

THE ATOMIC BOMB
10 January 1946

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GENERAL ARMSTRONG:

Gentlemen, the importance we attach in the Industrial College to looking ahead is indicated by the two speakers who will address you this morning on D plus three. We want to inculcate in the thinking of this class from the beginning that while this class here is to analyze and interpret the teachings of the late war, we want to do it in the light of the extremely radically changed conditions of warfare in the Atomic Age. That is the reason why we have asked General Groves and Commodore Parsons, who played such an important role in the development of the atomic bomb, to address the class this morning and to tell us something about the implications of the Atomic Age in the thinking and in the planning for which this organization is responsible.

I have told the General and the Commodore we have here in the 90 officers of the class a cross-section of the Services. If they had listened, as I have, to the brief biographical sketches each one of you is giving they would realize we have here a group representing almost every single activity in the Army and the Navy, particularly on the industrial mobilization side.

The Atomic Age is something that is almost beyond the mental grasp of any of us. We do not know yet what it means. We are certain it means much for the industrial mobilization thinking we must do.

General Groves is a graduate of the United States Military Academy, in the Class of 1918, graduating at the top of his class. He was commissioned in the Corps of Engineers. Before that, however, General Groves went at an early age to the University of Washington. He followed that with two years at Massachusetts Tech. Then he has also gone to the War College, the Engineers' School, and the school at Leavenworth. He, therefore, comes to this work with not only a broad background in military education and civilian education, but he has also had the assignment that makes him the most sought-after speaker in uniform in the United States because, as the head of the Manhattan project, General Groves was responsible, as the leader of that vast enterprise, for the swifter ending of the war.

Gentlemen, it is a pleasure to present to you Major General Leslie Richard Groves.

GENERAL GROVES:

General Armstrong and gentlemen: I am not particularly interested in discussing or paying much attention to what this job was comprised of. I think you have read about it or heard about it. Certainly there has been enough discussion.

There are a few things I should like to say on that and then I should like to talk about the effect of atomic energy on the Army of the future--

that means the Navy, too, apparently--and on warfare as a whole; what that means to us and what it means in more ways than one. One way is the atomic energy itself. Another way is the tremendous effect on warfare of scientific and industrial developments; the kind of officers we must have to do that development, in the management sense; and also what must be done for those officers if we are going to have them. That, to me, is the most important thing today.

I was not dropped into this project with no experience in the management of large affairs. I did not have the usual career of an Engineer officer. I spent most of my time on the military side. I had two short tours of river and harbor duty, totalling four years. The rest of the time was military service, including all the education that there was about, except the Industrial College. I am aware of your problems for I was in charge of procurement planning for four years, along with the development of equipment, for the Chief of Engineers.

From 1940 to 1942 I was in active charge of actual operations in the field in constructing army facilities in this country.

You do not learn management of large affairs without actually doing it.

The Manhattan project was done through the cooperation of the United States of America and everybody in it that was affected. That cooperation came from all sources. It came, not so willingly perhaps, from people who were affected. But still, because of the military discipline, there was no question in the Army or the Navy but what, when we needed something, we always got it. We got it willingly, too. If we did not get it willingly the first time, the people who were giving it found out it was much better to be willing about it. They soon found out the project had the whole-hearted support of General Marshall and Admiral King. It did not take long for that to permeate throughout the War and Navy Departments.

There has been a great deal in the press that would lead the person who knows little about it to believe the job was done by a handful of geniuses, who could solve differential equations in their heads, and who engaged in parlor games involving the most abstruse mathematical philosophies. That was not true; it was not true from start to finish. It was a team job which took 120,000 peak employment. You do not have 120,000 people if you just need one brain child. We needed the brain children. We needed the management. We needed the skill of American workers--and I underline the word "skill"--and the ingenuity of American management.

We also needed the driving-force and the over-all management that was supplied by my organization. When I asked for officers, I was never satisfied with any officer unless his record showed he was a superior officer. A great many of them I knew by actual performance on construction. The ones I did not know, if they were to be used on other than routine administration, I normally saw before they came in. In two or three minutes I had to size up whether that man would work. I can tell all of you from my personal experience, in these last six years, it is very seldom, when you are picking men for extremely responsible positions--or even minor positions--that your first intuition is not correct. If you like the looks

of the man at the end of a minute or two-minutes' conversation, he is usually a good man. If you are not so sure about him, he is a good man to stay away from--if you have any choice. If you do not like his looks there is no use wasting your time on him.

I can honestly tell you, if any of you are seeking positions of importance, it has been my experience the man who is seeking the position usually throws his chances away by talking too much. He is talking about how eager he is for a certain type of work, or how he does this or does that. If he could keep his mouth shut, he would do better.

The job was a tremendous one. It required the utmost in physical capacity, not only of the workers but also of the top management. It meant continuous duty. It meant going practically for the whole period with what the doctors would say was an inadequate amount of sleep, rest, and everything else. It took the utmost physical capacity to stand it. A great many of our officers were unable to stand it physically and had to be given leaves and rest. At times this was most distressing. Fortunately, the men on whom the biggest burden rested did not have to take that rest. I hope they have all come through it without any permanent injury. I do not know. Some of us feel very, very tired--tired physically; as well as tired of some of the things we are having thrown at us.

After the thing was finally over, a great many of the people had the reaction one would normally expect them to have. Some got it as they were relieved from active duty. They went to pack to go home and collapsed while packing which, apparently, is the way with people who have been under terrific strain.

Any plan for the mobilization of industry for war must have a thorough knowledge as its basis. It must plan to utilize the administrative and also the technical ability of American industry--the management. There is not a big company in this country I know of--and I know a great many--that, if you selected, say, six men out of that company, the rate of earnings and the efficiency of operations would not take a sudden nose dive. To those of you who know some big industries, take the one you know best and think it over. I think perhaps then you will appreciate the truth of that statement. It is indeed startling.

