for resistance or escape than the 1,000-plane strike.

I can imagine a thousand atomic bombs and an airport like Tinian's to send them off. But not even the United States could prepare a thousand Tinians with ordinary bombs. There are simply not enough people. Destruction has changed qualitatively with this new energy. War can now destroy not cities, but nations.

There is even more to be said. I remember vividly the lunch we had at the prefectural building in Hiroshima. The Japanese officials came there to talk to us and to describe their experiences. I sat at lunch next to and spoke to the chief medical officer of the district. He had been pinned in the wreckage of his house for several days after the explosion. He lived a little more than a mile from the point of impact, and was still wearing splints. His assistant had been killed, and his assistant's assistant. Of 300 registered physicians, more than 260 were unable to aid the injured. Of 2,400 nurses, orderlies, and trained first aid workers, more than 1,800 were made casualties in a single instant. It was the same everywhere. There were about 33 modern fire stations in Hiroshima. Twenty-six were useless after the blast, and three-quarters of the firemen killed or missing. The military organization was destroyed; the commanding general and all his staff were killed, with some 5,000 soldiers of the garrison of 8,000. Not one hospital in the city was left in condition to shelter patients from the rain. The power and the telephone service were both out over the whole central region of the city. Debris filled the streets, and hundreds, even thousands of fires burned unchecked among the injured and the dead. No one was able to fight them.

Senator MILLIKIN. What was the population of Hiroshima?

Dr. MORRISON. About 300,000.

There is a word for this kind of attack; it is described as an attack of saturation. If you strike at a man or a city, your adversary protects himself. If you attack a man, he runs or strikes back at you; if you attack a city, it throws up flak, it musters its firemen, it treats the wounded. But if you strike all at once with overwhelming force, your enemy cannot protect himself. He is stunned. The flak bat-

teries are all shooting as fast as they can; the firemen are all busy throwing water at the flames. Then your strike may grow larger without increased resistance. The defenses are said to be saturated. The atomic bomb is a weapon of saturation. It destroys so quickly and so completely such a large area that defense is hopeless. Leadership and organization are gone. Key personnel are killed. With the fire stations wrecked and firemen burned, how control a thousand fires? With the doctors dead and the hospitals smashed, how treat a quarter of a million injured?

There is one more novelty. A Japanese official stood in the rubble and said to us: "All this from one bomb; it is unendurable." We learned what he meant. The cities of all Japan had been put to flame by the great flights of B–29's from the Marianas. But at least there was warning, and a sense of temporary safety. If the people in Kobe went through a night of inferno, you, living in Nagoya, were going to be all right that night. The thousand-bomber raids were not concealed; they even formed a pattern of action which the war-wise Japanese could count on. But every hour of every day above any Japanese city there might be one American plane. And one bomber could now destroy a city. The alert would be sounded day and night. Even if the raiders were over Fukuoka, you, in Sendai, a thousand miles north, must still fear death from a single plane. This is unendurable.

I should like to interpolate a few remarks on the kind of damage that the bomb does. I think I can describe to you very simply what happens and that will make clearer to you what we saw there.

When the bomb is detonated in the middle of a city, it is as though a small piece of the sun has been instantly created. There is formed what we have called the ball of fire, which is a hot, glowing mass something about one-third of a mile across, with a temperature of about a hundred million degrees Fahrenheit in the center of it.

The effects from this small sun are as you would expect. In the first place, there is a sudden creation and expansion which pushes away, with terrible violence, the air that once occupied this region.

This air, shocked into motion, as we say, moves just like a blast wave from a great explosion of TNT. We often measure the effectiveness of a bomb in tons of TNT equivalent.

This pushing air creates an enormous pressure, even a great distance away. Behind the wave of pressure, which travels rapidly through the air, there come great winds, 500 to 1,000 miles per hour, winds which damage and destroy all structures.

If you stand near this piece of the sun——

Senator MILLIKIN. Those are the winds rushing to fill the vacuum; is that right?

Dr. MORRISON. They are winds which occur partly from that, sir, and also partly because the wave starts in the air. It runs too fast—the air cannot move fast enough to keep up with the wave, so it follows somewhat like a breakwater wave, and this is the great wind.

Senator MILLIKIN. I see.

Dr. MORRISON. If you are near the sun, you must expect to get burned. The people near it are burned on the body; the people and the structures underwent terrific radiant heat.

In New Mexico, where we were 10 miles away, on a cold desert, I felt as though the hot sun had been out for an hour when the explosion occurred. My face was warmed up.

There, in Japan, the same effect happened. Since they were closer there, instantly all organic material was burned up. For some distance it burned up the flesh.

As I shall show later in my prepared statement, for a considerable distance it set fire to piece of wood, curtains, textiles, to anything inflammable in the neighborhood.

There are two more effects. At the instant of the explosion there is emitted from this small sun not only the great push through the air, the violent blast, which is the violent explosion—there is not only the concentrated heat which you would expect from being close to the sun, there was also a great amount of radiation, like the radiation used by doctors, like the X-ray radiation used for the treatment of cancer.

This radiation is very penetrating. There is no protection behind a foot of concrete, for example.

Senator MILLIKIN. How about lead?

Dr. MORRISON. It is possible to have protection. It depends on where you are. You will have no protection unless the material is thick enough. If you have 20 feet of concrete or 5 feet of lead, you are safe enough if it is in front of you.

This radiation produces special physiological effects which I would like to describe.

There is one more effect which may or may not be effective in a military sense, besides the instantaneous burst of these ray-like emanations.

There is left on the ground an enormous amount of radioactivity, corresponding, in the maximum case, to thousands of tons of radium. If this is the case, if this is deposited on the ground, it will be difficult to approach that area, that region, for a long time.

Senator MILLIKIN. Mr. Chairman, I have a question.

