

Colonel Harry E. Jordan's Remarks  
Introducing Lt. Col. Julian S. Hatcher, O. D.

The Army Industrial College,  
October 23, 1936

It is a great pleasure to me today to introduce our speaker.

He comes from my Corps in the Army, the Ordnance Department, and if there is any man in the Army who is entitled to be called, and rightly called, an expert in his line, I think Colonel Hatcher is that man.

He is an expert on small arms. He knows them from the start to the finish, and I think his reputation is established not only in the Army and Navy, but has been established in other Governmental departments here in Washington. He has been called upon by the Department of Justice time and time again to straighten out matters for them, when his advice as an expert was needed.

No United States team ever goes abroad to take part in any competition unless Colonel Hatcher goes along to keep them out of trouble. He is either the secretary of the team or he is the Ordnance advisor, and he has made so many trips back and forth across the Atlantic helping our teams out that I have ceased to keep track of them. It gives me a great deal of pleasure, gentlemen, to introduce to you an Ordnance Officer and a real expert in small arms, Colonel Julian S. Hatcher.

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Manufacture of Small Arms Ammunition  
by  
Lieut. Colonel Julian S. Hatcher, Q. M.

The Army Industrial College  
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Gentlemen:

Colonel Jordan has been extremely kind in his introduction, but there is one thing that he did not say. I sort of feel more or less uneducated because I have never had the pleasure and privilege of going through the Army Industrial College. I hope to have this privilege some day, and I will just say that and leave all the rest out.

This morning I am going to try to tell you something about some of the difficulties that the Army faces in industrial mobilization. The work that I am in at the present time happens to be industrial mobilization. I am up in the Baltimore Ordnance District, one of the fourteen Ordnance Districts that we have in this country, and so long as I do that work every day I am brought strongly face to face with some of the difficulties that we have to overcome. The problem that the Army has in getting supplies for any major war is a tremendous one, as you all know, because wars are fought on such a scale today that the munitions that are required are simply such as to tax the entire resources of the country. Even if we had the manufacturers they would go out and take all the raw materials that we would have if we got all the munitions we wanted.

Every branch of the Army has its problems, and some have more difficult problems than others. Let us take the question of food, for instance. For an army, that is quite well established. We know exactly how much a soldier eats; we know how many soldiers we expect to have in mobilization, and the proposition is sort of a cut and dried one. The manufacturers of canned food, or any other kind of food, operate in time of peace and they operate in time of war, and the problem is no different in time of war than in time of peace. They merely furnish more. The same thing applies to shoes, or clothing, but when it comes to certain other materials that are furnished by some of the Supply Services -- and I do not mean the Ordnance only because we have others: the Quartermaster Corps, the Chemical Warfare Service, etc. -- a totally different proposition arises. We go out to buy something not made in times of peace. Nobody makes it. You cannot step out and request the manufacture of 75-mm guns today by saying: "I want guns like this", because nobody makes them. You cannot go to a manufacturer and ask for shells or powder because they are not made commercially. There is a totally different aspect to the picture when you go out to get something like that than when you go out to buy trucks. And another thing is, as I said before, that when a Supply Service, such as the Quartermaster Corps, goes out to buy a certain amount of food, or plans for a certain amount of food for an army, they know how much they are going to need; they know what the mobilization is going to be and how much these people are going to eat, but when they endeavor to plan for ammunition it is a totally different proposition. The ammunition needed

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in a war depends entirely on circumstances. We may need a whole lot and we may not need so much. Of course, in order to play safe they figure on having a battle every so often and expending ammunition in between, and the requirements planned for are enormous. I think that the requirements are such that there is no chance of ever getting all that is stipulated in the requirements.

In future battles, if we have another war, the tactical actions are going to be absolutely limited by the amount of ammunition that we will be able to get hold of. For an ideal situation, we might say, "We will put guns hub to hub all the way across the front. We will start shooting shells at the enemy and keep that up as long as the war lasts." That is the ultimate thing, but we cannot do that. It would take entirely too much ammunition. While the amount that is stipulated in our requirements is not that much, it runs up to something in that general direction.

During the World War the total amount of small arms ammunition that was required, according to the figures that came out of the army in France, was such as to mean that if all the brass in the country was put into small arms ammunition there would not be that much brass. In other words, there was no chance in the world of ever getting that much ammunition. We did not get that much ammunition, and, as a matter of fact, we did not happen to need that much ammunition.

I should like to say one more word before I turn to this ammunition in detail. (Indicating exhibits) There is a great deal of confusion exists in the minds of many people as to just how easy, or how hard, it would be for us to step right out, in case of a general

mobilization, into industry and get the material we need. The average man in the street says: "Why sure, we will not have any trouble. The American manufacturer has always met the problem. Look at Henry Ford! Look at this, that, and the other! We can depend on the American manufacturer. He has the world by the tail. We do not have to worry at all." I think probably the average man in Congress thinks the same thing.

How far that is from the actual truth is illustrated by an incident that occurred the other day in one of our Reserve Officers' meetings. Each one of the Reserve Officers assigned to my office has an assignment in time of war. Many of these assignments are as inspectors in some of the big plants that are going to make our ammunitions, in my district; others are assigned to the office, and those Reserve Officers study that problem. They know what we are supposed to do in the district. They are the men who, when the general mobilization takes place, are going to be called right into the office, and they are the ones that have to start the production and inspection of ammunitions in the district. It will be done by commercial firms, but those officers will supervise it from our office; so they naturally study the problem, and we have meetings from time to time in which those things are all discussed. We have a lot of visitors -- officers from the different branches of the Service. Naturally, when we have a Reserve Officers' meeting officers from some other branches -- Corps of Engineers, Infantry, etc. -- will frequently come in because they want to learn something about the Ordnance problem, and to get two

hours credit for attending the meeting. We always have a certain number of visitors from other branches of the Service. In one meeting we were talking about the amount of machinery that would be needed. They were figuring that up in one of these plants. One officer said: "May I say a word?"

I said, "Yes."

He arose and said; "There is no use your doing that. The Government is taking care of all that. They have arranged so that all the commercial plants in the country are going to make everything we need as soon as we have mobilization. They have arranged it all."

