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THE ARMY INDUSTRIAL COLLEGE
Washington, D. C.

Course 1936-1937

THE INDUSTRIAL WAR LOAD AS IT RELATES TO THE
OPTICAL INDUSTRY

By

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January 14, 1937

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After that introduction, I do not know whether I should say I feel at ease or not. I think a little to the contrary. It is going to put me up against a pretty hard job to live up to it. I have never done any work as a college professor. This is my very first experience. I haven't been in a class room since I left Syracuse twenty-five, thirty, or forty years ago, so I do not know whether or not I am going to be able to do a very good job of instructing, but perhaps I can think out loud on this subject and then if you ask questions probably I can leave something here that will be helpful to you.

I have been very much interested in this planning work because of the good job Major Winningsstad has done up in Rochester. Before he came to town our Company was rather opposed to taking a hand in this planning program for an emergency. I think we were justified in not being interested because up to that time we had the impression that the Government Departments were not in a position to profit by our planning. It was coming to us too piecemeal. We would be asked "How many fifteen foot range finders can you build in case of an emergency?" We knew very well that if we sat down, sharpened our pencil, and tried to figure out that problem, after a great deal of hard work we might have an answer but it would not be worth anything to anybody because we knew that if the emergency came we would not be building just fifteen foot range finders, we would be building at least a dozen other instruments and maybe a lot of them more important than this thing we were asked to plan on. For years we took the stand that we were not going to have anything to do with planning unless the Army and Navy got together. Well, they haven't got together yet and still we have been trying to be helpful in this planning program because Winningsstad explained to us the impossibility of getting the ideal setup and pleaded with us to be helpful, feeling that any kind of planning that was done would stimulate others to take an interest and maybe ultimately we would arrive at a condition where intelligent planning could be done. I think we were wise in doing that because we have learned a lot in cooperating with the District Ordnance Office, and I think the day is arriving when more intelligent planning will be done. It is true, we haven't heard anything from the Navy as to what

their requirements would be in case of war. The word we have gotten from the Air Corps has come through independent channels - it hasn't come through the District Office - so it has been hard to tie it in.

When we completed our planning with Winningstad up there, we felt that we had a picture of what the Army Ordnance needed, and I think we had a pretty good picture. When that was all finished, some officer up in Buffalo came down and said "Now, how many of these lenses could you make for us, and how many of these lenses could you make for us in case of an emergency?" That is sort of discouraging, you know. You cannot do intelligent planning that way, and we were inclined to turn them down and say "We understood that the Eastman Kodak Company was going to make all the photographic lenses during the war and we would not be bothered with that." But they came back and said "We can get a better picture of what conditions are if you do give us your capacity for photographic lens manufacture." So we made good fellows of ourselves and are now trying to give them an answer to that question, but I do not think it will mean much because it will have to give a lot of ifs and ands tied in, and those ifs and ands will be of a nature that people who are not in on the ground floor will not be able to interpret. Therefore, I want to make a very urgent plea to you people who are going to be interested in this industrial problem as time goes on to, first of all, when you go to a manufacturer, try to get the whole picture. I know it is a big job - it cannot be shaken out of your sleeve - it is going to take years of plugging away to get it. You will find that in order to interest most industrial people that that is a requisite. You are not going to stir up their interest, you are not going to get any worthwhile planning from them unless you do that.

A few days ago I saw this procurement plan that has finally been finished on fire control instruments, and I think it is a swell job. There are a lot of things in it that mean nothing at all but it shows the result of a lot of careful thought and if it accomplishes that purpose alone - getting the people to think about this procurement program in time of an emergency - it is worth a lot even if it cannot be followed. The people who had a hand in making that plan know so much more than they did before that when the emergency comes they are going to be able to plan further and bring order out of chaos. We who went through the World War from an industrial standpoint can foresee that if we have an emergency during the life of the people who went through the war, with the present planning, conditions are going to be so much better that

there isn't going to be any comparison. Things are going to run along comparatively smooth, and we are going to get out so much more product of the type that is really needed.