Would it disturb your sequence of thought if I would go into the lead matter now?

Dr. MORRISON. No, sir.

Senator MILLIKIN. Are there any other readily available metals that could be used to shield things, that could be used as a defense against the atomic bomb?

Dr. MORRISON. The only point is getting enough material. It doesn't matter what it is if you have enough of it. It may be concrete, dirt, or lead; whichever it is is not very important. Lead, of course, is very heavy and to get a mass of material is convenient with lead.

Senator MILLIKIN. In other words, a thin sheet of lead may be equivalent to 2 or 3 feet of some other material?

Dr. MORRISON. I am afraid not. An inch of lead is equivalent to 10 inches of concrete. The factor of lead to concrete is about 1 to 10. Gold would be twice as good.

Senator MILLIKIN. What does the person wear if he goes into one of these infected areas?

Dr. MORRISON. I don't know. I don't quite understand. There is nothing you wear for protection.

Senator MILLIKIN. I saw a picture in a paper of a tank that moved in there, in New Mexico, and it said that the tank was coated with lead, or something of that kind.

Dr. MORRISON. Yes.

Senator MILLIKIN. Now, when the men get out of that tank, what do they wear?

Dr. MORRISON. They didn't get out. They would have been fried if they had gotten out at that time. They stayed in.

Senator MILLIKIN. Do you see a field of considerable usefulness, where defensive measures are concerned, in lead or any other metals?

Dr. MORRISON. Well, going underground would be helpful. I think that lead is especially valuable, lead is useful, if you have a small room and you want to keep it small. Otherwise, you might as well make it with concrete. We have a similar problem when it comes to sealing in all plutonium reactors. As far as I know, except for instruments, there lead is not employed. These other materials are cheaper. You see, it is much cheaper to use 10 feet of concrete than its equivalent in lead.

Senator MILLIKIN. Thank you.

Dr. MORRISON. As I was saying, there is left on the ground, under some circumstances, this large radioactivity.

In New Mexico, where the explosion was on the surface, this activity was sizable. In both cities of Japan, this activity was negligible, simply because of the tactical choice of the method of employing the bomb.

It has been described in the press. In New Mexico, the bomb was detonated close to the surface; in Japan, a considerable distance above the ground.

In one case the radioactivity was concentrated on the ground; in the other case, in Japan, it was spread over a great area, and so there was not enough of it; it was negligible.

Senator HICKENLOOPER. May I ask a question?

The CHAIRMAN. Yes, Senator.

Senator HICKENLOOPER. How far away did the heat generated from the bomb kill individuals? At say the 100-foot level in New Mexico, as compared to the 1,500- or 1,800-foot level over these Japanese cities, what would be the comparison?

Dr. MORRISON. Would you please wait? I think I have that question covered in my statement.

Senator HICKENLOOPER. Yes. I don't want to disturb your train of thought.

Dr. MORRISON. Yes, sir. I answer that question directly in the statement.

I simply want to give a picture of what the physical effects were and then I have this prepared statement from observations in the area of damage.

Senator JOHNSON. You left out one step.

Could you tell us something about the reaction? I suppose that the air rushes back into the vacuum. That is, you describe the air as being pushed out at the time of the explosion.

Now, there must be the secondary reaction, of air rushing back in and causing damage through that suction that would follow naturally.

Dr. MORRISON. Mostly there is nothing left by that time to damage. If you built one in between the two, it might suffer some damage.

Senator JOHNSON. The buildings are all torn down but that suction is, relatively, something that will not amount to very much because the damage is all done. Is that the theory?

Dr. MORRISON. That is right.

Senator JOHNSON. But is there not a tremendous suction?

Dr. MORRISON. There is; but not too much effect where individual buildings were concerned. We could sometimes see buildings where, at the edge, the air blast had struck from behind, not in the front. That effect would depend upon the shape of the building and such freak effects might happen.

Mostly, the impact, like a hammer, causes the damage, and following this hammer blow is the rapid wind; after that, the suction phase is not very important.

Senator JOHNSON. We have had described to us here cases involving concrete buildings reinforced by steel. We have been told that the interiors of the buildings and the partitions had all been torn out. It just occurred to me that that reaction, perhaps, did that.

Dr. MORRISON. That is quite likely. I was just going to say that in the next sentence.

Senator MILLIKIN. Mr. Chairman, pursuing that same subject a little further, I have seen many pictures of damage over in London during the bombing, which showed that the buildings collapsed towards the location of the bomb. The explanation was that it was caused by the suction rather than by the hammer effect of the blast. Does that prevail also as far as this particular bomb is concerned?

Dr. MORRISON. No, I don't believe it does. It is rather less important in this case than in small explosions.

Senator MILLIKIN. I was curious about that.

Dr. MORRISON. I think that the effect has been exaggerated even in the smaller explosions. If I might put it this way, the bigger the explosion, the more negative the effect of the suction phase, the less important it is.

Senator MILLIKIN. You get the first hammer effect, which does the job, and the second effect has nothing to pull down.

Dr. MORRISON. Yes.

The damage done in the cities struck by the atomic bomb is not easy to realize. Houses and buildings for a mile in all directions are totally destroyed. A good deal of comment has been attracted by the ferro-concrete structures whose walls still stand. These are very strong buildings. But they too are useless. I have been in these buildings. The window casements are gone, the interior walls are down, the roofs are collapsed, the furniture battered, plumbing fixtures and heavy machinery overturned. A great blast wind followed the shock and ripped through the buildings, destroying their interiors. Most of them burned. Brick buildings, and even steel-frame buildings with brick walls, are extremely vulnerable.

Senator MILLIKIN. Did I understand you to say a while ago that this wind you have described reaches a velocity of 500 or 600 miles?

Dr. MORRISON. That is a very conservative figure. A 1,000-miles wind is common.