He did not know the "they" he was talking about was us. He said: "Let me illustrate. Over here in Curtis Bay the Dupont Company has a plant that makes paint, and that plant, the minute a war starts, the day after mobilization, is going to start delivering smokeless powder to the Government. The Government has arranged all that. We do not have to worry about that here."

That is fine, we will go on to the next subject. There was not any use trying to educate him along that line. What that plant he was talking about over in Curtis Bay, that was going to make powder, actually does is take a black sand from the seashore in India,

38% of iron, some oxide, and dissolve it down in chemicals, and that is the basis of this paint. The operations there are no more like making smokeless powder than they are up in 's tailor shop. So there you are. But, "we are going to have powder come out of that plant in great quantities the day after mobilization."

I am going to leave that subject now and talk just a little

bit about the manufacture of small arms cartridges, some of the difficulties we run into in their manufacture, and just what we are going to do in case of war to get some of those cartridges.

We have here a .30-Caliber Service Cartridge, a .50-Caliber Cartridge, and a .45. The manufacture of all of them is about the same and they present very much the same problem; therefore, I will take the .30-Caliber, which is made out of brass. Brass is a very easy metal to work. For cartridges brass in long strips is used. This (indicating) is a section of one of the strips. It does not have holes in it; it is just a long strip of brass. This is fed into a machine that punches out these disks and pushes them into a little cup like that (indicating). When that brass comes to us it is as soft as it can be. It has to be soft so we can work it into this shape (indicating); so we can take a flat strip of brass and make it into a thing like this (indicating), hollow on the inside. That brass is just as soft as it can be, but when we work it and force it through a machine it hardens. If you take a piece of copper and put it in a fire it will get soft; then if you hit it with a hammer it gets hard again.

A fellow goes to college. He goes into the shops where he does his practical drills. He takes a piece of brass and makes a bowl out of it. He puts the brass in the fire, heats it, and then beats it with a hammer. In a little while it is hard and can be beaten no more. He puts it in the fire again, beats it some more, and gets a bowl out of it. The same thing is done here. When it has been beaten into this shape it is put back in the fire, into a furnace or

very carefully specified and controlled temperature, heated up, put into a punch press, and punched out into a form; put in the fire and heated up and punched out again, etc., until it gets to be quite long, like this (indicating), and when it gets to that point there is another thing enters into it. That cartridge must be hard when it is finished. It must be hard in spots because if it is not hard it will not be strong and if it is not strong when it is fired the brass will act as so much putty and the gas will all come out in the soldier's face and put his eyes out. So, the way the brass is hardened is by hammering on it, or something of that kind.

When it gets to this point (indicating) it is put in a machine and hit a heavy blow on the base. This is called "bumping", and makes the base hard. From that point on they do not let the base get in the fire again. The base must be kept hard. If it gets in the fire again we have a cartridge that will put the soldier's eyes out. It may not put them out entirely but it will come close to it -- it will let the gas come out into his face. The head of the cartridge must be kept hard from that point on (indicating), but the body of it has to be tapered and brought down to a smaller size. In order to taper that cartridge this part must be softened, so it is put in the fire; the top part of it is heated but not the base.

It is then put through a machine which tapers it like this (indicating); makes a neck on it. This is a very delicate operation. If you soften that cartridge too much in making it taper you will find that when you go to shoot it you cannot get it out of the gun. You fire it, try to lift the handle of your bore and you cannot do it.

One of the great troubles we have with our cartridges is that so many of them stick so badly that after a few shots rapid firing is impossible.

Why not make it harder there so it will not do that? We can make it harder so it will not do that, but when we do that and put the cartridge in a machine gun it is likely to rupture; your cartridge fired breaks across and half of it is left in the gun. The gun is then hopelessly jammed up. So, we have the problem of making a cartridge that is hard enough so we can fire it in a rifle and then open the bore, and making it soft enough so that when we put it in a machine gun it will not break. So far we have never been able to solve that problem.

The cartridges we now have are soft enough so they will not break in a machine gun but they are terribly hard to operate in a rifle. Actually when they make ammunition for a rifle they make it slightly harder in the body, so it is perhaps doubtful for use in a machine gun unless the machine gun is kept in very good condition with the "head space", as they call it, down to a minimum figure.

Even now, in peace time manufacture, making the cartridges as carefully as they can, they are faced with the very delicate point of it not working in a rifle or not working in a machine gun, one or the other.

This is just a cartridge case we are making. In the bottom of the cartridge case we put a little primer. I shall pass over the primer for the time being, and will have something more to say about it later on. We ran into a little trouble with them during the war which is very interesting and instructive.

Next the bullet is made. The bullet is made very much like the cartridge is made. The bullet is made of lead but the outside is covered over with a jacket of hard metal. This is necessary because at the velocity we fire bullets today if they did not have that hard metal on them they would melt and smear all along the barrel, the bullet would be no good, and the barrel would be filled up with lead on the inside. We make the bullet jacket very much the same as we do the cartridge case, putting the lead inside of it. Right there is a point: the lead is put in the case. That sounds like it ought to be simple and end the whole matter, but it is not simple. During the World War we found that our cartridges did not shoot far enough, so we made them with a tapered base, and the tapered base increases the range from 3400 to 5700 yards -- just that tapered base on the bullet. But, with the tapered base there is a tendency for the gas behind the bullet to smash it down so it will go through the barrel of the gun without hitting the rifle, and will tumble, and if you are shooting over the heads of troops it will fall on the troops and kill them. So, we have to have something to prevent it from doing that, and the only way we can do that, that we have found so far, is to harden that lead core by putting a lot of antimony in it. That was a proposition which was very bad; it was strategic material; you could not get it in this country, but we did not know of any way of getting away from putting eleven per cent of antimony in the bullets. However, finally we found that we could use a by-product of the lead mines, antimonial lead, so that problem does not bother us any more. That is just one

little point.

The next thing we do is to load that cartridge. We put some powder in it and put a bullet in it and we have our cartridge all finished. If you are a manufacturer of jack knives or razors, when you get that jack knife or razor all made according to specifications and you have checked it with the drawings and check the hardness and temper of the blade you are all fixed and ready to go, and there is no question about it, but when we get a cartridge all made according to specifications and it looks alright, then is when our trouble starts. We find that it does not act like it ought to act nine times out of ten. The same thing is true here as in the baking of cakes. Some women bake good cakes and some bake bad cakes and all use the same formula and the same oven.