I do not know what you people know about the Optical Industry. I have picked out a few figures from this procurement plan on fire control instruments, which perhaps you know more about than I do, but I am just going to bring out a few points as I see them to help me build my story. According to the plan, there are twenty-six different optical instruments required by Army Ordnance. There are twelve plants lined up to carry on that work. The Bausch and Lomb Optical Company has six different instruments on its schedule and during the first year are supposed to turn out sixty-eight thousand units, American Optical have two complete instruments and optics for three - a total of thirteen hundred units, Spencer Lens Company have three complete instruments - a total of five hundred units, K & E. have one complete instrument - total of thirty units. Those units do not mean very much. When I say K. & E. have thirty units to build in the first year and Bausch and Lomb have sixty-eight thousand, that does not mean that we have about fifteen hundred times as much of a job as K. & E. There are different types of instruments in there K & E. only have height finders, anti-aircraft height finders, and although we have those in our program, too, we have a lot of binoculars and things of that kind that bring that unit figure way up. Eastman Kodak has optics for two instruments - seven thousand units in all. I think that gives you a picture of the size of the job that we have in Bausch and Lomb, and when I speak to you as a member of the Bausch and Lomb organization I am probably speaking for the Optical Industry. I haven't any authority to speak for the rest of these people, but you can see from the nature of the relative jobs that we have to do that, the picture I give you is probably typical of the Optical Industry.

There is another figure that this procurement plan gives. It shows a percentage of capacity. The figures given for these concerns vary from twenty-five per cent to ninety-six per cent of their capacity. I do not think that means anything at all, because it was so difficult to arrive at a definition of capacity. There are so many different kinds of capacity. There is capacity of floor space, there is capacity of special equipment for one type of instrument, there is capacity of general equipment that might be used on a variety of instruments, there is man-power capacity. There are so many different angles to this capacity that I do not know what it means. However, when we put in our schedule of what we could do, we did try to put a capacity

figure in there because it was insisted upon. It was sort of picked out of thin air. Maybe a little head work was used, but it was largely out of thin air. We totaled ninety-six per cent capacity. I stated, when that figure was handed in, that that was ninety-six per cent of the ultimate capacity I thought we could reach under normal expansion in time of an emergency. If you know what that means, some time I would like to have you put me wise. I really do not, and I do not think the other people who put down twenty-five per cent of capacity have any better idea than I have of what it means. Since putting in that figure, I have tried to explain a little bit more just what we can do in case of emergency, and I have assumed that we will be allowed to carry on fifty per cent of our normal commercial capacity. I hope that condition can be brought about. I think any concern that is asked to turn over all of its capacity for war work is being asked to do a very unfair thing. There are some people who may have thought Bausch and Lomb profited during the World War. We had enormous Government contracts. We made money on a lot of those contracts - the income tax return probably showed what would be called a fairly large profit - but after the war, when we got through with our shrinkage pains and got back to normal running capacity and tried to win back the commercial business we lost by giving practically all our capacity to Government work, that profit was a pretty pink figure - in fact, I think you can call it decidedly red. I think with the type of legislation we have had lately, where a concern cannot build up a nest egg for the future to take care of that sort of emergency, that a concern, even like Bausch and Lomb, that has had a healthy growth over the last eighty-five years might actually go to the wall if it isn't allowed to carry on a fair amount of commercial business, something it can use as a nest egg to build up again after the emergency. I am not saying that because we want to shirk our duty in case of war. Fifty per cent of normal capacity means very little compared with total capacity - I am assuming that in case of war we will probably double our equipment and triple or quadruple our help. Therefore, the present fifty per cent becomes perhaps fifteen per cent of what we will be doing. I don't think that is an unfair percentage. If we are allowed to do fifty per cent of our present commercial work, and we assume that the load put on us by departments other than Army Ordnance (Army Air Corps, Navy Ordnance, Navy Construction and Repair, Medical Corps, and all other branches) is one-half the work we will have to do for the Army Ordnance schedule, then we will have a volume of work that will require the expansion that I just mentioned, doubling our equipment and probably using that doubled equipment before we get through, practically continuously,

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that is, at least two shifts and I would say three if it is possible to get the help to put on three shifts.

The equipment in the lens grinding field will have to be made by ourselves. We cannot buy lens grinding equipment of the type we use on the open market.

On the machining end, the metal end of the instrument work, we have already turned into the war planning people a schedule of equipment that we think we will need in detail to meet the schedule that is laid down. It amounts to almost double what we have now - in dollars and cents.

It will be a real job to get equipment and men. I haven't the figures with me, but I would venture to say that during the World War we tripled or quadrupled our equipment. We are now saying that we need to double it only, so relatively it is an easier job than it was then. As far as the problem of getting help is concerned, I am inclined to think that right now it would be more serious than it was in the World War. Either through having some curve on the ball or through plenty of good luck, we find ourselves right now at the peak of our peace-time load - we are doing more business now than we have done in the past on instrument work - and we find that we have absorbed all the trained people that we can find, not only in the Rochester area but we have gone into other areas trying to find trained optical people and they cannot be found. Therefore, if the emergency faced us right now we would have to begin training people. In the metal end that is not so serious, because the people who can do nice machine tool work can be trained to do the type of work that is required to make parts for optical instruments, but on the optical work it is a real job - to get what we term "optical instrument makers."