I think the same thing applies in everything, including the Army. It even applies in labor unions. For example, if one could take the top six men in almost any labor union complete confusion would be seen. That confusion would not get over until new men had been sorted out and gotten into those positions. I do not say there are not men who are perfectly competent down below, but nobody knows who they are. They have to be sought out. They have to prove they know what is what. I think the Army and the Navy must also know those men; must know who the men are in every company if they are going to do their job.

In connection with procurement planning as it was done in the early thirties, we looked into the capacity of a company, but I cannot recall at any time anyone ever discussing who were the key people in that company; who were the men they could actually depend on to get what might seem to be the extremely difficult or impossible item out on time.

I think it is very important for future war planning to know in every company the key man; also to have files on the company as to what it can do on time, and to have a list of the names of people we could count on. Sometimes it is the president of the company. Sometimes it is the chairman of the board, who may be an old gentleman of seventy or seventy-five, who is the real driving spark in that company. He may not do so much but he is the man who picks up the phone and calls somebody up and starts things going.

It has been a very remarkable experience to find in one of the biggest companies in the country that the president of that company was the man who practically fixed up the things that were causing us so much trouble. When I called him on the phone he did not answer back and say, "I'll find out about it" and then call me and say, "Why Mr. So-and-So tells me such-and-such". His usual answer was: "Well, I was out there the day before yesterday and was in the shop and talked to the foreman. This is the situation. I have called Mr. So-and-So, who is the vice-president in charge, and I have raked him over the coals and told him I wanted a report tomorrow; that I had to report to you. You don't have to worry about that any more."

In other companies we went down the line. We went to whatever man was the key man in that company from the standpoint of getting it done. I think that is one lesson I have learned that is applicable to your future planning, namely, to know who the men are and also to know them in time. We must also know the men who are in charge of procurement planning; if they are going to be there when war breaks. Of, if not, we must have built up in those key men the impression that the Army and the Navy know what they want; that the officers are competent people and are not just good golfing companions; or anything of that kind. They are not interested in social friendships. They are interested primarily in what I would term "official friendships": men they respect; men they can always count on; and men in whom they have confidence.

The biggest compliment that was ever paid to me in that connection was by one of the largest concerns in this country, a concern which has a legal department that spends months going over a single contract, trying to find out which comma to change so that it will keep the Comptroller General or someone else from making an adverse interpretation; they paid me this compliment when I said a certain paragraph should not go into a contract and that while it gave the Government the right to do certain things, I did not expect to do those things as long as they operated as they had in the past. In response to a query, "Couldn't we put that in the contract?" I said, "No, that could not be put in the contract." Now while they had no assurance (except to know how long I would be there) they said, "We would rather have your statement on what your policy is going to be than to have anything written in the contract." That is what people who are involved in procurement planning and procurement in time of war have to get across so that the people they are dealing with will have confidence in what they have to say. The ones who do it must know what the problems of the manufacturer and supplier are. At the same time they must not ask for the absurdly impossible. They cannot proceed to tell the manufacturer how to do it. They can say, "Why don't you do

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it this way?", if they have an idea that is constructive. They can show some knowledge. They can make suggestions. They can also say they saw something done somewhere else and they wondered if it would not work in this plant or under these conditions. They will find that is very gratefully received. They will build up the respect I told you we must have if we are going to get the cooperation of industry.

Now as to the atomic bomb and its effect on the future. I am not discussing the past, except to tell you it was a team job. It took a tremendous amount of American capacity to do it. It was not the achievement of one or two men.

The atomic bomb has been set off three times: once in New Mexico and twice over Japan. Commodore Parsons can tell you about one of those going off over Japan, from a personal point of view. I could tell you about the one that went off in New Mexico, but I do not think it is necessary. The thing for all of us to remember is that it is a devastating weapon of surprise; that no military organization has ever had anything comparable to it. They can use it to carry warfare to the heart of a nation.

It is most effective as a surprise weapon. Three well-placed bombs can easily knock out any large city. I am speaking, of course, of an industrial city. A city like that means a city of about one million population. Two bombs would knock out the capacity of Washington, with the exception of the Pentagon, and that would in all probability take an extra one. The reason for that is distance. If you could move the Pentagon over to the other side of the river, over near New War or anywhere in the Federal Triangle, and if you could move the Navy Yard or the Navy Gun Factory up into the same location, then one bomb would do it and would do it without any difficulty at all. One bomb would destroy the City of Washington from the Capitol to the Cathedral.

That is what the thing will mean. There is no necessity to completely raze a city. If you take out the key industry in that city-- usually the key one or the key two who are actually doing the damage-- that destroys that city's capacity. If we think of a surprise attack with a hundred bombers starting out, carrying these bombs, perhaps fifty of them will get there. It all depends on how much you think the capacity of the airplane and the Air Forces is. I think it all depends on the distance and the flying conditions. But certainly out of a hundred, fifty of them should be able to get through and fifty would destroy maybe 20 key cities. You can picture from your studies here, past or future, I imagine, what that will mean. It would mean putting the United States, for example, into the same condition the South was in during the Civil War when the North had the industrial capacity and the South did not. The only difference now is that we need a little industrial capacity to fight a war.

It is going to require years of study, experiment and development to determine the best kind of an Army and Navy to build around the atomic bomb and like weapons. There are a few things I would like to tell you about that, then answer any questions you may have in mind.

If the United States should engage in a major war in the next five years, the bomb would probably be somewhat similar to what we have. Developments are not made any faster than that. If it goes beyond that we may get out of the airplane class and into the rocket class. Maybe our Navy would consist of submarines and nothing above water. We will find out about that, I think, a little later in the year. Maybe the submarine will be a launching tube for a rocket. In any case there will be decided changes if anyone wants to spend the money for development. Compared to what we have been through the development cost will be very slight and the effort will be slight. Yet, here we have not been playing any penny-ante game, as you all well know.