There are all kinds of troubles that can happen with cartridges and they do happen right along — some of the most astonishing troubles! You cannot take any Tom, Dick, or Harry who has been manufacturing something else and put him on that job and be sure of getting a good cartridge. In fact, during the World War we never got any cartridges except from the people who had been making them before.

I have spoken of the troubles that we may have with cartridges. Even if we make them soft enough so they do not rupture in the machine gun they may stick in the machine gun; its extractor will pull the rim off and leave them in there, with the gun hopelessly jammed. We have talked about the ruptures. Well, if for any reason the head of that cartridge is just slightly soft, as I said before, it is likely to open up and let the primer out and let the gas back and cause a great

deal of trouble. If the body of the case has any kind of little inclusion or elimination, when you fire that cartridge you are likely to get a split in the body that will let the gas out. We had a great deal of ammunition in the World War like that and it caused a lot of trouble.

One of the very bad things that happens is that when a cartridge case is made and put in storage we are not sure what will have happened a year from that time. A year from that time we may find a little crack running down from the neck of the cartridge where it has been pushed into big diameter and pushed into small diameter when manufactured, which strains the brass and tends to make it harder, and that hard brass will crack if left for a year or so.

Now, it is not only the Army, and the cartridge manufacturers who have brass crack like that. Almost anybody that makes a brass object that is reduced in size very much will have the same thing happen. If you will think back, you will probably remember brass objects around your home that have cracked. During the World War we got a lot of safety razors from the Gillette Razor Company. They were sold for 2½ a piece by the commissary. The handles cracked. In time of peace we used to give \$6.00 for them. They are now somewhat less in price but they still crack, although they do not crack as quickly as the ones made during the war. We give the average Gillette razor about a year and a half to crack now. At any rate that shows that it is not only the cartridge maker, only the Army, that does not know how to make cartridges and is dumb and to whom that happens. Look at a

flashlight down at the bottom where the reflector is; look at a lamp where the socket screws in, and very frequently you will find a crack there. The cracking of brass is very common, and that is one thing we want to get away from. Naturally we cannot go on making cartridges, which, when we get them out and go to fire them, are all broken. You may say: "Fire them before they are broken. Fire them several months after they are made."

I will tell you what happened down on the Mexican Border in 1916. I was sent down there at the time that trouble happened, when came over and raided Columbus. We did not have any machine guns in the Army at that time. We only had about 164 machine guns, I believe, all together, and we bought three hundred Lewis machine guns made for the British cartridge. That was when the World War was going on and the United States Cartridge Company was making those British cartridges for Great Britain and we commandeered, or otherwise obtained, a large shipment of those .303 cartridges to fit those guns that we grabbed in that emergency that happened on the Mexican Border. We went right down there with them; they were fresh cartridges right from the factory, but before I got them out there to be used in those machine guns, where I was going to instruct the people, thirty per cent of those cartridges were cracked open; we could shake the bullets right out of them. That was during the war and that stuff was being shipped across the ocean, to Great Britain. It was not worth shipping. The cartridge makers, trying to make a lot of cartridges in a hurry, got into this trouble. The trouble is, there is no absolutely perfect way of preventing it. The way they

actually do prevent it nowadays, and the way they did then but now they are very much more careful about it, is that before the primers are put in they are put through a furnace that puts a flame on that part there (indicating) and heats it hot right at the end, which takes out a number of strains. You may say: "It would be fine to heat that hot enough to keep it from season cracking," but, if you heat it to the extent that you are absolutely sure it is never going to crack it gets so soft that it falls down and crumbles up when you put the bullet in, or the bullet gets out of line and you have all kinds of trouble. That just illustrates the strange things that may happen even if you know all about making cartridges.

One of the great troubles with ammunition for a long time has been what is known as "metal fouling." When you fire the cartridge through the barrel it goes through at such a tremendous speed that that hard metal in the jacket has a tendency to solder itself on the inside of the barrel, which ruins the accuracy of the gun and puts you on the rocks. We had been trying everything to overcome that, everything from lubricating the bullet on down, and in 1921 Frankford Arsenal found a good way of getting away from it. They put some strips of tinfoil in the powder. This amalgamates to the copper and takes it out of the barrel. Then, they thought it would be a fine thing to put tin on the outside, so they plated the bullets thinly with tin. It worked perfectly; there was no metal fouling. In all the tests they made at Frankford it worked perfectly, so they made some tin plated ones for the National Rifle Matches, and sent them out there.

I was stationed at Springfield but at that time I was sent out to Camp Perry to be at the National Matches as Ordnance officer. The rifles

were blowing up right and left. A man would lie down on the ground and pull the trigger and the whole rifle would blow up in his face.

If it did not kill him he was lucky. I saw one blow up not two feet from where I was standing. I immediately got out an order and told the people not to put any grease on the bullets. They were greasing the bullets, and every time they put grease on one and fired it it had a tendency to blow the rifle up. We never saw one blow up that did not have grease on it. The whole story was that that tin on the neck of the bullet was a very fine point. That brass was just like solder. It would grab right on to the

(indicating) A bullet like this is pulled out of the cartridge case with seventy pounds pull; while those tin plated bullets require three hundred to six hundred pounds pull to put them out of the neck of the case. The powder comes in and rips it loose and drives the bullet on out, but if you put grease on the outside of the neck of your cartridge the grease fills up all the space on the outside of the cartridge and the minute that pressure comes up on the inside it tries to swell out but the grease is incompressible and before the grease has time to move away the powder rises to a dangerously high pressure. This powder is put in here with the idea that as soon as it starts to move the bullet will start to move, and if it does not move something has to give.

Putting that grease on there would blow a gun up. This was totally unforeseen, but people were out there using that ammunition and we

had to stop it before somebody killed himself. Nobody got killed but they came very close to it.

We have gotten over that now. We do not have any metal fouling because they use a kind of metal for the jacket that does not foul the barrel, but we had not then discovered that. This was in 1921.

In 1930 we had another little bit of fun, very much the same thing. The primers that are used in these cartridges have an anvil inside of them that is right in the center of the cartridge. There is a little venthole that lets the flame from the primer go into the powder and right over that venthole is this little anvil that the percussion mixture is pressed against when the firing pin strikes it and the flame has to go around both sides of that anvil, and is forced through this little constricted opening. (indicating).

