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UTILIZATION OF SMALLER PLANTS

23 March 1949

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MR. BAUM: Gentlemen, one of the most difficult problems of war production is the effective utilization of smaller plants, particularly those of smaller manufacturing companies. This morning we have as our speaker an industrialist who, early in World War II, successfully organized a group of these smaller companies for war production. He directed their conversion from peacetime manufacture to the production of ordnance material, and because of his initiative and managerial ability, these companies contributed substantially to three major ordnance programs.

His lecture is titled "The Utilization of Smaller Plants." I know of no one more able to speak on this subject than Mr. Robert C. Enos, President of the Standard Steel Spring Company and Chairman of the Board of the E. W. Bliss Company. Mr. Enos.

MR. ENOS: Thank you very much. I might say that introduction is slightly exaggerated.

We are a small company in Coraopolis, Pennsylvania. Our business is manufacturing springs and bumpers for automobiles. In manufacturing springs, we necessarily heat-treat steel. In making bumpers, we form steel, both hot and cold, and heat-treat it.

As most other people in business in 1940 and 1941 were doing, we were looking around to see what we could make, with our equipment and the knowledge that our people had, that might be of help in case we went to war. We thought about making armor plate.

Armor plate, up to the Second World War, had been regarded as something very secretive; there was a great deal of mystery connected with it; and it was pretty well corralled by two or three of the large steel companies. We began to make inquiries. We talked to Ordnance, to the Navy, and to the Air Corps. There was some question in their representatives' minds--and I think rightfully so--as to whether a company manufacturing springs and bumpers could make armor plate. But we got the specifications for the Army, Navy, and Air Corps; we got some steel; and we made armor plate.

To make armor plate is really a simple thing. It might be surprising to you gentlemen to know that the heat-treatment of automobile springs has to be watched even closer than does the heat-treatment of armor plate--heat-treatment is practically all there is to making armor plate. Anyone with any commercial knowledge of heat-treating can make very fine armor plate, provided that the steel is reasonably clean and of the right kind of analysis.

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After we had qualified on the proving ground with the Air Force and the Army, we began to give more thought to it. We thought we knew what we could do, but we were not so sure about it. At about that time we began to look around to see whom we would pick as a prospective customer in the event of war, and we decided that we would pick one of the automobile companies that were contemplating engaging in the manufacture of tanks. They were the people with whom we had done business for a great many years, and we knew how they did business.

Cadillac got an order for the first small tank. We told its representative that we would like to talk to them about supplying the armor plate. Since General Motors had always been the biggest customer of our company, and we had a certain amount of standing with General Motors, I think that company reviewed our application to be considered as a source quicker and with a better reception than it did the application of anybody else who might have put in an application. We had competition from a couple of fairly good-sized companies--U. S. Steel and Republic Steel--but we got the contract from Cadillac to make its armor plate. I am not so sure that we would have gotten the contract if Carnegie or Republic had had any capacity available and if Cadillac had thought that its wants could have been taken care of by those companies.

We got that order, and we were going to make the armor plate in our own plant at Coraopolis. We had the order only three days when we received a telephone call from an official of the International Harvester Company--another customer. He said, "We are going to make tanks out in Davenport and Bettendorf, Iowa, and you are going to make the armor plate." I said, "You're all wet. We don't have any capacity." He said, "We just talked to the Ordnance Department--and you are going to make it. A few minutes later I got a call from Colonel Crawford, who said, "You are going to make Harvester's armor plate." Well, that was a little more authoritative statement than Harvester's.

We decided that we would put a building on some land we had near our spring plant. We worked 36 hours and brought to Ordnance a plant layout that was pretty much in detail, including heat-treating furnaces, presses, flame-cutting equipment, and so forth. We brought it into Colonel Crawford's office, and he called in some of his people. We laid out this print, and a pile of details with it, on a big table. Colonel Crawford just pushed it all right on to the floor. He said, "We don't have time to build any plants." Any of you who know Crawford can appreciate how he does things. He said, "You have had competitors in your business." I said, "Plenty." He said, "If you can convert your Coraopolis plant to making armor plate, is there any reason why your competitors cannot convert their plants to making armor plate?" I said, "No." He said, "We want your company to assume the responsibility of taking care of the shortage that exists at the present time and that will continue to increase over and above what the integrated companies like Carnegie and Republic can take care of. We will give you all the help

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we possibly can. We will give you money for additional facilities over and above what you have in these plants, but we want you to utilize existing plants and existing facilities as much as possible--and time is an important element." He said, "We have given Carnegie authority to build a brand-new armor plate plant at Gary, Indiana, but it is going to be 18 months before this plant will be equipped and ready to turn out armor plate, and God knows, we've got to have it now."