We do not know what would happen in an atomic war, but we visualize it as one in which the decision will be reached before great forces, such as were employed in this war and in the World War I could be mobilized and put into the field. A large percentage of the available forces should be in components which can carry immediate offensive war to the enemy.

I visualize airborne troops landing and destroying the enemy's capacity to produce atomic weapons. Then I visualize the use of atomic weapons against the enemy's industrial capacity, so that the side with the atomic weapons has the overwhelming powerful hand. The real question is, How much punishment is the nation that does not have it willing to put up with? Once a real attack is made with atomic bombs and the capacity of another nation to make such bombs is destroyed, it is going to be very difficult for them to fight a war, unless they are willing just to fight on and on forever in what would be termed typical South American or Central American guerilla fighting. I do not think modern nations would be willing to do that.

Any defense against the bombs would be inadequate. The only defense we can foresee is to stop the carrying vehicle. Passive defense is possible. I think you will all be interested in that. Passive defense consists of dispersion, primarily; and putting things under ground. I speak of dispersion of not only the military and the population, but also the dispersion of industry. I mean dispersion in the sense in which it has not been discussed in this country. It really means a revolution in our production methods. It means dispersing complete production units. Instead of having a factory that builds all the wheels in the automotive industry and another one that makes all the fuel pumps, and another one that does this or that in a tremendous assembly line, it means the possibility of producing a hundred trucks a year in one plant from start to finish. If the atomic war is of long duration, it will be the wearing out process that proves to be vital. The war, in my guess, is going to be fought largely with the initial stock pile of military equipment, augmented by very minor production of the essential items. I think that is something that is of extreme importance.

We cannot count on industrial mobilization as we thought of it before, where we are going to be able to go in and build these large airplane plants and all the sub-suppliers, bring them in and assemble them. I do not know how many of you ever saw those assembly plants we built for airplane manufacture. They were the only buildings I have

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ever had anything to do with that reminded me of the Pentagon in any way. They also were enormous buildings, only they went down the road for about a mile and a half--somewhere between a mile and a half and a mile long--and they were about 500 feet wide, I think. We could have taken a division in there and marched it up and down to our heart's content. I think several divisions could have put in there.

I do not think such things are advisable in the future if the enemy feels the destruction of them is worth an atomic bomb. That is what we are faced with. What will they think is a worthwhile target? There is, after all, no use in the world trying to use it for a minor affair.

It also means we cannot count on having a port such as Cherbourg, Portsmouth or Antwerp that we can continue to operate. If we picture the European war again, it means we could not count on keeping New York harbor as an operating port. If the enemy had one bomb it might destroy that port, the destruction of it would be the thing that would be vital. It means we cannot count on any one major installation. It means no single thing we have can be fully protected and sure against enemy attack and immediate destruction.

There has been a great deal of discussion--it is political--about how this thing should be handled in the future. I should like to tell you about that because while the Army and the Navy are supposed to be out of politics--and are as soon as they get a directive from the President, or something like that--the thing we ought to know is why the War Department, with the concurrence of the Navy Department, asked that the atomic energy problem be placed in the hands of a commission instead of saying, "Well, let's keep that in the War Department". The main reason for that was the question of whether, if that were done, it would not just outweigh everything else in the War Department. That was felt to be the case. I know that the Secretary of War and the Chief of Staff would have to spend their entire time discussing minor matters connected with atomic energy. I know also nothing would bring down adverse criticism on the heads of the War and Navy Departments faster than this would. The reason is nobody knows the answer. We cannot go out and discuss it on the blackboard. It costs a tremendous amount of money. Every decision made is a touch-and-go decision and in time of peace the people who object to those decisions, and perhaps have other ideas, can make themselves heard to the point where we cannot possibly function.

We asked, therefore, that it be placed in the hands of a disinterested commission; one not responsive by its makeup to political pressure and one that would be given the authority and the responsibility by the Congress for making the decisions. That has been objected to by a great many organizations on the ground it was dictatorship, and that so much power should not be placed in the hands of nine men. That objection has been raised despite the fact that we have kept insisting, since the thing came out into the open, that a great many vital decisions that would control this whole subject for years to come--maybe for all time--now had to be made and could not be delayed, and that we wanted this commission of nine men to be making those decisions.

Now all the opponents insist that they should not be given all the power to make those decisions. No one seems to know to whom they want the power given. The effect, though, is to make the responsibility for the decisions rest largely in my own hands. So, instead of having nine men they have one.

That does not mean that major policies are not determined higher up. Major policies can determine some things, but this job is too complex and too technical for the major policies to be decided without the technical advice that is really all-controlling.

How about a process? Should this process be abandoned? Should the emphasis be put on another one? If we should abandon it, we can never start it up again without getting our people back together again--and we do not usually get people back together. How about a new type of bomb? Should we emphasize this or should we emphasize that? As I say, those are some of the decisions that will last for years to come.

That is the decision that is now being made largely on what I feel should be the case. Instead of being made by the commission, which I had hoped to have in existence and actually functioning now, every decision that is of any importance, practically, is going to be made before any such commission can be set up and can really know what it is actually doing.

I should like to read something I prepared the other day. I should like to read it because I think it is of extreme importance for all of us to think about. It is what I should like to have you carry with you today if you carry away nothing else.