We in the United States are the only people in the world that use that type of primer. Everybody else uses one known as the Berdan primer. That has no separate anvil. It has the base for the pocket raised up to form a mound that acts as the anvil and on each side of that has a hole pierced, which lets the flame go straight in to the powder, igniting the powder very much more easily and supposedly very much more uniformly than the kind of primer we use. The Berdan primer was invented in this country. It was used here for many years, and it spread all over the world from our invention. Back in 1890, or along about then, it was abandoned because they wanted a primer that they could push out from the inside, due to the fact

that so many people in those days reloaded their own cartridges.

That is the reason we went to the kind of anvil we have now.

Back in 1930 they were trying to get better accuracy with better ammunition. They got wonderful accuracy, but as soon as they started firing the bullets they began blowing up guns again. A tremendous heat wave came by just at that time. The temperature was 103. I think I was in Europe at the time, and did not see just what happened. What actually did cause that high pressure was not determined at the time, but I think what happened was that the powder grains used were probably somewhat brittle and that straight shooting of the gas in against the grains would allow that blow of the gas from the primers to pulverize the powder grains. The pressure of the powder is due to the size of the grain -- the smaller grains get higher pressure -- and when you pulverize that you get So, we had to withdraw that and put in another lot, and that is not so long ago.

We can go on almost indefinitely telling about the things that might happen to ammunition. We have much trouble with it, but we have far less than the commercial companies because we make .30-Caliber ammunition all along and study, the best we know how, to avoid all these difficulties. We know all that the commercial companies know because they allow us to have the benefit of their experience, so do not get the idea that the Frankford Arsenal alone has trouble. The Frankford ammunition made during the war was the only really satisfactory ammunition made during the war, and after the war everybody

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that could get hold of it wanted to get that ammunition to shoot.

Concerning ammunition, I am going to quote a few figures on the requirements, etc. These figures are confidential and I want you to consider them as such. Everybody here is in the Service, I understand.

Colonel Jordan: I want to ask that everybody here please regard these figures as confidential.

Colonel Hatcher: I am not going to bring out any very important ones but all figures that I give you are confidential.

The situation during the World War was that at the beginning of the war we had on hand about two hundred million 30-Caliber cartridges. That is all we had. That was our war reserve. We had one factory that could make one hundred million rounds a year, which was Frankford Arsenal. That was the situation at the beginning of the World War. The requirements set up were enormous, but actually at the end of the World War we were getting two hundred and seventy-eight million rounds of ammunition a month. That was what we were actually getting at the end of the World War. Just how we did that is of quite a little bit of interest.

Our present requirements for 30-Caliber ammunition are three hundred and eighty-six million rounds per month, and the production at the end of the World War, when we had been working on it a year and a half, was two hundred and seventy-eight million rounds. In other words, we want practically fifty per cent more ammunition now per month than we actually were getting at the end of the World War. At the beginning of the World War our ammunition factories had been working for three years for the Allies, trying to work up the production, so we can say that the

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production we were getting at the end of the World War was four years' effort on the part of the companies to get up to that production -- not a year and a half but four years, because they started at the beginning of the World War.

We want to get three hundred and seventy-eight million rounds of ammunition a month. How are we going to do it? As I said at the beginning of this talk, we cannot go out to some manufacturer as though we were going to buy shoes and say: "Give me so many rounds of ammunition," because nobody makes ammunition except just a few people. Let us see who makes ammunition. In 1918 we had Frankford Arsenal that could make a hundred million rounds a year; we had the Remington Arms Company, the Peters Cartridge Company, the Western Cartridge Company; the Winchester Repeating Arms Company, and the United States Cartridge Company, and all those were big firms. Those people had been in the habit of getting an order of a million rounds a year from the Government every year. Only a million -- that is not many in small arms cartridges because a small arms cartridge is only a small thing. A million rounds they were getting before the war in Europe broke out. When the war in Europe broke out those companies immediately got contracts from the Allies to make cartridges. A number of Ordnance officers (that was three years before we entered the war) received attractive offers to go out and help those people make ammunition. One of the officers was Colonel Phillips of Frankford Arsenal, who went to Remington Arms Company; Thomas D. \_\_\_\_\_ went to the United States Cartridge Company.

When we went into the war we had Frankford Arsenal that could

make a hundred million rounds a year, and we had all these other companies that had been speeding up their production and paying fabulous sums to get big factories so they could get large production on small arms ammunition, and still we did not have enough capacity.

Also, there was the National Brass and Copper Tube Company that had also taken big contracts; the Dominion Cartridge Company up in Canada, and we thought that we could get ammunition production by getting some other firms into this manufacture that never had been in it. The Crown Cork and Seal Company made a bottle cap that looks something like this (illustrating), so they decided they would be able to make ammunition. What actually happened was that Frankford Arsenal made seventy-six million rounds of ammunition from April, 1917 to November, 1918, and the Remington Arms Company made one billion, two hundred and nineteen million rounds. Now, why did not Frankford Arsenal make a hundred million, since they could make a hundred million rounds a year? That is an interesting little story about priming.

Frankford Arsenal knew all about how to make that ammunition and they were only making it at a small peace-time production rate. When mobilisation occurred they were asked to step up their production as fast as they could. They did this, and when the ammunition began going out to the troops they found that when they pulled the trigger nothing happened. It did not go off. Or, worse still, when they pulled the trigger there was a dull, sickening click and about the time they opened the bore of the rifle, a fraction of a second later, it went off. It is bad to put a gun up to your shoulder, pull the trigger — nothing happens — open the bore, and have it blow up in your

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eyes. Colonel R \_\_\_\_\_ of the Infantry, got his eye blown out that way. So, right in the middle of the war they suspended the production of Frankford Arsenal. It took them four months to get going again, and about five or six months of their production of ammunition was thrown out and destroyed, during the war when they needed ammunition in the worst way, because it did more harm to the friend than it did to the enemy.