Well, that was a pretty big order and a terrific amount of responsibility. The first thing we did was to set up a meeting; we selected Toledo, Ohio, because that was a rather central point for the automobile parts makers. We asked them all to come in, and they did, together with Ordnance officers. The competitors all came in, and they were most cooperative. We and the Ordnance people who were there outlined the picture. We showed them how we were going to convert Coraopolis. Then they came down to our plant, and we sent people up to their plants.

We started out with the idea that we would have to use only the companies manufacturing springs and bumpers. But in a couple of days we got another call from Colonel Crawford. He said, "You've got to furnish the armor plate for American Locomotive for the tank destroyer they are hollering for in North Africa. We can't get the armor plate. You've got to take that on." The thing just mushroomed. We finally had orders for so many thousand tons of armor plate that, if we had time to think about it, I think we would have been scared to death. The requirements were far beyond anything the automotive parts makers could take care of. We had to get people who had experience in the fabrication of metal or particularly in heat-treatment. So we considered who else we could get. We got people who made kitchen stoves and kitchen sinks, because, in the making of the vitreous enamel on the steel, there are really closer heat-treatment tolerance limitations, I might say, than there are in making springs. At the end, we had to go, among other places, to a manufacturer of bricks at Streator, Illinois. If anybody had ever said that he could make armor plate in a brick kiln, we would have said he was completely crazy. These brick kilns were long furnaces. They were out in the open air. The material was put in one end, and it would come out the other end. Strange as it may seem, by that slow soaking, we produced, by far, the finest armor plate we ever turned out.

The schedule we had did not jump by days; it jumped by hours. We had a top schedule at one time of 38,000 tons of armor plate a month. That was when everybody was getting scared, and so forth. We never got up to that schedule. I think the greatest amount of finished armor plate we ever turned out in any one month was 16,000 tons. The armor for a tank and armored vehicles ran anywhere from a ton and a quarter a tank, at the end, on the T-26, to 10 tons a tank.

We learned that these people wanted only the advice that we and the Government could give them. We did not call them subcontractors because

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a great many of them were bigger companies than we were. In most instance all we had to do was outline the plan, tell them what they had to do, and they carried the ball from then on.

Within 60 days from the time we started, without any government equipment, we were turning out armor plate. In September 1942 we had it running out of Ordnance's ears, and then Ordnance slowed us up. However, these manufacturers did an outstanding job. We could not have done it, and they could not have done it, if we had not had all the backing and all the help that we received from Ordnance. Colonel Crane was our first contracting officer in Detroit. I don't believe, however, that there were very many officers in Ordnance who thought our plan of making armor plate with existing facilities and with stove makers would work.

Among the people we had making armor plate was a company that made door handles for automobiles, the W. B. Jarvis Company, which turned out to be a good source. We had a company that made caskets straightening armor plate. We had one company--I think you will be interested in this--that turned out to be one of our best sources, the Chicago Vitreous Enamel Product Company. That company made armor plate in its vitreous enamel furnaces. I was over there one night and said, "What else do you do here?" "Oh," an official said, "we've got another war project." And in the same building, separated by a low wall, was his other project--dried eggs for Armour & Company.

We made armor for 41 different vehicles. We shipped armor plate, believe it or not, for American Locomotive for the El Alamein campaign in North Africa by air express; if you don't think it costs money to ship armor plate by air express, you are mistaken.

Not only was it a surprising thing that we met the government's requirements on production, but it was an interesting thing to watch how the price of armor plate under these circumstances worked out. At first the whole object was to get the armor plate. Then, after a while, you naturally became conscious of price.

Carnegie-Illinois had gone ahead with its big plant at Gary, Indiana. Perhaps some of you older officers recall that there was quite a little argument between our company and the head of Ordnance at that time. We had all the facilities and all the productive capacity that the Government needed. We objected seriously to being put out of business just because there was a new fully integrated plant that was now ready to produce armor plate. I think we are probably the only company that ever took on U. S. Steel and the others at one time and licked them.

