SOME LONG-TERM ASPECTS OF ORDNANCE RESEARCH AND DEVELOPMENT

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June 10, 1946.

GENERAL ARMSTRONG:

Gentlemen, the speaker this morning and I have been associated together so many years in the Ordnance Department that the introduction I could give him would be drawn and detailed if I related to you all of his distinguished service to the Ordnance Department and to the Army. Colonel Ritchie is a rare combination of a tactician as well as a specialist in industrial mobilization. He graduated from the Military Academy in 1917. I first knew him shortly after he graduated from the Ordnance School at Watertown Arsenal in 1922.

Colonel Ritchie has specialized in many of the important technical developments in the Army, such as centrifugal castings and the substitution of molybdenum for tungsten in alloys. He also spent years in the Office of the Assistant Secretary of War working on industrial mobilization plans, from 1934 to 1939, as I recall it. At present he has succeeded General Barnes, who was the head of the technical division of research and development work in the Ordnance Department. I know of no one on active duty in the Ordnance Department better qualified to speak on either subject--technology in ordnance or industrial mobilization in ordnance and in the broader field of industrial mobilization of the country.

We are well aware of the fact that the developments that Colonel Ritchie is working on today are going to modify radically our concepts of industrial mobilization. It is for that purpose that we have invited Colonel Ritchie to address the class this morning. Gentlemen, it is a privilege to present an old friend, whom we used to call "Sam" Ritchie, of the Ordnance Department. Colonel Ritchie.

COLONEL RITCHIE:

General Armstrong and gentlemen. General Armstrong is very gracious in his remarks. His sentiments and mine are mutual with respect to his accomplishments and our very splendid association together for many years in the Ordnance Department.

I feel it a very great privilege to come back here to my Alma Mater and talk to this distinguished student body on matters bearing on national security, matters in which we are all mutually interested.

I have been asked to cover some aspects of Ordnance research and development. Our program in that field is so broad that it would take hours just to read the books listing the projects. Therefore in this period I can touch only on a few of the high lights and trust that you will be good enough, if you have questions unanswered, to come later to my office, at which time I will be very happy to discuss in detail any of these problems we have underway.

I might mention that some of the things I would like most to say to you are of a classified nature and hardly appropriate in an open meeting. Some of the things I will say are of a confidential nature, and I trust you will so regard them.

The present Ordnance research and development program is the result of an exhaustive survey which began many months ago. We are continuing to analyze this program to insure that it has no dead wood and that it will provide our armed forces with the best possible Ordnance weapons and equipment now and in the future. It is a comprehensive program prepared in collaboration with the Army Air Forces, the Army Ground Forces, the Navy, and the Marine Corps. It has been approved by the War Department and is in line with the recommendations of the Stilwell Board, It has been critically examined by our Scientific Research Advisory Council which includes such outstanding men as Dr. Kettering of General Motors and Dr. Coolidge of General Electric. It has been thoroughly coordinated with other agencies to avoid duplication of effort and expenditures.

Our plans provide for the most effective use of technical resources both within and outside of the Ordnance Department. The greater portion of our funds will be spent in the magnificent facilities of our universities and industrial research organizations. We now have some thirty odd universities and colleges, more than twenty other outstanding scientific organizations, and a very large number of selected industrial concerns engaged in our program. In other words, our coverage is nationwide thereby tying in with Ordnance the best scientific talent and facilities in the country.

The smaller portion of our funds will be alloted to special Ordnance functions which cannot well be performed by civilian agencies. For example, ballistics and research in special Ordnance materials are of interest only to the armed forces and, therefore, must be carried forward at our own research and development establishments. These establishments include our ten Ordnance laboratories, the two experimental proving grounds--one at Aberdeen, the other at White Sands, New Mexico--and special facilities at the seven manufacturing arsenals. Some of our most vital and colorful activities are performed at these laboratories and experimental proving grounds which are essential to the entire Ordnance program. Some of these facilities are engaged in development and testing of Ordnance materials, others perform basic research in the fundamental science which underlies Ordnance, such as ballistics and metallurgy.