The Army and the Navy have not recognized the vital part played by the officers, enlisted men and civilians who have been engaged in this war in highly technical tasks. One of these highly technical tasks ended the war, without invasion, months before it had been expected. If we are to believe the recent article in the Saturday Evening Post, which claimed to speak with the authority of all General MacArthur's intelligence officers, it saved a million American casualties. I think the people who disagree--many of them very distinguished military leaders--and their grandchildren are going to read in the history books what ended the war and there is not going to be any argument about it. It is not whether Japan was ready to collapse, or whether Japan should have collapsed long before it did, but actually what did happen. As the Saturday Evening Post article stated, the military was ready to go on fighting and the Emperor changed his mind. He said the war should stop. According to this article, one would think it all depended on the whim of the Emperor. I, personally, think it did. I also think the Emperor's "whim" came about very suddenly.

If you read the calendar of events--the Potsdam declaration; the dropping of the first bomb after the Japs had absolutely refused to talk surrender on our own terms; how fast the Russians came in after the first bomb was dropped (how soon they would have come in otherwise, I do not know; I do not want to know until it comes out in the open and I think it will come out in the open some day); the effect of the second bomb and

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the general panic throughout all of Japan--I think there will be no doubts about it.

It is on that basis I say the technical people have something that should be urged on the Army. This is the way I feel and I put it in their behalf as one who is in a position to speak with a little more force than most of them can.

"If we are going to continue, as we surely must, scientific research and technological development and advancement of atomic bombs and other technical means of warfare, then we must have more scientifically trained men in the Military establishment. We should take our best men and send them to the best schools and institutions.

"These officers must possess such qualities of personality and leadership as to be outstanding in other respects as well as in technical work. If they are going to direct important work at a technical level they must direct and lead civilian scientists and industrialists; otherwise, our officers will be led by them and they are not equipped to lead us on matters so vital to military success.

"If we are going to have such officers on technical duty, the awards for them must be adequate. There should not be formed a corps of atomic bombers or scientists relegated to technical tasks for life, and considered a lower form of life. Instead, officers who are detailed on such technological war work should enjoy the same opportunities as those actually in command of troops, or theoretically on duty with troops." (I refer to persons such as Post Exchange officers, Post Adjutants, police officers, and the like.)

"The technical officers should not be barred from the command of fighting troops just because they can understand higher mathematics. They must have complete military experience. The Army cannot neglect the training, assignment and encouragement of officer personnel for technical work of all kinds. One of the urgent requirements with respect to atomic energy in national defense is the establishment of methods of securing the best officers, training them, and utilizing them, both during their technical work and afterwards, in responsible command positions on all of the problems of war."

To put it simply: I do not believe the ability to understand and to work with the most complicated scientific problems is a bar to the leadership of troops and to the leadership of the Army and the Navy. I, personally, think the past speaks for itself on the attitude of the Army and the Navy on that point. I think that attitude should be changed and changed rapidly.

Thank you very much.

GENERAL ARMSTRONG:

Thank you very much, General Groves.

Gentlemen, I have to point out that I was going to introduce to you "Commodore" Parsons; but the Navy recognized the importance of his contribution to atomic energy by nominating him to the grade of Rear Admiral and in spite of his insignia I shall introduce Admiral Parsons this morning with a great deal of pleasure in telling you that he was a graduate of the class of 1922 at Annapolis; he has had a distinguished career, and quite early in the game he was assistant to Vannevar Bush on the technical work that lead up to the atomic bomb. Gentlemen, the new Admiral, Admiral Parsons.

REAR ADMIRAL PARSONS:

I might say that things were already humming when I heard of the Manhattan District, which was in May 1943. I had just come back from five months of sea duty, introducing the radio proximity fuse to the Fleet and thought that I was going back to sea and suddenly found that my next port of call was General Groves' office, so I walked into a world that I did not know existed. I say things were humming. I was told by Dr. Conant that the date when they began to hum was the fall of 1942 when General Groves arrived on the scene and started action on the Manhattan District.

The place where I went was the mountains around Santa Fe, New Mexico, 7,500 feet altitude, about 40 miles from Santa Fe, where a community of scientists was assembling to do the final job on the output of the tremendous industrial plants that were being built there and also at Oakridge and Hanford.

Throughout 1943 we were trying to see what this thing might turn out to be in terms of an actual thing which might be delivered in war. We had to be realistic; if we generated something which would be carried only in a new and radically different type of airplane that was one way of insuring we would not get into the war. Also we had to make ourselves believe that every single step along the chain from theory to the target would be successful. If we had waited to prove each step was a success, we still would be half way there because we could not prove the steps in succession, we had to assume each step would succeed and make the whole design along those lines.

We came to realize throughout 1944 that the job of actually making the bomb was much more complicated and difficult than we had initially imagined in our discussions among excited physicists in 1943. The complication and difficulty were reflected in expansion after expansion of Los Alamos. I think before we would get one set of houses well under way we would have a teletype into General Groves saying we needed another expansion. We went from what I call the first spasm to the second spasm, to the third spasm of houses and building around the place.

In 1945 all of the hurdles that looked practically fatal early in the game had been somewhat successfully taken. Increased output was had from the plants at Hanford and Oakridge and it became apparent that, barring some major catastrophe, we would have a bomb. Then it was necessary to move overseas, or at least make all of our plans to move overseas, get a base, get our B-29's all set up and trained for that job,

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which was done, and I will say I got a tremendous respect for the regular military establishments when we had to work in complete secrecy and develop one to parallel those establishments, making maximum use, of course, of the existing facilities. But we could not use the normal administrative and logistic organizations of the War and Navy Departments without telling them what our plans were or what our object was and that was an extremely difficult thing to do.

We got out in the Marianas and were ready just about the time the test was held in New Mexico. That was another thing that we guaranteed to ourselves five or six months before in our plans that that test would be successful and that the first minute that material was available after that test the material would be flown to the Marianas and then from there flown to the Japs. It turned out to be just exactly three weeks from the July 16 test in New Mexico to the first delivery to Hiroshima. I flew back from the Marianas, was to witness the test in New Mexico, and then turned myself around as fast as I could with enlarged photographs of the New Mexico test to show to Admiral Nimitz and General LeMay, and then we showed the photograph in action to the Japanese.