There is one more thing I would like to talk about for a minute; that is, one of the things that helped us and on which I think we and our steel sources made a contribution. There was never one pound of

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nickel used in our armor plate. The theory--and the Nickel Company had done a great job of selling it--was that the only way to make armor plate is to load it up with nickel. Gentlemen, the reason we made armor plate out of steel that did not have any nickel was not that we didn't think we could make good armor plate with nickel, but that we could not buy from anybody any steel that had any nickel in it. We had to use an alloy steel that did not have nickel, and the armor plate made from that steel was just as resistant to penetration, just as resistant to spalling, and just as good in every way as armor plate made out of steel with nickel.

I would like to get back to the matter of price. When we started, our prices were high. We didn't know how much this material was going to cost. We had some ideas, and we started with a price considerably higher than that of the fully integrated steel companies. When we got down, in 1943, to a fight with General Campbell--who, by the way, is a very good friend of mine--we, with this conglomeration of stove makers, brick yards, and so forth, were making and delivering armor plate at a lower price than these fully integrated steel companies. We continued to do that through the war. This conglomeration of people who had never made any armor plate in their lives ended up making 20 times more in number of pieces than any one company, and at a comparable price. Comparing piece by piece, we ended up selling that armor plate for 18 percent less than U. S. Steel sold it for.

That, to me, is very interesting. It proves that you are not under a handicap, from a price standpoint, in utilizing these other plants. The Government put 45 million dollars into the armor plate plant at Gary, and I don't think it turned out 5,000 tons of armor plate. We turned out thousands of tons of armor plate, and the total money that the Government gave us and all of our subcontractors for additional facilities--burning equipment and similar things that we had to have--was little less than 8.5 million dollars.

In 1943, after we got off our chest the argument with General Campbell and U. S. Steel, and so forth, I thought, "This is going to be pretty soft from now on." Then there was a shortage of truck axles. General Quinton called up and said, "We want you to make truck axles." I said, "I don't know anything about that." "Oh, yes, you do." he said, "You used to be with Eaton Axle Company." To make a long story short, we went into manufacturing truck axles, and that was tougher than making armor plate, as Colonel Davis, who was our first contracting officer, knows.

What we did at that time was to tie in manufacturers of machine tools. Their production by that time had started on the downgrade, they all had existing facilities open, and they all knew what close tolerances meant. I think we had about 30 subcontractors on that. We utilized the things we had learned in the armor plate program, so the organizational part of the axle program was very much smoother by reason of that

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experience than it was in the manufacture of armor plate; but the product, I would say, was four or five times more difficult to make. There was a tremendous amount of machining, and the tolerances were much closer. In armor plate, we had welded tanks. We could flame-cut those. We could grind the edges if we had time. If we didn't, they would be filled up with welding metal. But we couldn't do that on axles.

The Government gave us a plant at St. Louis, but that wasn't any Christmas present either. If you have ever run a plant in St. Louis in the summer time, you know what I mean. We made part of the axles in our own plant, and we subcontracted the rest of it. We had subcontractors from Bridgeport, Connecticut, out to Sioux Falls, South Dakota, and none of them had ever made an axle. But with the cooperation and engineering help of Ordnance and its backing us 100 percent, we were able to take care of the government's requirements on axles.

That is about the story of our "subcontracting," if you would call it that, experience. We learned a great deal. Our company is a much better company because of the experience we gained. I think our subcontractors all gained by it.

One of the things to remember--you may run into this in the future--is the fear of subcontractors that when the war is over or the orders have been terminated, the subcontractors are going to get stuck with a lot of equipment, and so forth. Toward the end of 1942 we felt, "We are in now, but we want to be sure we are going to get out of it all right." I think it will help you to interest your prospective people if you are able to show them how they are going to get out without losing any money that they might make--it certainly was something if anybody made any money out of the renegotiation people you have over at the Pentagon.

That is all I have.

QUESTION: Mr. Enos, did you make springs all the time you were making armor plate? Did you continue with your spring business?