In brief, our program is a three-part one comprising first, continued improvement of the best of our present standard weapons and equipment; second, research and development of the most promising experimental items which are so new as to be still subject to radical improvement. Such items include guided missiles, new rockets, bombs, fuzes, guns with rates of fire and projectile velocity far beyond those now standard, new fire control systems embodying revolutionary improvements in target detection, location, and tracking. The third part of our program covers fundamental research which will ultimately evolve other weapons of the future. Far-reaching long term projects appear throughout our program and, naturally, we shall be alert to change direction and scope of these projects as new leads are opened up by our own scientists or those of any other nation.

At this point I should like to mention two facilities of great importance in our program which are the products of research sponsored by the Ordnance Department. The first looks somewhat like a telephone switchboard but in reality it is the most amazing computing machine ever built--the Electronic Numerical Integrator and Computer or, for short, ENIAC. It is among the foremost scientific achievements of the war. It contains 18,000 vacuum tubes as compared with 400 in the most complicated radion station. It computes the trajectory of an artillery shell in a few seconds, a task which a human computer using old trial and error methods might not finish in a lifetime. It solves intricate problems a thousand times faster than any machine ever built--problems that are hopelessly beyond the scope of other methods. It opens up new fields of research, not only to the Ordnance Department, but to all branches of science and performs computations beyond the capacity of the human mind. The ENIAC performed calculations for the Los Alamos project which, as you know, dealt with the atom bomb. The director of that project wrote that the complexity of those problems were so great that it would have been impossible to arrive at any solutions without the ENIAC. But the ENIAC, in spite of its supreme position at the moment is not the end. We have a project under way with the Moore School, University of Pennsylvania, and the School of Advanced Science at Princeton which we expect will give us a machine one-tenth the weight of the ENIAC and which will compute ten times as fast.

Then there is the supersonic wind tunnel built during the war at the Ballistics Research Laboratory at Aberdeen Proving Ground. A picture of this wind tunnel shows a model bomb suspended in the airstream which blows past it faster than the speed of sound. Other experiments test artillery projectiles at many times that speed. Special cameras photograph the shock waves formed by the projectile, and delicate balances measure the forces acting upon it. The supersonic wind tunnel paid back its dollar cost by its first wartime test. It detected and corrected a design defect in a certain very large bomb which otherwise would have been discovered only after months of experiment and the expenditure of scores of bombs, and, what is more important, possible delay in delivery of these bombs to the theaters. The tunnel's important contributions to the design of high-velocity rockets, guided missiles, and jet propelled airplanes have only begun. If it were not available, there would be a serious gap in our national security program. These facilities extend to about five times the velocity of sound or, as the scientists term it, to a Mach number of 5. We now have under construction at the California Institute of Technology, a new hyper-velocity ballistic tunnel which will have a speed of about ten times the velocity of sound.

Our program provides for operating these research facilities to full capacity and also for building new scientific equipment as fast as it can be developed. Additions this year will include a trans-sonic range to study ballistics at critical velocity and a pressure chamber to study behavior of bullets fired at enormous speeds and altitudes.

ARTILLERY DEVELOPMENT

The advent of high-speed aircraft and large rocket propelled missiles at the close of World War II offer a new threat for which a satisfactory ground defense must be developed. Our antiaircraft equip-

ment was effective against planes flying at 400 m.p.h. Antiaircraft equipment now being developed will be far superior against planes flying at over twice this speed. We are developing means of accurately locating unseen targets at ranges beyond 100 miles. The time of flight of projectiles from gun to target will be reduced by at least one-half.

Regardless of the performance of individual components in the complex antiaircraft system, satisfactory results in combat depend on improved methods of linking them together. A description of "Existing Equipment" shows six major components set up as they are used today, namely guns, tracker, height finder, director, radar, and power plant. These components are now being integrated into a system similar to that set forth in the foregoing description under a heading: "Recommended Equipment." In this system three major components--the guns, combined radar, director, and power plant--replace the six used in our present equipment. The fourth device is a radar search equipment to locate the next target to be engaged.

With mobile artillery, the essential aim is to reduce the weight by at least one-fourth to facilitate transport by aircraft. Gun and carriage accessories such as tracks and skis must be further developed to permit polar operation at extremely low temperatures. Projectile velocities of 4,000 feet per second, a 25 to 50 percent increase over present designs, must be attained to insure the destruction of the heaviest armor at longer ranges. We are developing electronic range finders to replace certain optical types now considered inadequate. Other electronic instruments are under development such as data computers and devices for measuring muzzle velocities which will substantially increase the efficiency of artillery.

