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NAVAL GUN PRODUCTION PROBLEMS

24 February 1948

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CONTENTS

	<u>Page</u>
SPEAKER—Rear Admiral Theodore D. Ruddock, Jr., Superintendent, Naval Gun Factory, Washington, D. C. ....	1
GENERAL DISCUSSION .....	13

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THE INDUSTRIAL COLLEGE OF THE ARMED FORCES

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CAPTAIN WORTHINGTON: Admiral Ruddock needs no introduction to any of us, but I would like to mention the fact that he has had an interesting experience in the ordnance field. He has been proof officer at the Naval Proving Ground, Dahlgren, Virginia. He has been the Director of the Production Division of the Bureau of Ordnance and Assistant Chief of the Bureau of Ordnance. On the operating or fighting end of ordnance he commanded the U.S.S. MASSACHUSETTS in central Pacific operations during the war, and later commanded Battleship Division 4, which stopped the Japanese in Surigao Strait. I take great pleasure in welcoming Admiral Ruddock back to this platform.

ADMIRAL RUDDOCK: It is indeed a pleasure to be back here. Last year I gave a talk about the Gun Factory. I was told this year that you wanted me to talk about some of the problems that we have in ordnance production. They are so manifold that I am going to limit myself to some few comments in regard to our general planning and some of the problems that we had to solve during the late unpleasantness.

When we first started to put ordnance on ships, it was very simple. The first one, of course, was the old Greek fire. That was very simple. Then we built wooden guns and put them on ships. We had to turn the ship, train it, so the gun would shoot where we wanted it to. Then we learned how to make cast-iron guns and put some of them on, with the same result. Then we mounted them, put them on a couple of wooden vertical pieces, mounted on four rollers. We turned them around with block and tackle and took up the recoil with another block and tackle with a man hanging on the end of it. There was also a weight on it and it would slide along the deck. Again we had to train the ship. We had to turn the ship so that the gun would approximately point where we wanted the bullet to go.

Now, along in the early eighteen hundreds people became interested, so far as the Navy was concerned, in being able to shoot in any direction regardless of where the ship was pointed. So some pivot guns were put in, what they called mounted guns, in the forward and after parts of the ship, forward of the foremast and aft of the main mast or mizzenmast.

When we went to steam, it became apparent that something better had to be done about this. The general development was first exemplified in the Monitor, which had one gun turret which could be pointed in any direction regardless of where the ship was going. There was very little machinery as such. The designs were drawn as a picture, colored in

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Of course, in the early days, when they cast the guns, that was very easy. I saw the specifications for our cast guns of the War of 1812. We made the casting, took it out of the mold, turned it muzzle up, poured it full of water, and if it didn't leak, it was acceptable. Incidentally, most of those were built in Georgetown. There was a little foundry over at the mouth of Rock Creek Park. I believe some ruins of it are still there. That is where practically all of the naval guns for the War of 1812 were cast.

It might be of interest to just note in passing that the Guerriere, Java, and Macedonia, after they were captured, were brought to Washington to what is now the Gun Factory and refitted for service. Just recently we were modifying our old building No. 2, turning it into quarters. We pulled out some of the old fireplaces that went up through the middle of the building, and we found an old account log. In that log was the cost accounting of the refitting of those ships. How it got behind the fireplace nobody knows. Incidentally, we also found a pay roll for the year 1833. The bricklayers at that time got 32 cents an hour. I have been wondering since we found that pay roll who was fired for losing it.

The most complicated thing we have to deal with is the mechanism for closing the breach of the guns, which in our new automatic or semi-automatic weapons is very important. Also the mounts, including the power, the amplification, and the driving of the mounts for remote control.

We normally have the designs completed by naval technicians, whether in uniform or not. We have a large corps of engineers who criticize these things and put the lines on the paper, so that the shops can go to work.

We naturally make the prototypes in our own plants. Some years ago the Congress passed a statute that said that all of these things were to be made in government plants. I don't know how seriously that affected the War Department, but it was very serious for the Navy Department because many of the plants could not make the things which they were required to make. So we had to tool them up. In many instances we asked the Army to do some of that work in arsenals, and those arsenals were tooled up, notably Rock Island. They have been doing that kind of work for us ever since.

But when we went to industry in 1939 and 1940, we immediately got up against the difficulty of finding plants with the equipment necessary to make the parts. They had the technical ability, they had the machinists, they had the supervisors, but they did not have the machinery. And that is still going to be one of our major problems.

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Now, from what I hear I am a little fearful that the present organizations are working along that same line. They intend to allocate plants to the Services and we are presumed to use only those facilities when it comes time to go to work. I think it must be more flexible than that. I think we must have the ability for each of the Services to survey industry and find those that can do the jobs with the least expansion, with the least provision of additional facilities; then come up with the allocation through the Munitions Board and the National Resources Board. We will be in difficulty if we do it in any other way.