MR. ENOS: I didn't tell you this, but somebody got the idea that we could make 500- and 1000-pound GP and SAP bombs. So we took an abandoned steel plant in New Castle and we made bombs by forming them on a 250-ton Williams-White mechanical press. It was a hard way to do it, but we made them. We ended up with over a million of those bombs. That bomb program also had some fluctuations up and down. Every time the Germans would win a battle, up it would go; then it would go down.

Now, we had all the armor plate business of General Motors. One day Mr. Wilson, president of GM, called me to ask if I would come up there. He said, "You have Fisher tanks, you have the Chevrolet job, you have the General Motors tank, you have Cadillac, and you have the Ternstedt turret. We would like to make some armor plate ourselves."

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There was no question that we were taking care of him; it was a matter of policy. He said, "Would you take over our Army truck spring business that we are handling in our own spring plant at Chevrolet so that we may convert that plant to making armor plate?" We were glad to get it because we thought we might keep some of it after the war was over, and we did.

We had to swing in the spring line somewhere. About that time the bomb production had been curtailed. We put in a line of springs at New Castle, so we also made truck springs for the Army during the war.

QUESTION: Mr. Enos, we have heard quite a bit of controversy on renegotiation. Some seem to think it is good, particularly the government men; many of the manufacturers have had criticism of it. Will you give us some of the pros and cons as seen from the manufacturing angle?

MR. ENOS: I think most of the manufacturers' griping about renegotiation was not because they thought the amount of profit allowed was unsatisfactory. There were not very many people in business who thought they should get rich on war business, because we had only one customer and we did not have any credit risk. I think the main trouble was in the wording of the Renegotiation Act, in that the average profits of 1936 through 1939 were used in estimating how much profit would be allowed on our business. It was based on what we were earning between 1936 and 1939, on our fixed assets, and on how big a company we were.

This is the record. U. S. Steel ended up with 4-percent profit; Standard Steel Spring, with less than 2 percent. U. S. Steel had a lot of money invested in bricks and plant and mortar. We thought that, even though we did not have so much capital as one of the larger companies, there should have been a more reasonable allowance. In other words, we were not complaining so much about the money the Government allowed us to make as about what we thought was discrimination. I believe that 95 percent of the people who found fault with renegotiation did it because of what they got in comparison with their competitors or people in some other line of business, not because they thought they did not get enough out of it.

I think, if we have another war, probably the new renegotiation act should be revised to make it more equitable from that standpoint.

QUESTION: Mr. Enos, I was surprised to hear you say that the combination of smaller companies making armor plate did it 18 percent cheaper than did the large companies. Did you include in the charges of the large company items such as the 45 million dollars that the Government spent for the Gary, Indiana, plant? How were the charges figured? And do you have any comments on why you were able to make it cheaper than any of the larger companies could?

MR. ENOS: The Gary plant was never operated in the production of armor plate. By the time that plant was completed and ready to run,

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the government's requirements for armor plate had dropped down; and the production of the Farrell plant of Carnegie-Illinois, where it had made armor plate for the British before the war, and of the Republic plant at Massillon, Ohio, together with the capacity we had created, was more than enough to take care of any requirements of the Armed Forces. In fact, in the last couple of years of the war we had to trim back our subcontractors. I think we ended up with only 12 out of a total of 33.

This question of price was one in which we were continually over our head. The figures I am giving you are for armor plate that was sold by the U. S. Steel Company to the Chrysler Corporation for the T-26 tank, as against the price at which we sold the T-26 armor plate to the Fisher Body Company. It is a matter of record, in renegotiation and so forth, that our price was 18 percent less. Why? I can't answer that. I think that, even with this hodgepodge, crazy-quilt idea, we had a pretty efficient operation. I think that the smaller companies that have good management are more efficient. I think they can make things cheaper, and this T-26 armor plate proved it.

All during the war Carnegie-Illinois made only two sizes of armor plate for tanks--for the M-3 and the T-26. As I told you, we had some 40 vehicles, from the Bren-gun carriage up to the T-26. If Carnegie or Republic, in our opinion, had been manufacturing the same variety of sizes, with the countless number of pieces, that we were making, their price would have been a lot more than 18 percent higher than that of the Standard Steel Spring Company.

QUESTION: The information you have given us seems to illustrate the case that, given all the tools, any fool can do it, but it takes real experts to do it without all the necessary equipment. Could you give us any idea of what yardstick you could use to measure management in terms of the expert, as you have given us this morning, which might facilitate, say, the allocation of contractors for plants, and that sort of thing?