Senator MILLIKIN. What is a hurricane wind?

Dr. MORRISON. About 120 miles an hour.

Senator MILLIKIN. I wanted that just for a comparison.

Dr. MORRISON. At Nagasaki, the Roman Catholic church was an old and heavy brick-walled building nearly a mile and a half away, and it suffered total destruction. It is likely that an American city would be as badly damaged as a Japanese city, though it would look less wrecked from the air. In Japan the wreckage burned clean; in a

western city, the rubble would still stand in piles in streets. But the city would be just as ruined, and the people of the city as dead.

The action of the blast on steel-frame factory structures is known from the wreckage of the Mitsuibishi Torpedo Works in Nagasaki. Japanese homes are lightly built, but their factories are about like ours. And the torpedo works buildings collapsed in a twisted jumble of steel onto the heads of the workmen and the still-turning machines. For a good mile and a half all factory structures were totally destroyed.

For 3 or 4 miles from the point of impact there is heavy damage, making half the buildings unusable. In Hiroshima the fires which began after the blast, some set by overturned stoves and chimneys, some by the heat from the bomb itself, burned for 10 hours. The flames stopped at the edge of the river. Many places were completely destroyed by fire which had only been partly smashed by the blast. It is not hard to understand that fire-fighting was impossible.

Senator MILLIKIN. Mr. Chairman, I hate to interrupt so often.

Dr. MORRISON. That is all right.

Senator MILLIKIN. Yesterday we were questioning a witness as to whether these same effects would occur in a heavily constructed area, like lower Manhattan, for example.

I think I asked the question whether the great bulk of the heavy construction, the buildings, would serve to insulate and confine the effects of the blast. Would you mind giving us your impression on that?

Dr. MORRISON. As the blast wave moves over the face of the city it loses energy by the knocking over of structures, it carries debris around; therefore, I think the more densely the city was built up, the more the number of buildings that would be caught in a given area. Therefore, the extent of the damage would be, or might be, somewhat smaller because there were more buildings.

Senator MILLIKIN. But the effect, in a quantitative way, would be the same?

Dr. MORRISON. Yes, sir.

Senator JOHNSON. What is the direction of this blast? Is it straight down?

Dr. MORRISON. It depends on where you are and where the bomb is set for. I am not sure that I can go into the details, but if it is close, it is straight down; if it is some distance away, it is horizontal.

Senator JOHNSON. Of course, this straight-down blast might raise havoc with the roofs, but it might not raise havoc with the walls of the buildings.

Dr. MORRISON. That is true. For example, in Hiroshima, the walls directly under the impact were intact while the roofs had been driven straight down. The heat and the radiation had killed the people; but the walls and even the telephone poles were still standing up.

The effect, of course, depends very much on how far away it is. At some distances, you have one effect and at some other distances you have another.

Senator MILLIKIN. Is it true that, so far as the bomb is concerned, passing what is below it, as far as the bomb itself, does it throw out energy in equal directions or does it have that energy thrown out directionally?

Dr. MORRISON. If the bomb is released very far above the earth, it would throw out the same energy in all directions. It is not, as a matter of fact, done this way; but I would not like to go into that question.

Even more striking than the damage to buildings is the great number of casualties. Very few people were in shelters, because there was evidently no large bomber raid. Virtually all the people in the streets within almost a mile were instantly and seriously burned by the great heat of the bomb. These burns covered all the exposed flesh, sometimes even clothing caught fire and burned the wearer fatally.

I remember seeing one man, a patient, who had worn a railway worker's uniform. This uniform, in Japan, is a dark serge with an insigne to designate his grade. This man wore, as insigne, a kind of a cross-shaped emblem over the left breast.

His whole body was burned very badly and blackened, with the exception of the region under this cross. That was because the white clothing passed the heat somewhat less than the dark clothing did. The dark clothing absorbed the heat and caught fire and burned him. Of course, the white clothing would ordinarily not do this.

There were reported to me some people who had even been wearing striped clothing upon whom they found the body had been burned in stripes. I did not see that.

People inside buildings were not burned by the flash, but were for the most part killed or seriously injured by falling walls and beams. Caught in the wreckage of their homes, many were burned to death by the secondary fires. Those fires resulted from combustion material set ablaze after hundreds of stoves had been overturned; this was in addition to the fires started by the bomb itself.

Of these people within a thousand yards of the blast, about one in every house or two—perhaps 5 or 10 percent—escaped death from blast or from burn. By chance these people were screened from the heat of the bomb by some object too light or too strong to kill them by falling upon them. Many literally crawled out of the wreck of their homes relatively uninjured. But they died anyway. They died from a further effect, the effects of radiumlike rays emitted in great number from the bomb at the instant of the explosion. This radiation affects the blood-forming tissues in the bone marrow, and the whole function of the blood is impaired. The blood does not coagulate, but oozes in many spots through the unbroken skin, and internally seeps into the cavities of the body.

The CHAIRMAN. Would there be a third-degree burn?

Dr. MORRISON. No; not from radiation; no burns at all. There were some dramatic cases of people who were protected from the burns——

The CHAIRMAN. You mean the skin would be absolutely normal and yet the blood would be coming through?

Dr. MORRISON. Yes. There might be a slight burn on the skin, but it was not essential.

The white corpuscles which fight infection disappear. Infection prospers and the patient dies, usually 2 or 3 weeks after the exposure. I am not a medical man, but like all nuclear physicists I have studied this disease a little. It is a hazard of our profession. With the atomic bomb, it became epidemic.

The facts and figures of this and other related effects of the atomic bomb are still under study, and remain for the time being classified information. I am not a medical expert in these matters, and I have tried to tell you only the things I have seen.