Shortly after the Italian invasion there was a critical appeal for heavy artillery which was barely met in time to avoid possible disaster. We must continue to develop large caliber weapons for operations against heavily fortified defenses. These guns, howitzers, and mortars will be mobile, yet of sufficient caliber to project with pin-point accuracy at long ranges, shells which will penetrate reinforced concrete and armor plate.

In the field of fundamental artillery research, the most important problem is increasing projectile velocities. A promising approach to high velocity guns is the smooth bore cannon firing fin-stabilized projectiles. Exploitation of this type cannon is important for "rocket assisted" shells. This development should double the ranges of our largest weapons and possibly increase ranges many times present limits.

We are developing new mortars for the infantry which will deliver pay loads eight to twenty times that of the 60mm and at three to four times the range.

AIRCRAFT ARMAMENT

With respect to aircraft weapons, it is essential to have aircraft cannon in the near future that can successfully combat aircraft with expected speeds of one thousand miles per hour. Increased speeds

in aircraft necessitate reduction in weight of weapons and their accessories, together with designs that will greatly lessen their air resistance. Additional requirements are greater muzzle velocities and rates of fire. Careful consideration is therefore being given to the weapons that will meet these requirements.

The Ordnance Department, in cooperation with the Army and Navy Air Forces, is conducting exhaustive tests at Aberdeen Proving Ground to determine the effects of various missiles on modern aircraft structures. One thousand war-weary airplanes, that would otherwise be scrapped, are being shot up with various U.S. and foreign weapons. Data obtained from these tests will be utilized in the development of aircraft cannon to be installed in aircraft of the future.

High enemy speeds and heavier armor of the future have made it imperative to develop new weapons. The cannon now in process of development will feature small silhouettes and light weight formerly believed impossible to achieve. They will be capable of firing projectiles at the unheard-of rate for cannon of 1500 rounds a minute, firing armor piercing and explosive projectiles with velocities double those now available. These cannon are designed to destroy any airplane, sink lightly armored ships, and to be employed against ground targets.

The supply of airborne troops by air is vital to their success in battle. For this purpose we are developing new type containers which can be dropped from high altitude and aimed at a delivery point in the manner used for dropping bombs. They will fall free to a predetermined altitude, at which height a suitable mechanism will open a parachute to slow down the container to a safe landing speed.

TANK AND AUTOMOTIVE EQUIPMENT

Our tank and automotive program is designed to maintain our superiority in tanks and other kinds of automotive equipment.

Consequently, we are designing tanks with maximum armor protection and super-velocity guns--tanks that can give and take the hardest blows without sacrificing reliability or mobility. These features are all combined in 60, 70 and 90-ton tanks being developed. The 70-ton tank will carry a powerful 155-mm gun in its turret.

Two of the heavy self-propelled weapons placed in operation near the end of the war were the 8" Gun and the 240-mm Howitzer.

We are now planning huge new self-propelled guns, such as the 280-mm howitzer motor carriage, to defeat the strongest fortifications. They will combine the utmost in firepower with mobility impossible for older type artillery.

We can visualize a battlefield on which crewless tanks maneuver, select their targets and fire with deadly accuracy. Such tanks are being studied. Men in well fortified positions will drive and fire them remotely by television.

Flying tanks gliding from the air to the battlefield can decide future combats. Preliminary studies for these tanks have been made.

We are developing tracked transport and prime mover equipment which is better than wheeled vehicles on battlefield terrain. Formerly, different types were needed for cargo and towing purposes. Now a new "cargo tractor" will serve both functions.

To enable our tanks to strike the enemy before he can strike back requires the development of special sights, optical and radar range finders, and stabilization mechanisms to keep the gun trained on the target when the tank is traversing rough ground at high speeds.

On future "D" days, if we must have them, tanks supported by swimming devices will swarm out of the water and crash inland. They will come under their own power from ships far at sea, furnish their own artillery protection, mechanically drop their floats upon reaching shore, and then execute their normal missions on land. We will develop new devices for our future tanks and many other items of special equipment that will assure satisfactory automotive operation under all conditions and in all climates from the arctic to the tropics.

Practically all the components — the engines, transmissions, power-drives and other parts that go into an Army automotive vehicle, must be developed by the Ordnance Department or under its supervision. This is so because commercial products are either inadequate or nonexistent for combat vehicles.