The effect of the bomb, of course, was tremendous in many ways. It affected a lot of thinking. One of the best summaries of it is in Professor Rabi's article last fall in I think the October Atlantic Monthly. He said that the average educated person in this country can make sense out of radar. The reason is that radar is based on nineteenth century physics which has more or less just grown into the lore of education and people accept it but if we had had a radar development similar to the atomic bomb it would be as though Maxwell conceived as the electromagnetic theory, twelve years later Hertz verified it experimentally and within one year more, say about 1892, we would have been fighting with radar and it would have been regarded as black magic; what Rabi says amounts to that. It is perfectly obvious that he is right; that nuclear physics was not known to more than one percent of the average highly educated persons in the United States or elsewhere in the world and, consequently, when we went from complete lack of knowledge to this phenomenon which General Groves referred to as stopping the war, which is generally agreed, people were completely stunned.

I think that explains some of the emotional thinking which has taken place since that time. The most important thing is to get it out of that category of emotional thinking and black magic. There is no black magic to it at all. I heard Dr. Fermi speak at Los Alamos once and the burden of it was that the atom obeys its laws with more respect for those laws than the average molecule in chemistry displays for its laws. In other words, high temperatures and pressures affect chemical reactions tremendously. In TNT or something else, that we call instability, is a crankiness in chemistry, especially in explosives. There is no crankiness in atomic energy, especially in the nucleus; it is a much more law abiding person and very stable, in fact, some people say much more stable than the people that work with it.

The atomic bomb development was carried out in such great secrecy and the basic technical decisions were made by such a small group that I should say the complete background on development in this country is had by only four people, beginning with General Groves, Dr. Bush, Dr. Conant and Dr. Tolman.

To get national and international advice from other people who may have adjusted a cyclotron and thereby become atomic experts is very dangerous especially when that includes all other groups too who suddenly become experts. I think we will cash in on this Senate Atomic Energy Committee tremendously, not only right now but in the near future, by having a highly intelligent, very serious people who will really get the background. They may not get the full technical picture but an over-all one that will be very important to the people in the United States. The line of education goes as the general people think and the pressure to get the word in this new field is already being felt. I know the physics departments of universities are under great pressure to have undergraduate courses in nuclear physics. That had been something that was talked about only by the highest powered graduates, the favored few in a group of graduate students would get this information. I know it is reflected over in the Navy Department. We were under pressure to get a course started over there in nuclear physics and we have made the preliminary moves to start a course in February with Professor Gamow and Dr. Hafstad. I think we will have to turn people away from that course. It will meet twice a week over in the Navy Department, I think on Mondays and Wednesdays. That is just an indication of the over-all pressure there is to get the word in this field and I think it is very promising and we will collect dividends throughout the next five years.

So far as the future is concerned, I think these indications are very good and we will throughout the next five years begin to crystallize thought in this field and realize some of the complications of it so far as plans are concerned, but if we fight a war say in 1949 I feel that it would bear a very strong resemblance to the present war. There would be atomic bombs delivered, but the war would not look like Life Magazine articles, showing huge rockets diving down at a city with an atomic war head in a rocket. We might like to hire the artist in Life and tell him to build the thing he showed in his magazine but short of that I do not think we have designers who can bring the atomic age to that kind of development for a long time to come. I should say that maintaining the status quo so far as possible and grafting on it a plan to look into the future is what we need for the 1940's, and in the 1950's we really will have to make up our minds about the direction we are going in from that time on.

GENERAL ARMSTRONG:

Thank you, Admiral Parsons. And now, gentlemen, we shall have the opportunity to put some questions to both these speakers. I would like to put this question to General Groves. In your talk, General, you spoke about the new integrated type of production and you spoke of one factory manufacturing all component things for a truck and turning out completed trucks. Do you really think that such a system of manufacture could be adopted? Would it not be better to adopt a system something along the lines that Dr. Anderson spoke about at our seminar recently when he advanced the idea that we should have a certain number of regions which are self-supporting completely integrated rather than to try to do that in the walls of one factory?

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GENERAL GROVES:

That would be entirely satisfactory because it would achieve the same purpose. The real thing is not to concentrate too greatly on one key element and it does not make too great a difference what that is. If all the magneto or spark plug manufacture is knocked out in the United States that is all that is necessary; therefore, spread the factories out sufficiently to prevent complete destruction.

GENERAL ARMSTRONG:

Bottlenecks would be not only in production but also in such things as railroad and transportation bottlenecks which would be extremely vulnerable and dangerous targets.

GENERAL GROVES:

Transportation would not be vulnerable particularly. It could be seriously interfered with, but I do not believe anyone could use a bomb of this power against transportation except to get a particular bridge or bridges. There would be a tremendous advantage over the past war in that we would not have to hit the bridge to destroy it but could come within a reasonable distance; it would have to be a very key bridge.

GENERAL ARMSTRONG:

I was thinking of our transportation bottleneck from east to west at Pittsburgh and Buffalo.

GENERAL GROVES:

I do not think we could do much on that because railroad traffic itself is not damaged. The switch and everything that sticks up is damaged but it is something that could be repaired quickly. One of the surprises was that I had expected the switches to be fused and there was no damage at all to the rails or highways or anything of that character. I think the black top gets a nice glistening finish but that is the only thing done to it.

GENERAL ARMSTRONG:

What would be the effect of the air pressure on an underground factory?

GENERAL GROVES:

It would not bother them unless the bomb went off under the ground which in time it could be made to do. We could do it if we had to very quickly, and I say quickly thinking of the fact that we have done something that is so tremendously difficult that any other difficult problem seems simple.