It goes without saying that, like most of the scientists of the project, I am completely convinced that another war cannot be allowed. A working and realistic domestic policy ought to be determined on the premise that some measure of international control of atomic energy will come and come immediately, based on functioning, material agreements among the great and the smaller powers. We have a chance to build a working peace on the novelty and the terror of the atomic bomb.

But I should not be a physicist if I left you with the impression that only in war a revolution has been made by the large-scale release of atomic energy. Man will not live the same again for this advance. I do not think you will soon see atomic automobiles, though you may soon see atomic rockets and atomic power plants. But the changes which will come are sure, and great, and beyond prediction. When science learned to control mechanical and thermal energy, we had the early nineteenth century maturing of the industrial way of life. When science learned control over electrical energy, we had the manifold changes which electricity has brought to daily life and to the structure of nations. When the chemists understood the nature of chemical energy, there was opened the way to new materials, to freedom from the restrictions of mine and farm, to the changes which chemistry is even today still bringing us. Now we have nuclear energy, based on a more profound insight into and control over the fundamental nature of matter itself. We have seen war change only 6 years after the key laboratory discovery in this realm. We physicists are professionals in change and in novelty. That new times will come is our firmest conclusion.

Senator HART. Mr. Chairman.

The CHAIRMAN. Senator Hart.

Senator HART. Doctor, when you compared in your statement an attack by 1,000 B–29's and one B–29, you said there was a great qualitative change in the destruction. Then you followed with your observations on Hiroshima, and about the only thing you said to support that statement was about the damage done by the gamma rays.

We had been led to believe from other testimony that when the bomb explodes well off the earth, as was the case there, that the gamma rays' damage is a very small proportion of the total damage.

Dr. MORRISON. I think I detected two questions in your question. Would you mind if I separated them and tried to answer as I see them, separately?

Senator HART. Yes, sir.

Dr. MORRISON. When you gradually increase something by simply piling on, by quantitative implementation, you come to a point where something new has occurred, and we have a qualitative change.

For instance, if you heat water, you heat it 1° at a time until it boils and there is still a quantitative change going on. But if you keep on heating, you get a qualitative change; it is no longer water, you have something new.

The reason I say that the bomb has made a qualitative change is the manner in which the atomic bomb works. Take the destruction of cities. When you use ordinary bombs to destroy a city, you do it with a great effort, all the resources of a nation.

With the atmoic bomb, it is done, more or less, with the left hand. I mean, one bomb, one city.

The whole attitude has been changed. They are not talking about the destruction of one city at a time any more; the new strategy will have to deal with weapons of destruction which will make one city too small a target.

In the future, it will not be the case of a raid against Berlin or against Hiroshima or Nagasaki on separate days, but it will be against all of them on the same day.

Senator HART. It seems to me still that you are terming as qualitative a change which I consider a quantitative change.

Dr. MORRISON. Well, this is a question of philosophy. What I am implying is that, by the piling on quantitatively you have produced a new mode of action which is in nature qualitative.

As you know, you might say an army is a collection of, say, 1,000,000 men. But if you have a collection of 1,000,000 men into an army, you have something different from just a collection of 1,000,000 men. In the same way, when you have a collection of atomic bombs, you have something different, then, which becomes a qualitative difference, because there you have a chance to destroy whole nations.

Senator HART. Well, I will drop that, Doctor, although I still think you mean quantitative rather than qualitative.

Do I understand you to say that the gamma factor in your explosion is not a material part, that mostly it is blast and heat?

Dr. MORRISON. This is correct.

Senator HART. Is that correct?

Dr. MORRISON. This is correct. The gamma radiation is a part of it, or could be; it all depends upon how the bomb is used, as I said. The way the bomb would be normally used, I do not think that the gamma rays would be material.

Of course, I do not know what the statistics are. In the case of Japan, under the conditions that existed there, there are simply no records, no officials, men familiar with the town who could tell us exactly what happened.

It is known that in Hiroshima 40,000 people came into the town the day before the bomb was dropped, to help evacuate it, because the town was on the list, and they felt it would be attacked and they wanted to evacuate it.

They had started work at 7 o'clock in the morning, they were still moving shops and furniture and the contents of warehouses, and so forth, and they were killed by the bomb.

However, no census taker, no statistician, is able to say how many people were killed in that explosion. It is my impression, gained as I walked through the city and the hospitals and talked to the men, that there was one man who escaped immediate death out of every one or two houses that were destroyed. There was always someone who, by chance, escaped the building falling on him and killing him, who, by chance, escaped the burns, even from the direct heat or through the fires that raged throughout the district. There were people who

walked away more or less unharmed, by chance—and even these did not escape death in the end.

Senator HART. Doctor, in the latter part of your statement, when you went into the political field, I believe you used the words that something must immediately be accomplished in our international relations so that atomic bombs would not be used.

What is your thinking around that word "immediately"? Is that altogether a theoretical idea, or have you some practical ideas about that?

Dr. MORRISON. I think, for example, that the implementation of the Three-Power Declaration, if it comes in the near future and if it is extended, will be an immediate step in the right direction.

I did not mean that the problem would be solved immediately; I mean that we should act at once. The reason I think that is this: that one of the great advantages that we have with regard to the control of this decisive weapon which does not adhere to any other weapon is that it is something new.

It is something which is not all over the world. There are no great industries connected with it, it is not filled with a tradition of continuity, it does not have a tradition of money or economics—those interests do not enter into it. There is none of this.

I think that if we catch hold of this opportunity and soon begin control, you will find it to be a much easier situation to handle than if we sit around 1 year, 3 years, 7 years, 10 years, making no progress. Then, when it has come to a full-fledged realization, by that time there will be greater difficulty. It will be widespread; there will be money in it; there will be great industries, and the economy of great regions may be dependent on it. It will be sizable, and it will be great, and it will be difficult to make such changes as should be made, because then, at that time, people will say that it is not practical.

Senator HART. I take it that you did not think that there was an immediate and complete solution practical. Let me ask you one thing.