Of course, they did not know just what caused all this. They had several good theories. They had simply used the primer they had been using for years, and took another primer some one else had been using. The old primer had sulphur in it and chloride of potash. These primers are made of a wet mixture of a very explosive compound and pressed into little primer cups, as shown here (indicating), and those are placed in what are called "dry houses", steam heat being used to dry those primers out so they will be ready to go off. It is alright to use the dry houses for a certain capacity, but they stepped production up as much as they could and put more primers in there than they had capacity for, which made the air damp. The dampness reacted with the sulphur in the primer and caused a sulphuric acid, which reacted with the other chemicals and made the primer sensitive, and all this was due to the effort of getting too much production. If that happens to Frankford Arsenal because they want to increase production, what is going to happen to somebody that has never made ammunition before? A thousand and one things may happen.

The Peters Cartridge Company made eighty-four million rounds of ammunition; Western Cartridge Company made forty-eight million;

Winchester made four hundred and sixty-eight million; and the United States Cartridge Company made six hundred and seventy-eight million.

That is a very interesting set of figures. All these people were making cartridges for the Allies and trying to get out all the cartridges they could. Remington Arms got Colonel Phillips, and the United States Cartridge got Frank D. \_\_\_\_\_ from Frankford Arsenal to help them.

These are people that actually had made cartridges before. They had made all those things. We went to the National Brass and Copper Tube Company, which was making cartridges for the Allies, and gave them a contract. They made twenty-two million all together, but those twenty-two million were thrown out and scrapped because it was found almost immediately that when they started to use those bullets they blew the guns up right and left. The heads of the cartridges were too soft and the bodies cracked. They were makers of brass and copper tubes, just like this (indicating), and we said: "These are the very people to make cartridges; they know all about handling brass." We were never able to get that situation ironed out, even with all of the talent we had in the arsenals and in the big cartridge companies. We could get no cartridges from those people, so they quit. The Dominion Cartridge Company, a small company up in Canada, finally got us a half million cartridges during the war. The Crown Cork and Seal Company built a tremendous plant, and a brass mill to go with it, and they never got a cartridge. That was the situation in 1918, and that is what happened.

What is the situation today? Let us look at it. Of course, we can take these out right away (indicating the National Brass and Copper Tube Company, the Dominion Cartridge Company, and the Crown Cork

and Seal Company). They do not exist. The United States Cartridge Company does not exist; the Peters Cartridge Company, owned by Remington, makes shotgun shells but nothing to be used during a war; Western and Winchester are combined, and Frankford Arsenal has about the same capacity as it had before. Where are we going to get our cartridges? Remington is also out, because the big plant they had has been sold. I was up there the other day, and they had sold and curtailed and cut down until all they had left was the pre-war plant. They have gone through with a knife and cut out all the outlying buildings, leaving only a few central buildings. That big plant is pruned down to nothing. That is the situation, and where are we? We cannot go out and order these cartridges.

The first principle for getting anything in industrial mobilization is to go to the man who has the machinery to make it. We do not want to go to somebody who does not have the machinery to make it, some one who would have to set up a factory to begin the manufacture of small arms ammunition. The first thing a man would have to do if he does not have the machinery is to go out and get cartridge machinery. Where is he going to get such machinery? Suppose you are a manufacturer and I come to you and ask for a machine to make cartridges -- just one machine -- I would not be able to get that one machine in less than four months. What is going to happen if I want to get a whole factory full of machines? How long am I going to be getting them? So, the principle to be carried out is to go to the man who has something that he can use, to the man that has the kind of press he can use, etc. If you want shells that have to be forged out, look over the country and find a man who has

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a press that can do that job. Alright, let us do that with small arms ammunition. The only people that have any machinery that can be used for the manufacture of small arms ammunition are those people who are engaged in its manufacture, because that kind of machinery is not the kind used for other things. It is not used in making automobiles or in making anything else. Ammunition is not made on a last or drill press, or on anything that you find in any other factory. It is made on special machines; on a bullet loading press, a primer loading machine, and on a cartridge loading machine, etc., and all those machines are absolutely special. There are practically no machines used that are required for the manufacture of small arms except in a cartridge factory.

In the manufacture of small arms ammunition we must start from the ground up, getting all special machinery. Just what that means I will explain to you. It is rather startling to me. Frankford Arsenal today can make approximately three hundred thousand cartridges a day. The best production they have ever made in any day is four hundred thousand. You may say: "If they can make four hundred thousand cartridges a day in time of peace, they ought immediately begin to make a million a day in time of war because they make those four hundred thousand in eight hours and in time of war they work twenty hours." They work one eight hour shift now, and will work two ten hour shifts in time of war, and if their output is fifty thousand an hour in time of war they can produce a million a day by working twenty hours." Can Frankford Arsenal make a million cartridges on mobilization day? Where are they going to get people to work those twenty hours a day? Everybody they get would be somebody that had not

seen a cartridge. They would have one shift that knows how to make cartridges and one shift that does not know a thing about it. Actually, the very best plan they have to bring that production up from the present three hundred thousand a day to a million a day without increasing their capacity would take nine months. What are you going to do if you haven't any machinery? There is one little situation that will put them back. There is one little point, that of putting the cartridge in the fire to get it soft again, which has to be very delicately controlled. They only have part of a capacity for this; they have to have two shifts anyway, and additional capacity could not possibly be obtained in less than four months, with all the delicate electrical control.

My time is now up. The situation as I have given it to you, I think, will give you some idea of just what I mean by the fact that this industrial mobilization is not all plain sailing. It is a tremendously important thing and a lot of very constructive and wonderful work is being done on it. It is not plain sailing and it is not a question of, as the Reserve Officer said at Baltimore, "they" having it all arranged.

Q. Obviously the existing setup of the war plans will not furnish anywhere near the amount of ammunition needed. What is the plan?

A. There has been a plan, which was to have all of these manufacturers greatly expand their present plants. However, that plan is now being drastically revised. The plan that is going to be in existence

is not finished at the present time because it is now in the process of revision. This revision is partly due to the fact that a number of changes have recently occurred in these commercial setups. The plan at this moment is in a formative stage.