MR. ENOS: I think the first thing to do is to get some smaller company such as ours to go ahead and assume the responsibility.

Most of these smaller companies are well managed. They have to be well managed or they don't live. We can turn more quickly in the smaller company than the big companies can. They have executive committees and finance committees and vice president this and vice president that, and so on. In a small company all you have to do is get three or four of your operating people around you, sit down, and decide what you are going to do. Maybe you call up a couple of directors. Sometimes you call them up after you have done it; sometimes before. We found out it was better to tell them afterward.

I had lunch last month with Albert Bradley, who is Executive Vice President of General Motors. He said, "Bob, do you remember the day you came into Wilson's office and asked him for a check for 30 million

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dollars?" And we laughed about that. This is how it came about:

We started this war program with a working capital of \$800,000. In April we had over 350 million dollars worth of business on our books. If we had permitted our comptroller to give our directors a statement, they would have seen we were just as broke as broke could be. But we weren't worrying; we knew that Ordnance had the provision that any prime contractor must give his subcontractors an advance of 30 percent if they needed it to carry along their business. We had over 100 million dollars worth of business with General Motors. So I went up to Mr. Wilson and told him I would like to have a check for 30 million dollars. It was not an unexpected request, but he called in Donaldson Brown, Mr. Sloan, and other "brass hats." He said, "How much cash do we have?" The treasurer figured out that they had about 102 million dollars cash. Mr. Wilson said, "Bob wants 30 million dollars. What about it?" Well, I ended up with a million dollars.

We left that night for New York, and the Army came up--and I mean the Army; there were several officers. From there we came back, went into immediate session in the Federal Reserve Bank Building, and we got a V-loan. Our company got the first V-loan made in America, and it worked out all right.

QUESTION: Sir, would you comment on what labor problems you may have had and also on what you think the labor policy of the Government should be, in general, in a future war?

MR. ENOS: We had no labor problems whatsoever. Labor was receptive. It knew what had to be done.

We didn't have any labor problems in getting into this program. The problems we had with labor were after we got out of this program and we started to get back into our commercial line of manufacturing. During the war the main drive was for armor plate, axles, and bombs. We didn't argue with anybody on the question of wage rates. We thought it was far more important to deliver the stuff when you people wanted it than to question a few cents an hour. Every industry, I believe, has paid in the last two or three years, and probably is still paying, a penalty for that. It is easy to raise wages, but it is not so easy to bring them down.

QUESTION: In reference to that same question, Mr. Enos, and the one that was asked before about your price, I take it that the fact that your subcontractors were distributed around in small communities and in small plants was one of the reasons why you, perhaps, avoided or were spared the manpower problems that these bigger plants in highly industrialized areas encountered. I understood you to say that at one time 33 was the maximum number of subcontractors you had and that your maximum output was about 16,000 tons a month. Could you

comment on the approximate average? Was it about 500 tons per plant and about 500 or 400 employees in the plant? Can you give us some idea of the size of the subcontractor to give us an idea of how far down we can go in utilizing the rather small subcontracting agencies?

MR. ENOS: We set up this subcontracting program and subcontractors with several ideas in mind. First, we got those we knew could make armor plate. Secondly, we were advised by the security department of the Government to spread these plants as much as possible in the event of a bomb or other attack here. We did that, particularly on the American Locomotive job and the heavier armor. We had it set up so that we had three plants, say, making part X-100 for a M-3 tank. We would have one of those plants somewhere near Chicago, maybe one down in Ohio somewhere, and maybe one a little farther east. In other words, in order to stop the production on the American Locomotive job, which was the hottest one, and then the M-3, we would almost have to have a national bombing.

We found that a company's size did not have much bearing on its efficiency. They were all pretty efficient.

I think the average number of employees that were used on this armor plate program--and it is in the history--was about 400. The number of employees, in a number of instances, was much lower because, while we had 33 subcontractors at the peak, bear in mind, when we started out, some of those had as many as three or four sub-subcontractors.

For instance the Burton Spring Company in Chicago did not have any presses for straightening armor plate. Until we could get it some presses, it farmed the straightening out. That is where one of these manufacturers of caskets came into it. He had straightening presses that were used in the manufacture of his product, and we brought him in to straighten armor plate.