Development of more powerful engines are proceeding. New engines will have twice the power of those in World War II. We are also investigating application of the gas turbine to heavy tanks. Future engines, and improved transmissions such as the cross-drive that will permit a tank to turn in its own length, will revolutionize tank performance.

We are continuing to develop wheeled transport vehicles having no commercial counterparts to meet military requirements. To prevent duplication of commercial activities this program is thoroughly coordinated with the Society of Automotive Engineers who have long maintained an Ordnance Advisory Committee.

AMMUNITION DEVELOPMENT

In the field of ammunition we have many far reaching projects. Ammunition items are very important because they give the pay-off at the target.

While a round of ammunition may look very simple from the outside it is, in fact, a highly complex combination of metal parts, high explosives, propellants, and fuze powders.

Ammunition Research and Development embraces highly specialized applications of many sciences, especially metallurgy, chemistry, physics, and electronics. We are now broadening our fields of search in order that we may produce, not better, but the best.

Bombs, and their fuzes, are developed for use by the Army, Navy, and Marine Air Forces. Despite the devastating effectiveness of existing bombs, the development of super-high speed, high altitude airplanes has make necessary the complete aerodynamic redesign of many types of bombs.

The destructiveness of present bombs initiated the retreat underground of major tactical and strategic targets. The threat of atomic power will accelerate that retreat. We are developing bombs that will penetrate to and destroy such targets, by improvements in design and by the use of Rocket Propulsion to give added punch. We have programs under way on the effect of shock waves which may render unsafe installations hundreds of feet underground.

The principle of the shaped charge is also being incorporated into bombs, thereby markedly increasing their armor penetration without materially reducing their demolition effectiveness.

There is a sectioned projectile which illustrates the shaped charge principle. Instead of filling all the space with high explosive, a part is taken out and a metal cone is inserted in the hole. The entirely unexpected result, when the round is detonated, is that the force of the explosive is concentrated in a jet of high velocity particles directed forward against the target. This projectile will penetrate 4 inches of armor plate which would be undamaged if we removed the specially designed cone.

The exploitation of this revolutionary principle is in its infancy. The program will take in the entire energy spectrum for the purpose of discovering principles other than radio that may be used effectively in VT fuzes. Particular attention will be made to acoustic, photoelectric, infra-red, magnetic, and electrostatic principles. It will certainly receive further development in grenades, antitank mines, rockets, artillery and recoilless gun ammunition.

Pyrotechnics are little known but highly important devices used for recognition, signalling and illuminating purposes. One of their most valuable uses is Pathfinder purposes for guiding large formations of bombers to their destination and to specific targets. A large variety of types is required to provide the necessary tactical flexibility.

Mistakes in recognition and signalling can be very costly.

In the field of Artillery Ammunition, developments of high velocity tungsten carbide core and rocket assisted projectiles are under way. The use of tungsten carbide projectiles in the past war increased the striking power of our tanks. Reports of tanks destroyed by one or two rounds were frequent. We have a 76-mm shot of this type. The slug, the pay-off part, will penetrate 6 inches of armor or 4 times its diameter. The fragments will kill or disable the tank crew and often set fire to the tank ammunition.

There has also been developed a new and improved small scale model which will penetrate 12 times its diameter of plate. This development foreshadows the end of the old fight between armor and projectile. By combining super velocity with tungsten carbide cores, it is certain that any possible mobile armor encountered in the future can be penetrated by new projectiles based on already known principles.

The field of Rocket Assisted and high velocity fin-stabilized missiles is new and unexplored. It is possible by these means to increase tremendously the range and striking velocity of such projectiles. We propose to investigate these possibilities thoroughly.

British official reports state that Proximity Fuzes saved London from the V-1, German Buzz Bomb. This fuze— a joint development of the Army, Navy and NDRC--is one of the most revolutionary developments of World War II.

In principle, these fuzes combine a tiny Radio Transmitter and Receiver with the necessary safety and explosive components. They respond to waves reflected from the target and explode the missile at the proper places to cause maximum damage.

It was developed in absolute secrecy, and though limited publicity has been permitted, it is still a secret weapon. Experience has proved that Proximity Fuzes increase effectiveness of air bursts on suitable targets from 5 to 20 times. Field Artillerymen have said "It is the answer to an artilleryman's prayer."