GENERAL ARMSTRONG:

Would you want to say anything about the military organization that accomplished the mission in the field?

GENERAL GROVES:

I would like to say a little on that because it is not generally known and it illustrates what happens when there is a complicated weapon. Usually when a weapon is tried out we have a lot of test-firing in the United States. The weapon is then sent over to the theater and the theater commander takes it and uses it as he pleases. That was not the case with the atomic bomb and the reason is that when we drop one it is the equivalent of an invasion of major importance that requires a decision at the top and handling at the top. The plans for the use of the atomic bomb were prepared in Washington by me and they were approved by the Chief of Staff and the Secretary of War; and I think the President, of course, was informed on the basic things--just the proper step there--and that plan was prepared with the knowledge that was necessary to have in order to prepare it, and any weapon of that character has to be handled that way. We ran an operations office in my office in Washington during the actual operations in the field and that office knew what was going on. It was responsible for the prompt advice to the Chief of Staff as to what we felt should be done next or if anything should be done. In our plans I think that one item came up about two days after our first bomb had been dropped, and when I discussed the matter, which had not been provided for, with the Chief of Staff his remark was, "Well, that's one thing that we forgot to provide for in advance." To me it was typical of General Marshall and something that some of us who had been given great authority by General Marshall appreciated immensely. And like everything else on this project we led the way and told people what to do and operated through the established agencies right up to the hilt and they operated on the basis of doing whatever we asked them to do without knowing why and in many cases without seeing any sense to our requests at all. That is the cooperation we had at all times and, of course, that kind of cooperation stems from the top.

GENERAL ARMSTRONG:

Thank you General Groves. Gentlemen, questions may be asked first by the class and then the visitors may ask any questions that they care to.

QUESTION:

I would like to ask General Groves what the raw materials are that go into the bomb, their sources and the approximate amount available in assuming that the present bomb is produced.

GENERAL GROVES:

That is easily answered because that is a subject we do not discuss. There are a number of subjects that I cannot discuss because they are secret. And the subject in question is on the barred list. I do not mind telling, of course; that uranium goes into the bomb as everyone knows.

GENERAL ARMSTRONG:

I might say to you that I put that same question to General Groves many months ago and got the same answer. I told him the information was

important for the Department of Research for the Industrial College and we would like to start studying those materials involved as well as the other elements, power, labor, transportation, and what not, but General Groves said to me, "Don't worry, we have our Department of Research and we are making sufficient studies." We hope some day he will be communi-
cative.

QUESTION:

Strictly as a layman, I have read that you may get a succession of explosive waves by the use of this bomb. Would you care to answer that?

GENERAL GROVES:

So far as I am concerned that is all hooey. Scientists can figure out how that could be done and they can get a nice demonstration, but I am not a bit worried about it and if it does happen we will not have to worry. The first thing is it will not start. If it does start it will promptly die out and if it does not die out we do not have to worry; that is about the size of it. About six hours before the test in New Mexico was to go off I was greeted with the statement that so and so was willing to bet one to thirty that we would blow up the State of New Mexico and one to one hundred that we would blow up the whole world. That is typical of what anyone at the head of an organization gets in the way of advice and comforting council. I never realized when I used to read about those interesting councils of war, when all of the staffs advised General Grant and General Lee how they should not do a certain thing, it was all wrong, and that they faced complete disaster and everything else, that that was what every commander got in the way of advice and that the only way to do was to pass it off and go ahead and do just as he pleased anyway. We take advice and listen to it and sort it out, but we must have enough strength of character and enough courage and willingness to take chances and enough sureness of our own intuition and knowledge. We have to be in physical condition so we can stand up under it and then disregard all advice--go ahead and make the decision. And I cannot tell you how many times on this project the advice on the most highly technical matters had to be completely disregarded by an army officer who was not supposed to be a skilled nuclear physicist. I was not quite in this 99 percent class that Parsons talked about of the educated people. I think he said the highly educated who did not know nuclear physics existed and after all, people who have been in the Army exclusively certainly fall in the highly educated class. I know you will all join me in that.

QUESTION:

I have heard it rumored, sir, that if an atomic bomb with a time fuse were to be placed in a suitcase in a building in some town and left there would be a disastrous explosion. Would it be possible that a bomb of such kind could be carried around by an individual?

GENERAL GROVES:

That could be possible if Superman was there to carry it around. The real truth of the matter is not that it could be carried around as

one bomb but that, if one could carry the component parts concealed rather easily, using trucks and trunks and very strong men to lift them in and about, the bomb could be assembled if the necessary high skill, the equipment and various other things were available. I think it is reasonable to say that a bomb could be concealed in a city such as New York without our knowing anything about it if we continue our present laxness in observing what goes on in this country and what comes across its borders. I would not hesitate at all if I were given the component parts, say out of this country, to assemble those component parts in any city in the country that you wanted them assembled in provided that was the job and I had the necessary money and men with which to do the work. I do not think that anybody would know anything about it until such time as it was told. It would be no task at all, but the carrying of a bomb in a suitcase, as I say, would take a Superman. The thing is not feasible; you cannot do that. We are not telling what the size of the bomb is. All you know is that it was carried in a B-29. That we cannot keep quiet.

QUESTION:

General Groves, I wonder if you would be a little more specific in regard to the effect of the time element on planning for future industrial mobilization?

GENERAL GROVES:

Prior to the Second World War we went on the basis of the First World War. Now we should, normally, go on the basis of the Second World War. Well, say we do. When M-day comes we would all start to work. In this war M-day came considerably ahead of Pearl Harbor, so far as industrial mobilization was concerned. That is not sufficient for the future because of surprise effects. We must have in warehouses an adequate supply of the essential materials. We must have not only the materials themselves available, but also we must have certain facilities for manufacturing those materials that are prepared and be ready to go into operation on the drop of the hat, so there will be no reconversion problem, for example.