Your statement has been about the power, the destructive power of the atomic bomb alone. In your thinking, do you place that in a different category than, for instance, an entirely merciless bacteriological form of warfare?

Dr. MORRISON. Yes, sir; I do.

Senator HART. Why?

Dr. MORRISON. I am not a bacteriologist, and perhaps I am wrong, but I have been in Washington on military affairs and on these matters I have spoken to people that know——

The CHAIRMAN. I defer to your greater knowledge, Senator, about the propriety of an open session to a discussion of bacteriological warfare.

Senator HART. I am merely asking a general question. If he is going into anything that he ought not to go into, I will withdraw the question.

The CHAIRMAN. You are acquainted with that?

Dr. MORRISON Yes, sir; I will not discuss it.

The CHAIRMAN. I just wanted to caution you.

Dr. MORRISON. Yes, sir; thank you very much. I simply wanted to say that the absence of successful bacteriological warfare is not a statement that people do not think about it.

Senator HART. Well, you do; and you do not put it in a different category, as a political matter looking forward to the protection of the world?

Dr. MORRISON. I do put it in a very different category, because it does not exist.

Senator HICKENLOOPER. Would you care to answer my question of a little while ago now, of a bomb set off 100 feet in the air? Will it burn better than a bomb set off 1,500 feet in the air?

Dr. MORRISON. A little further away, because, at a given distance, you are a little closer to the bomb. In other words, if you are right below the bomb and it is 1,000 feet above, you are 1,000 feet away.

Senator HICKENLOOPER. I understand that, but I wondered if the radiation would be conducted along the air of whether it might be dissipated in the air.

Dr. MORRISON. I don't think so; it might be. The reflected heat from the ground might have a small initial effect, but not serious.

Senator HICKENLOOPER. It is all hot enough?

Dr. MORRISON. Yes, sir. In New Mexico, where it did touch the ground, the ground is covered with glass for about 1,000 feet.

Senator MILLIKIN. Mr. Chairman.

The CHAIRMAN. Senator Millikin.

Senator MILLIKIN. What would be the effect if the bomb exploded in the ground, in terms of radiation, blast, and heat?

Dr. MORRISON. If it exploded at or near the surface of the ground it would be very much the same as high in the air, with the difference that the people would be closer to it and the difference that the radioactive material would then probably be left on the ground in large amounts, and, perhaps, with the other difference that the ground, perhaps, would be glazed and might be untenable for a very long time to come.

If you also wanted to include a situation where it was very far below the earth, 50 or 100 or 500 feet below, then it is clear that the situation would be very much changed here. I don't like to go into detail, but I would say this. It would simply produce not an air blast but an earth blast, a ground shake. There is no doubt but that it would have great military importance. I would rather not discuss it.

Senator MILLIKIN. How would you protect rescue workers and other relief forces that necessarily would have to operate in an area where the bomb had exploded in the ground?

Dr. MORRISON. I would keep them out.

Senator MILLIKIN. Well, there are essential functions, in any large city especially, that have to keep going—rescue functions and utilities and things of that kind—that, unless there was complete destruction, unless there was a determination that this area be forever abandoned, you have got to keep going.

I am curious as to how you would protect people that would have to work in the area as best they could.

Dr. MORRISON. I hope we don't have to face these problems. I would say simply that I imagine they should run in and out quickly, there would be a fringe where they could do that. There would be another fringe where they might send volunteers to do dangerous things, using tanks, and there would be a central region which they could just abandon.

Senator MILLIKIN. Suppose they had to go in, what sort of protective material would you clothe those people with?

Dr. MORRISON. Oh, you would need 50 tons of lead.

Senator MILLIKIN. Lead. I don't want you to think I am fanatic on the subject of lead.

Senator HART. Where is lead mined?

[Laughter.]

Senator MILLIKIN. Coming from the West, we are interested in those things. I want to know about what might be used in a defensive way. I quite agree with you that in most instances, for these stationary objects, for instance, it would be cheaper to get insulation from other materials. Then, you could close in the work with thicknesses of concrete or other materials, but if you have moving objects, people or appliances, perhaps, I take it that you will agree with me that lead and possibly other metals would make a good insulating material.

Dr. MORRISON. I do not want to give you the impression—it is quite wrong, but it is very easy to do it—that it depends on the material. There is really no specific material. It depends on the weight of the material you use.

If you could dress a man in a suit weighing 50 tons of lead or any other material, I don't care what the material might be, you could do that.

Senator MILLIKIN. You can't practically do that. You stated that you could surround it or him with a wall of concrete.

Dr. MORRISON. Yes; or lead.

Senator MILLIKIN. And, of course, there are many places where you could not surround even a stationary object that way. You could not put a wall of concrete around it, due to its placement. From what I have read it seems to me that you do have protection already for the articles of clothing, like shoes and personal equipment of people who have to approach these radiation places, that they may be clothed with protective material.

Dr. MORRISON. No; that is really a misapprehension, Senator, if I may say so. It is not possible to gain any worth-while protection by the amount of material that a man can carry on his own body. It is not possible; you just can't do it.

Senator HICKENLOOPER. That would depend on the degree of contamination.

Dr. MORRISON. But the point is that a man cannot carry enough protection, he cannot increase his weight that much. Also, the time element enters into it; how soon it is after the explosion.

Senator HICKENLOOPER. It depends on whether you want to go into that area in 20 minutes or 2 days.

Dr. MORRISON. It depends on whether you want to go into it in 20 minutes or in 20 minutes and 10 seconds; and most people would rather wait 10 seconds rather than carry the tons of lead they would need for protection.

Senator MILLIKIN. It comes from the degree of harmful radiation that remains, does it not. It loses its strength as time passes, does it not?

Dr. MORRISON. Yes; it does.