Q. What happened to all that machinery in the United States Cartridge Company and the Peters Cartridge Company?

A. That machinery was scrapped. The Crown Cork and Seal Company is a very good example: They had a complete plant for a million rounds per day at the end of the war. They had built a special plant, and they now did not have any use for it for cartridges, so they gave all the machinery back to the Government. The Government took it all to Frankford Arsenal, and much of the Frankford Arsenal old, obsolete machinery was thrown out in the scrap heap. Some of the good machinery was not adaptable because they were going to try a short cut system, so some of it was scrapped and some of it was kept in storage at Frankford Arsenal for some time, but it costs money to keep machinery in storage. The United States Cartridge Company folded up because they were not making money, and when a company folds up for that reason they haven't money to keep machinery in storage. The Ordnance Department could step in and buy it, but that requires appropriations. The Peters Cartridge Company had a very beautiful setup of machinery that was all new during the war. That machinery is still in existence. The company that owns the old Peters interests is very patriotic and they are holding that machinery at considerable expense to themselves. They hope that in case of an emergency they will be able to make that machinery available to the Government. That is all the machinery that is available.

Q. Colonel, what makes the so called boattail volatility unstable?

A. I did not say it was unstable. However, I see what you mean.

There was considerable difficulty in getting it stable. I might explain that a little better by a sketch. Can you see this part of the board? Here is a rough sketch of this bullet. This is a flat base bullet, in a gun barrel, like that, and the pressure of gas expands that bullet right there (indicating), and keeps it expanded along this side.

(indicating). You put a tail on it and there is a tendency for the gas to push the bullet in, and it will go through the barrel and squeeze down without having the rifle cut into the jacket of the bullet unless you have the inside core very hard so as to hold that jacket cut and make it take the rifle.

Q. Without the bullet tail, the pressure expands it against the side of the barrel?

A. Pressure springing against that flat base expands it but with the bullet tail the pressure goes out to the side and has an inward component there that tends to squeeze it in.

Q. How do the European nations avoid the corrosion of the powder charge?

A. It is entirely due to the composition of the primer. The European nations all use a primer that is non-corrosive. The corrosion of the gun is due to the primer salts deposited in the barrel of the gun. Many European nations use a primer that does not contain certain salts that do make that corrosion, and at the time we made that particular cartridge that happened. We were trying to get such a composition of

our own, but undoubtedly the primer composition made was too brusque. Just a small change in the composition materials of our primers would overcome that. If you put too much of some of those things in, the primer more or less . It is too strong for the powder. A small change in the primer composition would overcome that.

Q. What kind of powder do they use?

A. The Dupont I.M.R., Military Rifle. That powder is very stable. One of the troubles we had before the war was not knowing how long the powder would last. Apparently the powder we use now is almost indefinitely stable. It will last longer than any other part of the cartridge.

Q. Much of the .30-Caliber ammunition now issued is designated by the Service either for rifles or machine guns. Does Ordnance now have a .30-Caliber cartridge that is satisfactory in both?

A. The cartridge is now fairly satisfactory in both. It is satisfactory for machine guns and for rifles. If you fire about thirty or forty shots it causes the bullet to be quite hard to lift, but the reason we have cartridges that are designated for rifles or machine guns is because the war time ammunition and the other ammunition we have had in storage a great many years is inspected periodically to see whether it has deteriorated or not, and certain defects makes it dangerous in rifles while it may be perfectly safe in ground machine guns. If you have a hang fire in a rifle it glows out in your face, but that ammunition being satisfactory for use in a machine gun is graded for the machine gun only. Then again, during the World War some of it was packed in belts so

that it would be ready for use in machine guns, and that was marked for machine guns only, but at the present time our cartridge is satisfactory for machine guns and it is satisfactory for rifles, except that if you shoot too rapidly the bullet gets hard to lift.

Q. According to the information on the board, we have only three companies now against six during the war, and two sets of machines. When the question was asked back here: "What are your plans in time of war?" you rather sidestepped by saying they were under revision. Can you give us the possibilities that are open for the next war? We will now have to start in at once rather than at the end of four years' preparation. What are the possibilities?

A. Before I do that, I should like to ask General Schull if he thinks I should outline briefly what the plan is.

General Schull: Yes.

Colonel Hatcher: Alright, I will tell you briefly. The plan that we are working along right now is this: We have Frankford Arsenal, of course; we have Remington, and we have Winchester-Western. The plan is for Frankford Arsenal to make as much ammunition as they can of every type they are set up to make by expanding their existing facilities to twenty hour shifts. They are not to increase their factory or build a new factory but they are to simply make as much ammunition as they can with the existing machinery, ironing out weak spots. For the .30-Caliber that will be something over a million a day. Remington is to do the same thing, turning out over a million; Winchester-Western, something over two million, and the remaining deficit is to be taken care of by two new plants, one to be constructed by Remington and one by Winchester-Western,

the remaining deficit to be split equally between them. That is the plan we are working on now.

Colonel Jordan: When do you expect to get deliveries out of these new plants?

A. Not before nine months. That is perhaps optimistic, but we will get deliveries from the other plants, of course, at once -- not full capacity but what they are able to make now.

Q. We have subsidies for ships and aircraft, could we not have gotten subsidies for holding some of these plants that are now out of existence?

A. Of course, the most important thing we could do was to give each plant a small yearly order called an "educational order." That is the most constructive and the finest thing we could possibly do, but we need legislation for that. We have never been able to get such legislation through Congress because Congress does not see a necessity for it the way we do. Effort is still being made to get legislation to allow us to give these companies educational orders. As far as talking about subsidies is concerned, it is extremely valuable and important, the difficulty is getting it through. Remember the Nye Committee and all the hostility that was shown to munition makers? What would happen if you tried to go up and subsidize a munition maker?

Q. What is being done about the tracer composition? Is it being made more stable now than it used to be?

A. The tracer composition today seems fairly satisfactory. They had much trouble in the period after the World War with the tracer compositions that were made. They had some fairly satisfactory ones during

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the war, but they traced only a short distance -- six hundred yards. The Services wanted much more than that. They wanted them to trace two thousand yards, etc. They practically obtained a composition that was thought to be entirely satisfactory but a short time ago that composition caused the bullets to break wide open, because a little bit of Chemists assured us that that was entirely stable but our practice showed that the chemists were wrong because the composition broke down and cracked the bullets open. However that trouble passed several years ago and the tracer compositions we have now are very stable. They do not trace too long. Instead of tracing two thousand yards they trace a little over half that distance. Perhaps I am not up to the latest figures on that. However, the Services will ask for all things. They take a great big lantern and hang it on a railroad train, and then to expect a doggone little old bullet like this to be seen up there two thousand yards away!