I think it also means the Army must be ready to use a lot of improvised equipment. Today they cannot expect possibly to supply their troops all with the same type of trucks throughout. I also think the Navy must be willing to use things that are not quite what they would like to have.

I, personally, do not think it will make any difference in the fighting efficiency of the Army whether our troops are all equipped with olive-drab socks or some other color. I think we must be prepared to do whatever is necessary. Yes, we might have to fight a war with civilian shoes. I do not think that would hurt us. But I think we should be prepared to do it.

One thing we must be prepared to do in the future is to have the ability to use what is available and not be so fussy about what is essential. There has always been that question to consider. We have found, for example, one organization could use something that was not

considered so good by another. I have seen the Navy getting a lot better of certain equipment than the Army, on the ground that the Navy could not fail in time of an emergency.

I think we must be prepared to use equipment that will fail and just take our chances. If you will remember, in the old Indian fighting days there was an escort wagon and that wagon carried usually a spare wheel, spare this and spare that. The idea was they could start a company of wagons out with the escort wagon from San Francisco and could march on to St. Louis and get there with that wagon.

That is not the case today. We order equipment that, when it fails, we can throw it to one side. The over-all advantage is that we have equipment instead of having nice equipment coming in the future.

That does not apply when we get to something that will not work unless we make it of the very highest quality. That was the case with us. We could not economize on anything connected with the whole thing when it came to what went into it. We did economize throughout on some things like, for instance, the housing, the roads and the construction. We built things that would last for the duration, of what we wanted. But when it came to the particular project, well, some of our buildings will last a hundred years. You all realize they had to be built that way to do the job, not to last a hundred years. I think that answers it.

QUESTION:

Is there any type of construction that will stand up against the blast from one of those bombs?

GENERAL GROVES:

That all depends on how far away it is. If a bomb is dropped on top of it, nothing would stand up. If one dropped on the Pentagon, there would be no Pentagon left. But if the bomb dropped over in Washington, say a mile away from the Pentagon, I think the Pentagon would still be here. All the window frames would be out, and I do not mean just the glass. I mean the frames along with it. All the interior partitions, the temporary types of partitions, would be out. Every door in the building would be blown out. Furniture and everything like that would be thrown around. But no atomic bomb a mile away would destroy these columns with the reenforcing they have in them. This building is much more rugged than the average building. But so were the Japanese reenforced concrete structures, those that were modern. They were earthquake-proof, or reasonably so. I do not know of any building (besides those new ones in California) other than the Pentagon that is as rugged against a blast effect as those Japanese buildings were.

QUESTION:

I wanted to ask Admiral Parsons a question that may be a little unfair. He made some speculations relative to nineteenth century radar. We saw steam come in. It changed the Navy and it also changed industry. After all, this is an industrial college. We saw electricity come in.

It changed the units we had with which to fight a war. Then radio came along. How soon would you estimate industry will be basically affected by atomic power? Just a horse-back guess.

ADMIRAL PARSONS:

Probably not before 1955. That is a horse-back guess.

GENERAL GROVES:

I think that is a Navy horse-back guess too. I will answer that one too. I feel hurt; it is the first question that was not directed to me. I think it will not be really affected until about 1980.

QUESTION:

It took steam a long time to get here, you know.

GENERAL GROVES:

I would say in 10 years, if we put our hearts to it and our purse to it, we could probably have an atomic energy power plant, with production over stationary power to compete with coal at around \$15 a ton. You know what that means. Of course, as the prices go up and the coal costs go up the production costs would go up in proportion.

QUESTION:

It would go along with the inflation of anything else.

GENERAL GROVES:

That is correct, if we have inflation.

GENERAL ARMSTRONG:

Will not the atomic energy become cheaper?

GENERAL GROVES:

Oh, yes. That is figured on the 10-year basis. That is the estimate. That is the lowest guess. These advisers I was telling you about concurred it would be 10 years. My own personal guess is between 15 and 20.

ADMIRAL PARSONS:

I said "not before".

QUESTION:

Since we have opened the subject of harnessing atomic energy, how soon will it be before we can think in terms of atomic bombs other than its present physical structure? I think there was some mention of little bombs hidden in suitcases.

GENERAL GROVES:

We have never said how big the bomb was. As I told you, I mentioned Superman. Maybe you are not familiar with the comic strips. That is why the children of this country were not surprised about the atomic bomb. They all went home--they were perfectly familiar with it--and said, "There's nothing to that. We knew that was feasible." It was the grownups who were surprised.

It is not a suitcase proposition. We would not have used the B-29's for a suitcase proposition. I think the military plans could have been much simpler if, instead of having to fly a B-29, we could have taken an aircraft carrier up to within a couple hundred miles of the coast and then had a little Navy scout plane fly over with that suitcase and drop it. I think you can just assume we did what we did because we had to do it. That is the real answer to that.

The other thing is that there must be a certain amount of material to make this thing go off. It is known as the critical mass and the critical mass is the smallest amount that will give the proper reaction. If there should be a smaller amount, these neutrons as they are released will escape without doing their job. This is a generation proposition in which the neutron strikes an atom and out of that atom comes two or more, approximately speaking, neutrons. Those, in turn, strike other atoms. Some of them strike and they are flops. They do nothing.

There are always neutrons around in the world, but they are not in any quantity--that is, per square inch. But the whole idea is we must have a certain amount of material so that the neutrons do not get away and out into the open. We get this doubling effect on the generations. You all remember, I am sure, the horseshoe problem. Some of the ex-cavalrymen can in all probability tell you how many nails are in a horse. So that when you get up into the thirty-second power of two you are really up there in your figuring. The same thing is true here. That is all we really need; otherwise, we get a fizzle, like the fizzle on a firecracker.