Senator MILLIKIN. Therefore, you have a decrease there in terms of time of radiation and, perhaps, some sort of protective material which

might be utterly useless at the moment might be useful a week or two or 10 days from the explosion.

Dr. MORRISON. That is true; but it is not true that anything that a man can carry around will give protection worthy of being called protection.

Senator MILLIKIN. That depends entirely upon the problem of when you have to go into the area. Sometimes you, of necessity, have to go into an area. You are postulating that it would be better to stay out. I suggest it might not be better to stay out. I suggest that it might be essential to get in there. Neither you nor I can sit here now and imagine the particular circumstance that will call for the decision, but I do suggest that there might be a circumstance which will call for a decision.

Dr. MORRISON. This is quite true. I am simply saying that if he must get in there, he will not get the protection with, say, 100 pounds of lead; he can with 10 tons. The additional amount, say about 100 pounds, that he can carry will not protect him sufficiently.

Senator MILLIKIN. That, again, follows that you can theoretically coat a tank with lead.

Dr. MORRISON. Exactly.

Senator MILLIKIN. And so there are circumstances, and one of them was demonstrated by coating the tank with lead. I am not mentioning lead, except that I have heard it mentioned in the press; but it could be coated with some sort of a protective material?

Dr. MORRISON. Yes, but the protective material which is worn on the body of a man is not adequate against radiation.

The only reason that existed for coating the shoes of these men who walked in later and for their wearing special clothing was this: It was simply clothing in the nature of overalls, so that they would not carry away on their person any of the contaminating material. It was not to give protection.

You can get protection from walls. You must use walls, and these walls will be much heavier than anything a man can carry. He could not carry enough to get a worth-while increase in protection.

Senator MILLIKIN. Then, you have a double problem. You have the problem of protecting the man himself against radiation, and you also have the problem of keeping him from carrying out the radiation; is that right?

Dr. MORRISON. That is right.

Senator MILLIKIN. And in the latter instance, there is a definite need for some sort of protective material to cover that man.

Dr. MORRISON. That simply calls for clothing that he can wear and then throw away.

Senator MILLIKIN. Yes.

Dr. MORRISON. That is all the protection you provide there.

The CHAIRMAN. Doctor, the bomb was dropped over Hiroshima at something of a height. That height, I presume, was chosen to get the greatest blast effect that could be gotten. You have testified that many, many people there were killed by the gamma rays. Would that result in a large deposit on the ground?

Dr. MORRISON. It did not.

The CHAIRMAN. It did not?

Dr. MORRISON. It did not. There was no physiological injury to any person in Hiroshima from material deposited on the ground. We did not find any indication of that.

The CHAIRMAN. In other words, the gamma rays went through the body and then were exhausted before they touched the ground; is that the idea?

Dr. MORRISON. Well, the idea is this: the gamma radiation is a ray. Once it is emitted, it is absorbed; that is the end of it. It is energy which turns into heat or chemical energy, or something of that sort.

Therefore, it will not last. It is emitted, and that is the end; it is absorbed.

The things that last are the atoms of new elements which have the property of destroying themselves, giving out radiations, rays, in the process.

Now, this is not true when the bomb is exploded on ground. But these bombs were exploded in the air and the radiation disappeared, the gamma radiation moved through the area and was absorbed.

Senator HICKENLOOPER. I have another question.

Doctor, I would like to have your opinion on this question: Do you think it reasonably possible—we know that it would be theoretically possible—do you think that it is reasonably possible that science will abandon the field of investigation into nuclear research?

Do you think that there can be any law or any other force in the world that can prevent the investigations of science to the fullest possible extent in this new field?

Dr. MORRISON. I do not think that it is in the tradition of science that this has ever been done. Therefore, to secure such a result is evidently a problem of extreme difficulty.

Senator HICKENLOOPER. Science has never abandoned a field of investigation once it has been opened up?

Dr. MORRISON. I think in recent years it is quite right; in the last few hundred years, it has never been done.

Senator MILLIKIN. I mean in a field as successful as has been indicated here.

Dr. MORRISON. I don't know about the future. I hope it will not. I hope in the future they will bring forth new things, in peace as they have done in war.

Senator MILLIKIN. Won't science and education keep searching for more and more light on this subject, and more and more knowledge?

Dr. MORRISON. I believe that will be the case.

Senator MILLIKIN. Isn't that almost inevitable; I mean, isn't that the human inevitability?

Dr. MORRISON. I think on this question you probably have more experience than I.

Senator MILLIKIN. No, I am not a scientist.

Dr. MORRISON. No, but you are a man who knows how people act and organize themselves into states.

Senator MILLIKIN. It seems apparent to me that once there is an area where scientists have discovered something profitable and opened up a further field of investigation, that they will pursue that, the investigation, into natural laws. It never has been abandoned; that is, no major field of investigation of that kind has ever been abandoned because of the ultimate purpose or the ultimate results.

Dr. MORRISON. I believe that is true. I am not saying that you cannot destroy investigation, that it cannot be abandoned, if you insist upon it. I am saying simply that it has never been done.

Senator JOHNSON. Mr. Chairman.

The CHAIRMAN. Senator Johnson.

Senator JOHNSON. I should like to say to the witness, to Mr. Morrison, that he is the most eloquent witness that I have ever heard since I have been around Congress. I am sure that his power of description must be the envy of all reporters here present. I know it is the envy of all the Senators here.

I deem this paper that he has submitted to us a classic in direct statement, and I shall preserve it and I shall use it.

He has made an almost unanswerable argument against TNT, for one thing, and I think he has made some arguments that no military man can escape—much as our military high command are trying to escape, I don't see how they are going to escape the argument he is making.

In listing the choices of death, he tells us that the victims of the bomb had a good many choices. They might be killed by falling brick, or they might be burned to death by the direct blast, or they might be burned to death by secondary fires, and if they escaped all of them, the death ray would probably get them.