Q. Can this machinery that is used to manufacture the 30-Caliber ammunition be adapted to manufacture the .276, which was considered some time ago?

A. There would be absolutely no trouble about that. To illustrate, at the time of the war the British had several big factories making a rifle. That rifle was designed for the .276. There it is, and here is our .30, (displaying exhibits). There is not much difference between the British .276 and our .30. The British rifle was designed for the .276 but before they got it into production the war broke out. They already had a lot of .30's, so they changed their rifle over there. When we came into the war the question was whether to take a rifle that shot

our own ammunition or one that shot the British ammunition. We decided it would be hopeless confusion to take the British ammunition, so they decided to change the .303 to the .30. It took six months to make that simple change.. all the tools scrapped. The

machinery used for the .30-Caliber is absolutely adaptable to the .32-Caliber, or the .276, or the 6½ mm, or the 7 mm. They are all very much the same size, just a change in the diameter of the bullet.

Q. Colonel, you have drawn rather an impressive picture, but what have we done to it by the introduction of the semi-automatic rifle?

A. The only effect that would have on the ammunition picture would be such changes in requirements as would be caused by the fact that they expect the soldier, possibly, to shoot more ammunition. They use the same kind of ammunition. The reason for the introduction of the semi-automatic rifle is not so the soldier can blaze away more ammunition in a battle. He may do that, but the reason for it is so he will not have to be operating that bore all the time. The soldier lies down on the field, opens that bore with a great effort and makes a motion that can be seen. In the meantime he has lost his target. That is all very bad if you are in a field battle, but the real thing is that the semi-automatic is useful for low flying aeroplanes. If a battalion of Infantry bang five shots at an aeroplane they are likely to hit it.

Q. Will that result in increased consumption of ammunition?

A. It will undoubtedly result in an increase of ammunition. I doubt if it is going to result in as much increased consumption as people would think. It is not the objective of the semi-automatic

to have the soldiers bang away, but it will undoubtedly result in an increase of ammunition.

Q. Along the line of the .276, from the procurement standpoint is there any reason why the .276 should not have been adopted?

A. No, not from the manufacturing standpoint.

Q. How about the rifle end of it? Did that affect it at all?

A. You mean, whether or not we should have had the .276?

Q. Yes sir.

A. In fact, it is easier to make the .276 than it is to make the .30 because of less difficulty in functioning with the smaller cartridges -- sharper tapers, extracted more easily, and are a much more advanced cartridge. The reason for not adopting it was the confusion of having two kinds of ammunition. In the manufacturing of the .276 there are considerable advantages, not the least of which is that it uses thirty per cent less material, which is very hard to get.

Colonel Jordan: One other point about that, too, is that if you have ever been an Ordnance officer supplying ammunition and they give you another caliber to supply with the various kinds of ammunition, God help you! We had enough trouble with the .30-Caliber.

Q. What is considered to be the minimum military caliber that would effectively kill at battle range? Is it the .276, or is it the 2.56?

A. There are three calibers in common use: the 7.6mm, which is our own .30-Caliber; the 7 mm. which is the .276; the 6 $\frac{1}{2}$  mm., and

many nations use that, which is the .256. Of these three cartridges, for a battle range the most effective is the .256. A number of years ago the Navy used one that was 23-caliber, 6 mm Navy. Our own Navy used that for a good many years. They generally consider that the .256 is the smallest caliber you can use effectively at battle range, and one reason for this is that you have to have armor piercing and tracer bullets and if you get a smaller one than that you do not have room to put them in. If you get a high powered rifle, the smaller caliber the worse wound it makes, because when it hits you it turns over and messes you up in good shape. The worst wounds I have ever seen were produced by 6 $\frac{1}{2}$  mm bullets.

Q. I hope you do not mind us asking all these questions, but one of the difficulties, from the point of view of an Infantryman today, is that we are giving to the individual soldier a weapon, which, because of the high velocity and everything, can actually kill a man, I think, at the neighborhood, roughly, of 4500 yards; we issue that to a soldier who has, instead of a metal tripod, his arms and his shoulders to support the terrific impact that you get from that rifle. Now, as a doughboy, I am asking this question, from the procurement standpoint, leaving aside the tactical or other questions: would it be an insuperable job from a manufacturing or procurement standpoint to, if you insist upon having .30-Caliber ammunition throughout for both machine guns and rifles, put in a different powder charge, either a different powder or exactly the same powder in a different quantity, so that a rifleman would not be asked to fire a weapon that it takes a pretty good machine gun

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now to hold down?

A. If we should go back to the old 150 grain flat base bullet that we had during the World War and put in a smaller powder charge the procurement difficulties would be reduced. It would not be as hard to make some of those; boattail bullets would not be so hard to make; flattail bullets would be more easily and quickly and cheaply made, and the powder will cost less. It will cost less to low charge, but you are under difficulties because you may have surges of pressure back in there (indicating), or difficulties in having the powder in one end of the bullet or other. However, from the procurement point of view you can do that without any trouble.

B. How about the range?

A. He wants less range. I am not going into that. It is perfectly feasible from the procurement end. I do not mean that I favor it or do not favor it. I leave that out.

Colonel Jordan: I remember the old Craig rifle we had years ago. When we wanted to be sure we were going to have the cartridge explode, before we fired we would up end it so that we would be sure the powder was down against the primer. If we did it the other way the chances were we had a hang fire or got into trouble, but I do want to say that, as some one who has had experience in the issue of ammunition, I certainly would not want to see another caliber of ammunition introduced, nor another class of cartridges to keep track of to supply the doughboy with. I mean that definitely.

A. I happen to be an advocate of the .276, as perhaps you

have already surmised. The question from the using standpoint on that I do not believe is insurmountable. In other words, if we were to do away entirely with the ammunition for all shoulder weapons and make it all .276. As it stands today we have Normal Piercing .30-Caliber, Tracing .30-Caliber; and I think we did have at one time an explosive bullet of some kind. We have several different kinds of .30-Caliber ammunition supplied now.

Q. I do not know anything about it actually, but I believe it would be practicable to issue .276 ammunition for all of our shoulder weapons. For the machine guns, which are in different units not in rifle companies, we could still have the .30 if we still feel that we need a .30-Caliber machine gun. But, again, from the point of view of the operator, one of the reasons we have not been able to develop an air-cooled, light machine gun that one man can carry, which I think is pretty generally accepted in the Infantry as one of the ideal weapons we ought to have, is that our rifle marksmanship people are experts, who want to hurt a fly at a thousand yards, and have to have this high velocity, extremely accurate ammunition.