The Bureau of Ordnance did attempt to utilize the old Munitions Board allocations. Of course, they were never placed in effect by the President as it was supposed to be. But we did know what plants were allocated to us. I doubt if we used twenty percent of them, because under normal conditions the plant surveys conducted on those plants were old. The machinery which was installed sometimes did not represent what had been indicated in the survey. In many instances also the management had changed and the new management was incapable of doing the job.

To keep these data up to date will require a staff that we cannot afford. The Services will have to do that job and do it well. Most of you will at some time or another probably be with one of those boards. That is partly what your objective is. I would just like to plant that thought with you, because I think it is going to be very important.

Another rather important phase of our planning is what are we going to do with the present facilities which at great expense the Services have installed in various places to obtain the required production? Whether we like it or not, we must maintain those facilities, because we probably will not have two years in which to get ready next time. We must be ready to go. It took us those two years to get ready. I have in mind the heavy forgings industry, which made the forgings for our light guns as well as for our heavy guns, armor, and other types of heavy equipment, crank shafts, and long shafts for ships, the spools for our turbines, and things of that sort.

After World War I the forgings industry had a very fine installation, especially the two heavy ordnance companies—there were really three. One of them didn't get into it at that time to any extent. The three I have in mind are Bethlehem, Midvale, and Crucible. Of the three, Crucible did the smallest amount. But the other two had very fine installations for forging and pressing the heavy plates and heavy forgings of all sorts and for turning these forgings. They had big

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Now, as I mentioned earlier, the requirements on the present type of gun mount have increased in exactitude in all the Services. A little cartoon that appeared in one of the magazines—no disrespect is meant by this—indicated a perfectly frustrated lieutenant colonel sitting on the ground, hat on the back of his head, saying, "I thought I could remember when all you had to do to fire one of those things was to pull a string." He had a mortar that was under control from his central control spot. He was supposed to lay it in a certain way and he was supposed to fire it when he was told to do so. He thought that was just too much.

The requirements in that respect are very similar to what they are in the Naval Establishment. The accuracy with which these mounts must be built is astounding. We have base rings of fifteen to eighteen feet in diameter which must be machined to less than a thousandth of an inch tolerance. That is in order to avoid the back lag which would pound out your bearings when you get rapid reversals, and also to give you the necessary accuracy in control which you must have if you are going to hit the target. The Navy mill is 3.42 minutes of arc. That is awful small. That may represent a matter of half a thousandth clearance in your turning gear, your worm wheel, for instance. The Army mill, I believe, is a thousandth of a radian, which is somewhat less than the Navy mill.

Now, in getting the various parts which we have to buy commercially we immediately cross up with much of industry. The trunnion bearing for the 5-inch mount was very similar to and made by the same people that make the roller bearings for railway cars and the new locomotives. They are the cone type. So naturally when we want to buy fifty of these things, "No can do"; they don't want the job. So we pay through the nose for them. Then when you get into mass production, they don't have the facilities for making those things. But they are the only people in industry who can make that bearing. There is nobody else. It must be that accurate. It must be that kind of bearing. You can't afford to have that gun sliding back and forth in the trunnions as the ship rolls. You can't have it batter itself to pieces every time you reverse the direction of motion. It must be tight. The clearance is zero. That is the kind of accuracy we must have.

Now, to get anybody else to make those bearings you also run into the difficulty of patents. This fellow has his own process and he won't license it to anybody. What are you going to do about that? You run into these things all the time.

Now, for the power we slowly progressed from straight electric. In the early days we used the Ward Leonard system. I don't know whether you gentlemen are familiar with the old system. It is merely a matter of controlling the impressed voltage on the motor through the motor-generator system. We progressed through that into various and sundry

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one of six or seven types of machines. Naturally our service toolings are designed to utilize the battery of machines which we have. That is not necessarily the most economical way, but it is a way of doing it in the small number which we require in peacetime. So we tool up to do it that way. Maybe that particular machine is not available in industry. We are using machines at the Gun Factory which were designed and built in 1892. We are still using them. Certainly the tools that will go on that machine will not go on a modern boring mill.

So that reproduction data, although theoretically sound, we have found in practice to be very deceptive. There was a requirement in 1935 that everything made by the Services should have reproduction data put in a little chest together with all inspection data, designs of gages, and drawings of all the instruments and the presses. We did that. We tried to get a 3-inch mount built by Mealy Printing Press. When he got the drawings, he took a look at them and found that he couldn't build it from them. So we had to start all over again. So don't be deceived by something that looks very lovely on the surface.