So, it is not advisable to talk of atomic weapons in the sense of an atomic bullet or an atomic projectile that is fired from a gun. There must be a certain amount to start with, and that is one reason there is no substitute for it at the present time. Maybe somebody will find out how to do it. We do not know how and furthermore we do not see any such possibility. It is just like wishing we could overcome the force of gravity. Perhaps someone will do it some day, too. Maybe they will do it by trickery, let us say, like using an airplane. That does overcome the force of gravity, ostensibly, but actually it does not. Maybe we will eventually get around some of these natural laws, but I do not think so. I can say that perfectly well because I know it will not happen before I am dead and gone; so I do not have to worry about it.

GENERAL ARMSTRONG:

Will you discuss for a minute the decision which led to the selection of Hiroshima and Nagasaki as the target areas?

GENERAL GROVES:

I do not know--I think I can tell you a little about that. The first thing that is required for a target area is a target that is sufficiently remunerative and we wanted a remunerative target. Hiroshima was such a target. If you were to see one of the maps that were kept in the war room of the Air Forces at that time you would see that there were not many remunerative targets left. We, of course, had a number of targets selected, a sufficient number so that when the plane took off the pilot had his alternative targets and the target of Hiroshima was, we thought, the best target on which to work for the first bomb. Nagasaki was a different target and an unfavorable one for the atomic bomb; a great deal of its force was wasted. Nagasaki was a long, narrow strip and in part of it there was nothing, so instead of getting the maximum effect we lost a lot of force. The target was, I think, about three miles long and it varied in width from zero to not over maybe a quarter of a mile with water in the middle of it so there was a lot of waste space. It was, however, a very important Japanese industrial area and it was the type of area that was keyed to the Japanese production. It showed the Japanese that no structure of any kind was safe against coming bombing. The first target showed it but they could say well, those were not industrial operations, we had houses in there. Of course, they also had a lot of other things in there. As anyone knows, there was a tremendous number of troops in Hiroshima as it was the headquarters of the army that was responsible for that portion of the defense of the homeland. There were 9,000 troops in the headquarters alone so that other armies have headquarters as well as our own. Of that 9,000 there were, as you will recall, 7,000 casualties. I think 3,000 were killed or maybe 4,000 and 2,000 uninjured. There were about 24,000 troops in the city and about 84 percent were casualties. I think any commander would be worried with 24,000 troops and 80 percent casualties. It was a very important supply point. If you look at a map and study the railroad lines going down there and study the coal situation in Japan and the straits down there I think you will see why Hiroshima was picked; I think that is the real story. There will always be discussion as to whether Hiroshima was the best target to pick. If Tokyo had not been burned to such an extent of course we would have loved to have tried it. Tokyo undoubtedly would have been the target without any question and it would have been a magnificent one because of the effect on the Japanese people and also because no matter where the bomb would have dropped, the area would not have run out.

QUESTION:

May I address a question. As an Ordnance officer I have been embarrassed lately on account of the atomic bomb, not knowing anything about it, but mainly on account of this question. If an explosive detonates, what does the atomic bomb do?

GENERAL GROVES:

Atomizes, I guess.

QUESTION:

My second question is, is there any relationship between the theory of synthetic detonation and atomization?

GENERAL GROVES:

I would say that what we really get in the atomic bomb is that when those neutrons start playing around there is heat, and the result is a very high temperature in a very small area--that just expands and that is really it. I think probably the only thing you can do with that is to read the Smythe report and go into the theory if you like. You will get a little information on your question but it is the kind of thing that no layman will understand. I think about all we can say is well, it is just a very high order of explosion and whether you want to call it detonation or whatever you want to call it, it does not make any difference. The fact is we get something very hot and that starts things expanding. That is really what it is.

QUESTION:

Was not the story of the railroad tracks due to the extent of this bomb? Apparently the damage was surface. Did the rate of fall have anything to do with that?

GENERAL GROVES:

Not so far as I can tell.

QUESTION:

Have we any information as to how long it would take other nations, for example, Russia, to duplicate this bomb, or is it permissible to give that information?

GENERAL GROVES:

Nobody has any information on Russia so far as I know; everybody has a lot of conversation. There are only about three--Conant, Bush and Tolman, I think Dr. Conant would fall into that class--of the elder scientists. Dr. Conant agrees with me in general on the time and so does Dr. Bush. We do not say this is it, because we do not know; we say it may vary, but it varies in that order rather than getting down to the absurd order. If you read the papers, you can get a new rumor every day. The latest one, of course, came from the scientist in England. I am told he came from Northern Ireland and therefore does not necessarily fall in that classification; he is supposed to be with no apologies and therefore knows all about it. He has gotten his stories about the small baseball sized bomb that goes on some new principle of atomic energy, but he cannot tell anything more about it. That would be betraying confidence about it.

GENERAL ARMSTRONG:

Thank you very much, General Groves. I am not stopping this conference because of what you said about people from Northern Ireland. I notice you did not inquire whether anybody here was from Northern Ireland although you were somewhat concerned about any Russians present. Gentlemen, I think you see exceedingly well the logic of the timing of the addresses here this morning by General Groves and Admiral Parsons. We did that deliberately and we considered it a foundation on which the work of this class should be built. I am sure that all of you will agree that these profoundly interesting talks by the two speakers here who know more about this atomic situation than anyone else in the country-- I mean as a whole--have given us something to think about that will decidedly affect what we do here in the course. General Groves and Admiral Parsons, I want to express to you the thanks of the Industrial College. It has been a most illuminating morning for us and I know a most useful one. Thank you very much.

(15 February, 1946--200)