A. It is not our rifle marksmanship, it is because we happen to have this . It came from way back there.

Q. The only source of energy, as I see it, is heat energy. With this high powered ammunition that we have, our cooling devices have to be very heavy or we have to use water. We could adopt an ammunition like .276, which will kill a man at fifty or two hundred yards, and, after all, in war you do not shoot at 4500 yards except in laying machine

guns. If we could have .276 for rifles and .30-Caliber for machine guns I believe we could have only two calibers of ammunition, including tracer, of course, only. We have four now including the .45-Caliber pistol ammunition. I do realize, as Colonel Jordan says, the difficulty of distribution but I do not believe it is quite insurmountable.

Colonel Jordan: You are also very sanguine about getting money from Congress to build .276 rifles. We have a large supply of .30-Caliber on hand, and Swagger Sherley said down at the War College that there was one thing we were always going to face and that is lack of preparedness; we were never going to have what we wanted, and the chances are we were going to fight the next war with what we had from the last war. We have .30-Caliber, and I think you, as an Infantryman, are going to fight the next war with .30-Caliber.

Colonel Harris, would you care to say anything? We would be very glad to hear from you.

Colonel Harris: I got here after the lecture was over so I am fully prepared to discuss it. I would like to go on with the argument. I am inclined to believe that if we did not have Camp Perry we would be better off. I am rather inclined to believe that we have developed to where we have too good a rifle and too long a range, and I believe Colonel Hatcher has contributed to it.

Colonel Hatcher: Well, I want to say one thing: I believe that Camp Perry had nothing whatever to do with the fact that we haven't .276. It is a fact that we have had this 1906 ammunition and the rifle that fits it for many, many years, and I also want to say that the boattail bullet

with the long range is very unpopular at Camp Perry. They would love to go to something that does not kick so much. The most popular ammunition was reduced load ammunition. Where this boattail ammunition came from that we have is not from Camp Perry, Colonel Harris, but from cablegrams that came from the American Expeditionary Forces in France. I happen to know that personally because I handled those cablegrams, and that is exactly where it came from.

Colonel Harris: You know what I am driving at.

Colonel Hatcher: I have gone out to Camp Perry year after year, and I have acted as a break on people who want to get all kinds of things except service ammunition out there. I stop them right down, and say: "You have got to have service ammunition." I think you have a somewhat wrong idea as to my relation. The reason why I play this game is because I have been put on small arms work. Since 1916 I have been playing this game so I would be able to handle the Ordnance end of it.

Colonel Jordan: We have a powerful weapon. We have increased the velocity; we have increased the pressure; we have flattened the rejectory and made the weapon the effective tool it is. The question in my mind, and I do not pretend to know the answer, is whether we need a rifle that can shoot beyond what we can see. Perhaps we are overpowered or oversexed on this proposition.

Colonel Hatcher: Colonel, I have been on a good many of these Board meetings on the .376 rifle and the Infantry would be perfectly satisfied and the Army would be satisfied with a rifle that would shoot with accuracy and effect up to six or eight hundred yards, and this other thing is something we have and we do not know how to let go of it, like

the fellow who had the bear by the tail. We have all these millions of rifles and we would rather have the .276. However, we do have all these others and we cannot drop them.

Q. Would it be possible then, as an alternative, from a procurement standpoint -- I do not advocate the .276 any more than the .256 or any other number, simply something a rifleman can shoot without having his shoulder pounded to pieces, and, as the Colonel has said, if the Infantry would only be sensible in what it asks the Ordnance Department to do -- to put in reduced charge for .30-Caliber ammunition?

A. Absolutely, from a procurement point of view.

Q. Isn't that a possible solution?

A. That would be a reduced charge together with a different form of bullet, which is the same form we had for years and the same as that we have left of our war-time ammunition.

Q. That could work!

A. Absolutely, from the procurement point of view. From a broad tactical point of view it is another story. I am not trying to say it is desirable because we have the supply complication, but just answering your question specifically, from the procurement point of view, it would be.

Colonel Jordant: But from the distribution point, God help the Ordnance! You have introduced another element, another thing to issue. I do not want it.

General Schull, would you please say something to us, sir?

General Schull: Thank you. It has been a very interesting

discussion that Colonel Hatcher has brought out as a result of his talk. I might say that Colonel Hatcher, in connection with our procurement planning for our ammunition, has, in addition to his duties as District Executive in Baltimore, been placed in direct charge of developing our plans for the production of procurement of small arms ammunition in collaboration with the ammunition division of our War Plans Section in the manufacturing section in collaboration with the Hartford District, and he is getting a pretty good start in the development of these plans.

One thing that he did not bring out, or if he did I did not hear it, was that we have in reserve about nine hundred million, or from nine hundred million to a billion rounds of .30-Caliber ammunition, which is maintained, of course, by Frankford production from year to year, so that any shortage which may be apparent is more or less taken care of by this fairly large reserve. I do not remember how far that would carry us over into an emergency, probably three or four months. So, the situation is not quite as dark as you might think with regard to that, and, until we do get into production in these new plants, and into expanded production in the existing plants in seven or eight months, we would just have to conserve ammunition some way. It would seem to me that all we could do during that period would be to make this reserve last.

Colonel Hatchery: We are much more fortunate now than when we entered the World War. Then we only had two hundred millions of ammunition on hand. On the other hand, we had the factories which had been working for the Allies for three years which we now would not have. That balances it, perhaps.

Colonel Jordan: It has been particularly fortunate, I think, that we in the College have been able to have Colonel Hatcher come and talk to us today on this subject. I feel that the Class, as a general thing, does not appreciate what the Ordnance Department is up against in connection with small arms manufacture. I remember that last year after Colonel Hatcher talked one of the students came into my office and said: "Colonel, I thought the Ordnance Department had a number of problems that were pretty hard to solve but I think the manufacture of small arms ammunition is the toughest one of all." Well, we in the Ordnance will not agree to that, but it is a tough problem and I want you gentlemen to appreciate it.

Thank you very much, Colonel Hatcher.