Now, I mentioned that our major problem in an emergency is normally not to get production of those things which we now know how to make. As a rule our own plants—the arsenals, the Gun Factory, and other places in industry where we had a few parts made—can give us some production of those things. Maybe we will need more, but we can gain a little time on that by utilizing our own facilities. Your major problem is going to be to get those new requirements in manufacture, the results of the experimental and research work which have been carried on for those preceding years and are just about coming to fruition.

In designing those things and getting them into production it is very essential that what I mentioned as the military technician or the naval technician be very intimately connected with it in all of its phases. I will give you an example of the lack of such coordination. Just before the late war ended, the Bureau decided to develop a 3-inch automatic antiaircraft gun, which we hoped would be better than the 40-millimeter. We wished to reach out further with the pay load. We hoped to get a good rate of fire from it. That job was parceled out to industry for development. There was no technical supervision given to the design. I believe you saw the prototype mount on the floor there at the Gun Factory last week.

We got the first one that was built by this company and we started to proof fire it. That was the first time a technician had gotten into the game. Well, you would not recognize it today from what we received from the company. None of the safety features was included in the design, because they didn't realize they were necessary. Many of the parts were too weak to carry the load when the gun was fired. The power drive was entirely inadequate.

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it was. Until we began making the 40-millimeter gun over here and gave it to them, they didn't get it. You can't have that in any of the Services.

The service requirements cannot be known to some central agency of that sort. We must have freedom of action to get what we know we need to do our job. We have been assigned each of us a job to do. We have got to get it done. We must have freedom of action to get it. I think we all realize that if we ever come around to adopting a full control of military production, as has become the case in England, none of our military services will be as efficient as they ought to be.

I was supposed to cover the production problems. I don't know whether I have covered any of them or not. But I intend to just summarize a few points and then I will open myself to questions.

Taking them in the converse order, so to speak, I think the most important thing that we have to do is to assure ourselves that we have the military technicians there to supervise and to be sure that what we are getting is what the customer wants. Who is our customer? It is the fellow in the field, be he flying an airplane, piloting a ship, or be he taking the trenches. He must be represented and he must be the fellow that controls what is gotten.

The second is specifications. We must know what he wants. We must be able to put it down so that it can be understood, including the drawings and including the inspection procedures. We must know these things. We must have them down. They must be thinking on advance lines so that we are ready to pick up these things that are just about ready to become useful, designs that have come up from war investigations or research—for example, the V-2. We must be prepared to pick the manufacturer early when a thing has any promise whatsoever. I will expand on that even though this is supposed to be a summary.

In June of 1942 the Research Director came to me and he said that he thought this would be ready for production in another thirty days. What should be done about it? We know it was coming. We had made certain reservations in regard to facilities, in the many fields for the manufacture of the parts. We further had gone out and bought ourselves about a thousand tons of bar stock, which the War Production Board is still hunting for, and we were ready to go. The investment, obligated on the mere say-so that this might come through in a month, was 25 million dollars. But it paid off. We must be prepared to do that again.

We must have adequate machinery for making those things which we require, whether they are little, tiny gear machines or 1600 or 16,000-ton presses. We must maintain an adequate stock of replacement machines

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The other alternative, as I pointed out before, is for that group to make some broad surveys, and in consultation with the Services involved to make a general allocation of the facilities at the time the facilities are required. There must be flexibility. That was one of the failures of the German system. It was not flexible. Once a plant got the job, it had the job. The Germans tried to change that later, without much success in quantity or in certain respects in quality.

Now I will try to answer any questions which anyone may have.

QUESTION: Admiral, could you tell us what this manufacturer of the 3-inch mount was given to work with and why no adequate supervision was undertaken?

ADMIRAL RUDDOCK: The manufacturer was the United Shoe Machinery Company. He had been playing around with the Bureau of Ordnance, and, I believe, Army Ordnance, in connection with certain automatic weapons. He also had the background of the 40-millimeter quadruple mount which we had. The company itself was very adamant about having anybody come to help them out, its representatives knew all about it. If any suggestions were made, they said "Thank you" and walked off and did it their own way anyhow.

I think the Bureau was very wrong in that, but that is what happened. They had the contract. They said, "We are doing the contract. We will do it our way." That is what you run into. It is really a matter of the psychology of the company rather than lack of interest on the part of the Bureau of Ordnance to put somebody in there. The Bureau wanted it, but the company would not have it.

On the other hand, to expand that a moment, the Bureau of Ordnance now has a contract outstanding—it is a classified project at the moment—for building a 3-inch 70 gun which has a very high velocity, very much along the same lines of automatic loading as the 3-inch 50 which we now have in production. There are two companies working on that, along somewhat different lines. We don't know which one will turn out to be the better. But in each of those instances the companies are very cooperative and there are technicians in their plants, in their design sections, and in their development groups to guide them in the development, so that what we get will probably be much more nearly what we need than was the case with the 3-inch 50.