I want to ask him about the absence of oxygen caused by this tremendous blast and the wind that he has described, the vacuums, and all. Was it possible for persons to have suffocated for lack of oxygen, and were secondary fires handicapped by a lack of oxygen in the immediate region?

Dr. MORRISON. I do not believe so.

Senator JOHNSON. There is plenty of oxygen left after the wind has sucked them out?

Dr. MORRISON. You see, after the blast has passed you for 10 seconds, then everything is back to normal again. Presumably, if you are still in one piece under all these other conditions, you can presumably do without oxygen for 10 seconds. You cannot do without your head for 10 seconds; that is the trouble.

Senator JOHNSON. You cannot do without that at all, but the interval of the absence of oxygen would be very small?

Dr. MORRISON. Very small.

Senator JOHNSON. Ten seconds?

Dr. MORRISON. Much less, but I said 10 seconds is evidently not serious. I said that because I am sure of that figure. I know it is much less by a factor of a hundred or more.

Senator JOHNSON. So suffocation was not one of the choices?

Dr. MORRISON. Except by having things fall on you and bury you, which was not a very common cause.

The CHAIRMAN. Doctor, have you read General Arnold's report?

Dr. MORRISON. I have.

The CHAIRMAN. Did you by any chance read General Spaatz' story?

Dr. MORRISON. I read that in the train coming to Washington, sir, and was greatly impressed by it.

The CHAIRMAN. Do you think that that portrays what a future war would be?

Dr. MORRISON. I hope that it does not portray what the future circumstances of the world will be. I believe it portrays correctly, perhaps with a natural conservatism on the part of a general, what a future war would be if engaged in by the powers.

Senator JOHNSON. I have one more question, Mr. Chairman.

The CHAIRMAN. Senator Johnson.

Senator JOHNSON. I was intrigued by this statement: "I do not think you will soon see atomic automobiles, though you may see atomic rockets and atomic power plants."

Now, the atomic rocket is the thing I wanted to ask you about. My understanding is that up to the present time this atomic energy that we have is either a tremendous explosion, or else it exists in a minute sort of way. In other words, we either have a terrific explosion, or the atoms split very casually, one at a time, and nothing happens.

Is there any way of controlling that explosion so that you can use it for a continuous flight of a rocket?

Dr. MORRISON. I should like to answer that question, but not in the most direct way you asked it.

I would not like to say you could control the explosion, because that is contradictory. Before we could make a bomb, we had to learn to produce a controlled nuclear reaction. It was not a controlled explosion. I don't know what a controlled explosion means, but it was the release of energy at a uniform rate under conditions where it could be turned on and off. In fact, the great plant at Hanford is exactly this sort of thing.

Senator JOHNSON. But you cannot use the great pile at Hanford in a rocket bomb.

Dr. MORRISON. That is quite right, but you can make smaller piles.

Senator JOHNSON. Small enough to drive a rocket and still small enough to be carried by a rocket?

Dr. MORRISON. I believe so, but I don't think I can go into any more detail.

Senator JOHNSON. It looks to me as if it is the same question of lead pants you were discussing with Senator Milliken a while ago; that your pile would be so heavy that the rocket couldn't travel, that the energy it produced would be less than its weight.

Dr. MORRISON. But who is riding on the rockets, Senator? If there are no people nearby, no crew, you do not need a very heavy shield.

The CHAIRMAN. Senator, isn't that perhaps getting into classified information?

Senator JOHNSON. I think that is as fantastic as Buck Rogers, and I just wanted to challenge the witness on his statement here that we may see atomic rockets. I think that is a statement that ought to be challenged, and I challenge it.

Dr. MORRISON. I certainly will not engage in the manufacture of atomic rockets, because I see no use for them except in war; but I think it is a natural development of the thing we have been working on, and that such a thing could be produced.

Senator MILLIKIN. Mr. Chairman, I would like to ask the witness what he has done in the laboratory to prepare atmosphere so that it may become highly inflammable.

The CHAIRMAN. Isn't that classified?

It looks as though the chairman is getting security conscious.

Dr. MORRISON. These matters were discussed by Dr. Bethe yesterday, I believe.

The CHAIRMAN. Doctor, you have thought a great deal about the future of our defense, I presume?

Dr. MORRISON. Yes.

The CHAIRMAN. What relation has a 10,000,000-man army, every one of them able to shoot the eye out of a squirrel at a thousand yards, every one of them able to salute and come to attention and say, "Yes, sir" and "No, sir"—what relation has that in your mind to the ability or the power compressed in these bombs as a matter of defense?

Dr. MORRISON. Do you really want me to answer that question?

The CHAIRMAN. Yes; I don't know why it shouldn't be answered. It is something that I have thought about a good deal.

Dr. MORRISON. Well, I can say these things.

The CHAIRMAN. Unless you think it is classified information.

Dr. MORRISON. No; I think it is controversial discussion on a subject on which I have no special competence.

The CHAIRMAN. I ask it of you on the theory that has be so often quoted by Clemenceau, who said that war was too important to leave to the generals, with which I am in thorough accord.

Now, on that basis, as one amateur talking to another, tell me what the relation is as you have thought about it.

Dr. MORRISON. I am still working for the War Department. [Laughter.]

The CHAIRMAN. Let the responsibility be mine.

Dr. MORRISON. Let me say that if you have, as you will have in a future war, 1,000 or 5,000 long-range rockets striking our industrial areas, each one loaded with enough atomic explosive to destroy any city district, that is, the central part of Washington, lower Manhattan, or any small city of three or four hundred thousand, you will have an enormous installation which will perhaps intercept half of these, or seven-tenths of them, or something of that sort; but you will lose, as I think has been said before, something like one-third of your population in the first day of the war.