As time went on, the less efficient, higher-cost producer automatically took himself out of the picture. When we finally ended up, we had the best and most efficient and, of course, the lowest-cost producers.

QUESTION: Mr. Enos, in the matter of industrial standardization, how much of an asset were prewar ASA and SAE standards to you in this subcontracting? What standardization activities would you like to see us get into now to put us in a better position for our operations in World War III?

MR. ENOS: I don't think there would be much you could do to improve on what you had in the late war. We had no argument and no suggestions to make on any of the specifications and standards.

We found Ordnance very receptive to any suggestions that we or our people would make that would from time to time help the situation. I

would like to mention that the people in our group of companies made a material contribution on armor plate. If you remember, the old medium tank was a riveted tank; then they went into a welded tank. Well, because we had been forging bumpers hot in the big press and the bumpers were shaped like that (indicating), some of our people said, "Instead of having a piece of armor plate with two sides and a top and two welds, why don't we form it and make it one piece, thus saving welding material, time, and labor?" The Government was very receptive to that. The ballistic results were better because a projectile would hit the plate at an angle. I think over half of the parts of the T-26, which is a big tank, are now hot-formed, eliminating a tremendous amount of welding. We quenched the piece right in the press after it had been hot-formed.

QUESTION: Mr. Enos, in your operation with all these companies, did you feel concerned at any time about the antitrust laws? Do you suggest the wartime relaxation of such laws?

MR. ENOS: I think it might be made a little clearer. We had Colonel Duffy of Ordnance in on this program because General Campbell and General Quinton were worried, the same as we were, and we got some kind of clearance. I don't think it was worth very much, but nobody ever bothered us. I do think you might eliminate a little worry as to that.

QUESTION: Could you give us some idea of the means of quality control, the manner of conducting inspection, and that sort of thing?

MR. ENOS: We had, you might say, triple inspection on this armor plate. We had the inspection of the subcontractor himself, then we had our own inspectors, and on top of that we had government inspection. We didn't have too much trouble. At the start we had a number of men in every plant, but as time went on we found that these people could run their own businesses and could do a good job of inspecting. At the end, outside of a half-dozen roving inspectors, who would come in at different hours of the day and night without letting the people know beforehand, we did not keep permanent inspectors in these plants.

The question was brought up during the intermission as to how we did this thing. We made a number of prints, say, of the M-3 tank, called in these subcontractors, laid the prints down, and said, "Now, with the sized furnaces you have and the sized presses, and so forth, which one of these parts can you make?" We were talking "price per pound" at that time, so they picked the easiest pieces. Then we had to reshuffle that and try rightfully to give them the best pieces that they could take care of.

For instance, this fellow Jarvis, who made door handles and so on for the automotive industry, and the Gerity-Michigan Corporation, which the same kind of business, took the small parts. You people would not

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be surprised, but a layman would be, that some of these pieces of armor plate weigh only a little over a pound. The fellows with big plants, such as Pressed Steel Car, Kalamazoo Stove, and some of our competitors' plants took the bigger pieces. On the important pieces of armor we had three sources of supply at all times.

We bought all the steel and shipped it to these contractors, and we always retained the title to that steel in the name of the Standard Steel Spring Company. These contractors then shipped direct, at our directions. For instance, Fisher had armor plate coming from 8 or 10 or more subcontractors. We scheduled it on the basis of trying, theoretically, to deliver at the same time all the pieces that would fit together. It might sound a little more difficult than it actually was after it got rolling. There wasn't much trouble there.

MR. BAUM: It is my understanding, Mr. Enos, that you have set up a stand-by line for the manufacture of general purpose bombs. Would you tell us about that?

MR. ENOS: In the New Castle plant where we made the bombs, Colonel Davis and his organization made available to us a spinner and a wobbler; with these, together with the other equipment that is there, we could start turning out bombs pretty quickly in case it was necessary. We thought--and Colonel Davis approved it--that it was better to have surplus government equipment in the plant of someone who knew how to use it--and could make bombs--than it would be to have it in some government warehouse without too much care being taken to preserve the equipment; that is, greasing, and maintenance.

MR. BAUM: Mr. Enos, on behalf of the College, I thank you for a very interesting lecture and a most informative discussion.

MR. ENOS: Thank you.

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