QUESTION: What did they have to go on? Did they have design drawings?

ADMIRAL RUDDOCK: No; they did not. They had some sketches which showed the limitations on the work, the general specifications of the requirements, the number of rounds per minute, and so forth. They did not have a basic design except for the barrel and the breach mechanism, which, of course, they had to have.

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We had a foot-firing device on the 5-inch 38 gun. It had a central electric firing circuit which fired all the guns at once from a central station. That foot-firing device was used in case the firing circuit went out. The pointer himself could fire it when he was on the target by pressing his foot.

We sent the first one down to prove it. We got an awful howl down there. Every time they loaded the gun, it went off. It wouldn't wait for them at all. They couldn't figure out what was the matter. I happened to be in the design section at the time. We sent the gun back and I looked into it. We found that the accumulated tolerances, all of which had been taken on one side by the manufacturer or shop people, had just put this over the line on the foot-firing device. So every time the gun was loaded, the breach closed the foot-firing device and pushed the firing pin in.

Now, I don't know how that would have been caught by anybody just looking over the drawings. As a matter of fact, what we had to do was to go back and put negative tolerances on them with no positive tolerances. Those tolerances also came in the good direction, so that any accumulated tolerances could never push it over into the firing zone. I would think that a review of that sort would be useful, but I doubt if it would catch all of them.

QUESTION: Wouldn't it help the manufacturer, though, in being ready to go when there are a lot of other things that he must do?

ADMIRAL RUDDOCK: It would, very definitely. I would guess that for one of our gun mounts, to make such a review by the manufacturer, it would probably cost us about one hundred thousand dollars. If we can get the money, I think it would be desirable.

COMMENT: This is not a question. I would like to emphasize the warning you have given about the trouble that we had in England in our pompons. That arose really, I think, firstly from economy; and economy is the thing we are facing. We may have it again. You may have it. When economy is coming, it is extremely difficult to resist the urge to coordinate various services and bring them all into one. The opportunity of saving money then is very large. It is a thing that, I think, must be fought against, because once you get coordination, you can never split again, or it is extremely difficult to split. At the time the opportunity of saving is so great that it seems to be the only way of doing it. I don't know what the opposite one is. I think it needs a lot of thinking.

ADMIRAL RUDDOCK: I agree with you. I tried to make the point that the Services must be the people who decide what is needed. Each service must decide for itself what is needed for its own job. I don't

14  
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That commission came back and made an extensive report to the President and the Congress as to how the United States production of ordnance should be carried out. As a result the arsenal at Watervliet was established for the War Department and the Naval Gun Factory in Washington was established for the Navy. Their unanimous recommendation was that there be not a consolidated activity, after what they saw in Europe.

Also they recommended very definitely that all raw materials be manufactured in industry; that these plants do only the finishing work. I think their recommendation was very sound.

COMMENT: Have you had a chance to talk to Commander Mitchell in the last few months? He was over here just before Christmas.

ADMIRAL RUDDOCK: I saw him for just a few minutes.

COMMENT: I think if you had had a chance to discuss with him then, what he was talking about in 1940 and 1941, he would probably have been a bit happier. I would say the Army would have gone right along with him in 1940 and 1941, because, just the same way as the Navy, we were more or less told what we could have.

I think that was due greatly to the introduction of this Ministry of Supply just before the war. Then the war started we had a lot of high-powered people in industry. Just as with you and the Shoe Machinery Company, we in the case of tanks got into big truck-building companies. They said, "We are putting this on trucks and it works; therefore it must work in a tank." Of course, it just doesn't happen that way.

But what we are trying to do now—and I think we have achieved it pretty well—is that the control of policy and design and what you said is in the hands of the Services. But we do employ civilians to do the detailed designing work, in which they are usually better.

We also try to get our civilian designers out to pull the plug on the gun and see what happens. We take them from Commander Mitchell's department and our own design department; we actually put them on the gun and make them work it. Then they bark their shins and sprain their wrists and all that sort of thing on the rotten things that they produce for us. So we are trying awfully hard to get the two sides as close together as we can.

ADMIRAL RUDDOCK: I did talk to Commander Mitchell for about an hour. He did seem a lot happier about the situation, I must admit. He thought they were getting into the right channel. I feel that you are getting it under control, that you are getting the military and naval technicians into it at an earlier stage than you ever did before.

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CAPTAIN WORTHINGTON: On behalf of the College I want to thank you for your talk and for our visit to the Gun Factory.

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