I do not know; I do not like to think about prosecuting a war under these circumstances, and that is why I want to stop there.

How the war would progress after that is a question I hope we will never have to answer. It is clear to me that against such an attack a conventional army is of no value; whether it is of no value in the further prosecution of the war is something I do not know about.

The CHAIRMAN. I assume we have a navy in order to defend the country. I was questioning myself last night and asked, "What good is a navy if you haven't got a country to defend?"

Dr. MORRISON. You are going to always have a navy to defend, Senator. [Laughter.]

The CHAIRMAN. I think I will let that one lie right where it is.

Has anyone else any questions?

Senator HICKENLOOPER. Not unless you want to explore that field a little more. It is a rather interesting field.

The CHAIRMAN. It is; I will let you go forward with it. That last one stopped me, Senator, and in fact I think the whole argument was made in the one sentence.

Senator HICKENLOOPER. I am sorry, Mr. Chairman, but I was engrossed in a maze of figures here so I missed the doctor's argument on this number of men, and so on.

I realize that you are a physicist and not a professional soldier——

Dr. MORRISON. Thank God.

Senator HICKENLOOPER. But let us assume that the United States, or any country, elected to use the atomic bomb, having a sufficient stock of them for either offense or defense.

Roughly, if you have any opinion, about how many people do you think we would need efficiently trained to use that weapon successfully, either in offense or defense?

Dr. MORRISON. I am not quite sure how you successfully use it in defense.

Senator HICKENLOOPER. I realize that the fellow who hits first has a tremendous advantage in this thing.

Let us suppose that we are going to use the bomb and want to use it efficiently, that is, to kill the most people and do the most damage to our enemy.

Dr. MORRISON: Well, let me try to make a guess. I have not thought about this question, and it is useful to think about only to show how expensive the whole proposition will be, I hope.

These bombs will cost, as Dr. Oppenheimer said a couple of times—and I may quote him without any violation of security—in the order of $1,000,000 apiece.

I think to launch them in some fancy and complicated missile, like a super V–2, would probably not be practical unless the V–2 itself cost only 10 times as much as the bomb, as in the case of the airplane in relation to its bomb load.

Let us say it cost $10,000,000 to launch an atomic missle. Now, if you have to do this in the number of thousands, and were spending around 10 or 20 billion dollars, you probably have an equal sum for all the administrative and communication problems, so that you will spend in the order of $50,000,000,000. You can transfer that into the number of people who have to be employed in the enterprise as well as I.

Senator HICKENLOOPER. Could you give an opinion on this? Could we successfully conduct an atomic war, just using some very rough figures now, with, say, a well-trained military land force—let's leave the Navy out of it—of a million men as easily as we could with a trained force of 10 million men on land?

Dr. MORRISON. I really do not know. I would prefer not to discuss those questions.

Senator HICKENLOOPER. Well, my point is as to whether or not 10,000,000 foot soldiers would contribute anything more to the launching of an atomic attack than 1,000,000 foot soldiers, for instance, or whether the 9,000,000 would be surplus?

Dr. MORRISON. I think not one foot soldier will contribute to the launching of an attack, but there are other things to do. I do not want to discuss what other things may be done.

I think that you can see what our point of view is, namely, that to launch an atomic attack you need people to press buttons and make instruments. What else you need is not my province to discuss.

Senator HICKENLOOPER. In other words, I was trying to develop the point whether you believe marching armies would contribute very

much to the effectiveness of the atomic bomb from our standpoint, or whether it is purely or almost exclusively a scientific and engineering problem confining itself to the construction of the materials and the launching of the ships—with the trained personnel, of course.

Dr. MORRISON. I think that the impact of war will be so great in the first day that I do not know what will happen thereafter.

Senator RUSSELL. Mr. Chairman, I regret I was a bit late. I wonder if the doctor has discussed the range of these rockets and these missiles, and whether he thinks there is any limitation on the distances that they can traverse with accuracy.

Dr. MORRISON. I know nothing about rockets or missiles from my own experience. If the Germans were able to make a rocket under their conditions that will travel 300 miles and hit within a couple of miles, if they were able to do that under circumstances in which they could not develop weapons like we were able to develop, such as the atomic bomb, I do not doubt that 10 times this range and equal accuracy is attainable.

I do not know of my own experience, but it seems to me common sense that progress in this range will be made. There is certainly no new physical fact involved, but detailed engineering study.

General Spaatz and General Arnold have spoken about these things and must have received information that these things are practical. I myself see nothing against them.

The CHAIRMAN. Are there any further questions?

Thank you very much, Dr. Morrison.

Senator MILLIKIN. I would like to add my appreciation to that of Senator Johnson of the very graphic and informative descriptions you gave us of the conditions at Hiroshima.

The CHAIRMAN. Dr. Goudsmit.

STATEMENT OF DR. S. A. GOUDSMIT, PROFESSOR OF PHYSICS, UNIVERSITY OF MICHIGAN

The CHAIRMAN. Dr. Goudsmit, have you a prepared statement?

Dr. GOUDSMIT. I have no prepared statement with me, but I may have one later.

I wish to point out first of all that my connection with the atomic bomb is quite different from that of the previous witnesses. I have not worked on the project at all, except in intelligence functions.

I was connected with the War Department mission which was sent overseas in order to find out what the German progress was along the project of the atomic bomb, and that was what we have done, and that is the information which I can give you.

Also, because of that function, I may have a few suggestions which might be useful, even though they are one-sided suggestions, as to control and supervision.

In spite of certain preliminary newspaper reports, we can say that the Germans did not have anything at all. They were way behind. They just did not have the vision which the Allied scientists had, I believe.

I have put down a few points about the German progress.

The German scientists had abandoned the hope of making a bomb during this war, entirely. They used the idea of the bomb to sell it to the Government and to the military officials.