To maintain our leadership in Proximity Fuzes, the Ordnance Department (in cooperation with the Navy) has activated an agressive research and development program. As a result, new types of electronic fuzes--which make these obsolete--in combination with new types of munitions may be expected to revolutionize previous tactical concepts.

SMALL ARMS

We are the sole development agency for all small arms and small arms ammunition used by the land, sea and air forces of the United States. Small arms include, in addition to items commonly referred to as such, the recoilless rifles, small rocket launchers and body armor.

There is no single individual in our combat forces who is not concerned with this phase of Ordnance development. In the late war over 98% of gun armament of Army airplanes was caliber .50 machine guns. Machine guns are mounted on every combat vehicle and practically every foot soldier carries a rifle or carbine or operates a machine gun. To keep our place in advance of our potential enemies, development must continue space with progress in science and industry.

The pay-off in the caliber .60 development is reduced time of flight. There is no weapon in existence in this or any other country which will deliver a projectile to 600 yards in a comparable time. The caliber .60 machine gun is expected to double the probability of hitting. It is anticipated that the latest models of jet propelled airplanes will be armed with this weapon. Completion of the development is essential to fulfillment of the aircraft program.

The M2 aircraft caliber .50 machine gun, firing at a rate of 800 rounds per minute, was officially characterized by the Commanding General of the Army Air Forces as "The most outstanding aircraft gun of World War II." By the summer of 1945 the Ordnance Department had started production of the M3 caliber .50 firing at a rate of 1200 shots per minute. During the course of the present calender year we expect to obtain a cyclic rate of 1500 rpm. Within a few years we expect to attain rates

of at least 5000 with 30,000 as an objective.

The mobility of the foot soldier is limited by the weight of his weapons and ammunition. We are now designing a seven pound replacement for the famous nine and one-half pound Garant. It will have all the punch and fire power which have been found so necessary in combat.

Body armor supplied to our aircraft crews resulted in a 50% reduction in deaths and 80% reduction in wounds. Progress in this field must not stop. Body armor to provide protection against radiant energy, as well as fragments, must be developed in view of the application of atomic power to warfare.

Reduction in weight of small arms ammunition by use of aluminum cartridge cases can reduce the load of a heavy bomber by as much as one-half ton. The continued development of aluminum cartridge cases is essential.

The 57 and 75mm recoilless rifles, developed and put into combat toward the close of the recent war, were enthusiastically received by the using troops. For the first time in history the fire power of Artillery was placed in the hands of the foot soldier. Three German tanks were destroyed by the first eight rounds fired in combat. We are now developing a repeating and automatic mechanism for recoilless weapons and also a recoilless weapon to fire jet assisted projectiles.

In the field of guided missiles we have a potential weapon which will revoluntionize warfare. During World War II, as in World War I, the Ordnance Department was active in the development of rockets, but our war efforts were concentrated on producing relatively short-range rockets for immediate use in the field and the air. The advent of the atomic bomb changed the picture. At once long range, controlled missiles became of extreme importance.

These are new type weapons on which development work is just getting a good start in this country; large expenditures of funds and time will be required before effective controlled missiles can be perfected.

The primary aim of the Ordnance program is to produce missiles that meet new military requirements of the atomic age, but the field is so new it is essential to place emphasis on fundamental and basic research. Our step by step program has been most carefully planned, not only to provide the necessary basic knowledge from all fields of science and to apply this knowledge to missiles, but also to conserve personnel and funds and prevent unprofitable duplication.

The free rocket development program covers rockets from the Bazooka to the large rocket propelled bombs. The famous Bazooka Rocket gave the foot soldier for the first time a weapon with which he could combat a tank single-handedly. The new bazooka will have enough punch to blast holes through thicker tank armor than has yet been used. It will have greater accuracy to hit moving targets and roughly twice the former range.

Powerful jet propulsion units are being designed for the Army Air Forces to enable huge aircraft of the future to take off with much greater pay loads from shorter runways.

Extremely high velocity aircraft rockets are being developed for firing from the fastest planes still on the drawing boards. They will be fired from the world's first automatic launcher--at machine gun rates, a single hit will destroy the largest of bombers.

In the newer controlled missiles field we are making definite progress. We are vigorously pursuing a systematic step-by-step procedure and are obtaining basic research data in supersonic aerodynamics, new fuels, jet propulsion, and control systems which are being applied to a series of development missiles. Some of these have already been test fired. Others are under construction.

In our contract with California Institute of Technology, a liquid fuel rocket was developed which, in its first tests, set a U. S. altitude record of 230,000 feet, a height never before attained in the history of man at which instrument recordings were made. This rocket is known as the WAC Corporal. To meet the urgent demand for a high-altitude meteorological rocket to carry instruments into the unexplored ionosphere, we are redesigning the WAC to attain an altitude of 500,000 feet.

The Ordnance contract with the General Electric Company is making the Buck Rogers myth a reality. Emphasis is placed on the extremely long range, ground to ground controlled missiles.

These giant rockets will travel more than five times faster than sound, capable of streaking into space and then, controlled by complicated robot "brains," dive with uncanny accuracy on a target thousands of miles away.

One of the steps in this project is a scientific research study of the German V-2. V-2 firing tests are being made at the Ordnance Department's White Sands Proving Ground in New Mexico. Captured V-2 parts were shipped to this country to assemble sufficient rockets for a history-making program--one which not only will save much development time and money by contributing important information to rocket designers, but also what is possibly more important, help to solve the secrets of the unexplored upper atmosphere. By allotting the warhead space, formerly filled with explosives, for the instruments of scientific institutions, data on the phenomena in the ionosphere will be recorded on ground receivers. The unknown regions begins at 19 miles, the ceiling of balloon-borne instruments the V2's will rise over 100 miles in our flight tests--far beyond the wildest dreams of yesterday. Knowledge gained will include temperatures, pressures, currents, bacteria and gases above the stratosphere--but the most far-reaching of all might well turn out to be developments resulting from cosmic ray research. In my estimation, this project on V-2 firings is a splendid illustration of the way research and development should be handled, that is where all agencies concerned participate to the end that the soundest possible program is set up and carried forward to obtain the maximum useful information. The V-2 test program is a cooperative project in that the Army Ground Forces, Army Air Forces, the Navy, the Signal Corps, and certain outstanding scientific institutions and representatives of important collateral fields of science are participating with the Ordnance Department to obtain the greatest return to the country with the minimum expenditure of time and funds.

Another phase of this long range weapon program is a controlled missile for coast defense. A project for a detailed study of the problem was established last June with Radio Corporation of American, and will be completed in the near future. The next step is to develop the missile--one which not only will direct itself for hundreds of miles to an approaching target for a direct hit, but also will travel so high and so fast that shipboard defense against it becomes practically impossible--a weapon so superior to present coast defense weapons there is no comparison.

We must expect other nations will develop missiles capable of crossing oceans. Countermeasure missiles are therefore included in our overall program Bell Telephone Laboratories is now engaged in the development of an aircraft interceptor missile.

Interceptor rockets for use against supersonic guided missiles are under study by several Ordnance contractors including the General Electric Company.

The guided missile has suddenly become one of the most important weapons today. It takes little stretch of the imagination to envisage a perimeter rocket defense of the United States. We cannot discount the possibility of launching from underground sites, loads of atomic retribution for delivery in an hour on an enemy in any part of the globe.

We are in a transition age of speed and change, moving swiftly toward the elimination of time and space. Ordnance research and development is geared in full realization of these conditions. The objective of the Research and Development Service is to obsolete as rapidly as possible our existing weapons by providing still better ones for the future.

GENERAL ARMSTRONG:

What is the effect of the escaping gasses in the rear of one of those recoilless weapons? Are they of high velocity?

COLONEL RITCHIE:

They are something that you have to guard against in an area of some thirty yards in the rear. It is dangerous to be in the immediate rear. You will get burned.

GENERAL ARMSTRONG:

Have any accidents occurred during their use at the front?

COLONEL RITCHIE:

None at the front that I know of. We thought that perhaps there would be considerable objection to that, but apparently there was not.

We also thought there would be objection to the flash, which would disclose their position. But in the Pacific area--I happened to have the good fortune to be there while they were using these weapons--there was no trouble about that at all. They liked them very much.

GENERAL ARMSTRONG:

What is the effect on the need for cartridge cases in that type of artillery? You have a new type of weapon. Do you have a new type of cartridge case? Is that brass or what material is it?

COLONEL RITCHIE:

Those are steel cases, punched out. They can be produced very readily.

GENERAL ARMSTRONG:

You spoke of aluminum cartridge cases.

COLONEL RITCHIE:

These were for small arms. It is conceivable that they might also be used in larger calibers if and when other materials become scarce and in case aluminum is not as scarce as the others.

The weight element in airplanes, of course, is an exceedingly important one, as we all know. There you can cut off, say, half a ton from one of those heavy bombers like the B29, that means a lot to those people. They can carry so much more gasoline or so much more armament. Weight is a very important element.

GENERAL ARMSTRONG:

Are there any questions, gentlemen?

A STUDENT:

Do you think it is really a wise policy to use German scientists and give them these laboratories in which to continue their research and possibly eventually take it back to Germany or elsewhere?

COLONEL RITCHIE:

Of course, their work here is being conducted under very guarded conditions, very carefully controlled conditions. What the ultimate outcome will be as to their future disposition I am not in a position to say at this time. But I think we can rest assured that it will not be possible for them to take things back to any other country which would be detrimental to us.

I think, answering your question another way, it has been very fortunate that we succeeded in getting these scientists, for reasons which I am sure you all can imagine; not only to help us, but for other reasons. They have been a great help in analyzing and helping to fire these V-2's at White Sands.

COLONEL LONGINO:

I have followed with deep interest this very fine talk. I see that the Ordnance Department has wasted no time in taking advantage of the possibility of research and development immediately following the war. I want to ask this question, because in our research and development activities in the Office of the Quartermaster General, while we have some people to put on research and development, and while we apparently have sufficient funds in sight to continue that for a fairly long period of time, we are now being, I might say, threatened by personnel cuts and ceilings being imposed upon us which make it almost impossible for us to do the job we think should be done. I wonder if you would be kind enough to tell us if you are having that experience. If so, can you give us a few pointers on what you are doing about it which we might use?

COLONEL RITCHIE:

I happen to be a member of the Secretary's Committee on Scientific Personnel. As you probably know, we have been struggling with that problem now for several months. All the technical services are faced with somewhat similar conditions, that is, the imposition of ceilings, which they keep pushing down and down. I assume that Ordnance is living through the same difficult times. But we are doing our best to hold on to the best people that we can. We are trying to take on, and have taken on, others from the outside on our rolls. We are attempting to improve the conditions of these scientists as fast as we can with the regulations and limitations otherwise imposed. But I think we are all in the same boat, all the technical services, right now, because I happen to sit in this board having representatives from all the technical services. I haven't answered your question very clearly, I know; but I can say we are all having the same troubles, I am sure.

COLONEL LONGINO:

We are about 55 per cent below what we really need right now. We are facing an additional cut of 15 to 20 per cent. I thought you might have some ideas on the subject.

COLONEL RITCHIE:

Nothing except to say that we are all living through the same difficulties. You know, the Secretary recently issued a directive trying to emphasize the importance of maintaining within the War Department an adequate scientific and technical staff and directing that all echelons concerned take such steps as could be taken to improve the conditions of the scientists and to build up their staff within that general directive.

COLONEL LONGINO:

I hope those having the selection of scientific personnel will take full cognizance of this and see if they can give us some help.

COLONEL RITCHIE:

General Doriot was the member from the Quartermaster on the board. He is fully aware, of course, of what has been going on in that board.

GENERAL ARMSTRONG:

Colonel Ritchie, I am sorry to say that we have to vacate this auditorium for the use of another group in just a few minutes. I am sure that your talk, which is so clear and fascinating in its detail, has convinced this class that we have to look toward a very different future from the past that we have known. Certainly the Ordnance officer or the artilleryman, that I used to be, and that I thought was fairly modern up until recently, is about as obsolete as a Civil War artilleryman or Ordnance officer.

I think, gentlemen, you can readily see how we must direct our thinging toward the future, basing it on a keen, careful analysis of the past. But the future is so completely different that you can see why some of these guided missiles and other integrating machines of various sorts have got to be used for developing a new and better thinking on the side in which we are concerned in the Industrial College.

General Ritchie, I want to tell you that you have reconciled me more than ever to my retirement at the end of this month.

COLONEL RITCHIE:

Thank you very much, General. It has been a pleasure to come back to this College once again and discuss these matters with you.

Just confirming what General Armstrong said, we are certainly in an age of transition. We are in an age of speed, where time and space are being eliminated. We are attempting to gear our ordnance procurement into a realization of those conditions.

GENERAL ARMSTRONG:

Thank you very much.

(30 Oct. 1946 -- 200)L.