We should be doing more, but we are doing considerable in training people. In our lens grinding plant we now have about fifty young fellows going through an intensive training, trying to make lens makers out of them. In our Instrument Division we have a hookup with the Rochester Mechanics Institute, which is sort of a trade school, giving a cooperative course. These boys get their class room work at the Mechanics Institute and then come over to the factory and get practical work. That is working out pretty well. It is being done in other industries in Rochester also. Those boys work in pairs. One boy is at school while the other boy is at the plant, and they alternate about every other month. We have about a dozen pairs of boys going through now -

about twenty-four boys. They are not college graduates - they are high school graduates who are taking this additional work. It is the kind of training that in case of an emergency would have to be done in a very intensive manner.

That brings me to a point that Colonel Jordan suggested I mention. One of the officers of the General Staff came to Rochester a few days ago, during the depression, and went through our plant. He went over our figures, found that we had very few people of draft age, and came back to Washington with the announcement that in the case of an emergency the optical industry would not have to be exempted from draft. Well, from the figures he had he probably could justify his stand, but unfortunately he didn't get the whole story. Naturally during the depression we took care of our people who had been with us for years. If we had to lay people off we laid off the young people, so he caught us at a time when we did have mostly old trained people, but when we have to build up our force we cannot take an old man and teach him how to become an optical instrument maker. We have to start with a kid more or less. Between the time this officer was in Rochester and today (I looked up figures just before I came down here) I find that eighty-one per cent of the people we have hired have been of draft age. When he was there, about six per cent of the people we had were of draft age. If we are going to carry on an expansion program, such as I am talking about, ninety-five per cent of the people we hire for that expansion ought to be of draft age if we want to get anywhere. In other words, we in Rochester will need two or three thousand young fellows when the emergency comes, to train to do this work if it is needed, and I think it is pretty well conceded that optical instruments are a rather necessary part of the program.

Maybe you would like to hear a little bit concerning the optical glass situation. I think Bausch and Lomb are fortunate in being the only optical industry that makes everything from the raw material up. We are in a rather enviable position in that respect, and it allows us to do a lot better planning job than people who haven't all those facilities.

Back in 1912, I think, we started the first optical glass plant in the country. We had inklings of war troubles in Europe, and we were afraid that if they ever had a war over there we would have to go out of business. We started experimenting, making optical glass in a small way. Well, the whole optical industry saw the need also between that time and 1916, and the Bureau of Standards shortly afterward got to working on the

problem, The Pittsburgh Plate Glass Company and the Spencer Lens Company followed, so when the war broke out we knew a little bit about the optical glass problem. In April, 1917, the Government selected Dr. Fred Wright, of the Carnegie Institute, who had been doing work on molten quartz, to come up to Rochester and take a hand in the optical glass problem. He ultimately brought up with him about twenty men, physicists and chemists, who had been working along similar lines, and starting with the production of a couple thousand pounds a month, with their help, our plant and the other plants in the country worked up to about eighty thousand pounds of optical glass a month when the Armistice was signed. Production that last month was something like seventy-nine thousand pounds of optical glass, but it was used to make standards it was not good optical glass, but it was used to make instruments. We are awfully ashamed of some of the instruments that were made during the war. The glass was not what it should have been and the instruments that that glass went into were made by inexperienced help, so we are not proud of the work that was done. It probably served a purpose and was helpful, although I do not think a great deal of it ever got to the front because we were too slow in getting going.

Today we are in a lot better position to take care of the optical glass requirements. During the war we made in Rochester sixty-five per cent of all the optical glass that was made. These other people dropped out of the game after the war, but we continued in it. We are now the only manufacturer of optical glass, other than the Bureau of Standards, which I do not consider a commercial venture. They are doing a good job for the Navy. I understand they are making all the glass used by the Navy in their optical shop. Pittsburgh Plate Glass, I believe, are making some of the more simple optical glass, ordinary crowns and flints. I believe that Eastman buy some of their glass from the Pittsburgh Plate Glass, and I think they are in a position probably to get back into the optical glass game, but I do not think any of these other concerns are. I do not think they have any skeleton of organization left to get back into the game. I believe that with what the Bureau of Standards can do, and Pittsburgh Plate Glass, that our glass plant can carry the balance of the load. We are now producing regularly about five thousand pounds of very good optical glass per month. From what we have seen of foreign glass lately (we do not see much of it), we believe honestly that we are making better optical glass than is being made abroad, generally. If we were willing to use optical glass as it was used in the World War, within a few months we could make all the optical glass that is needed for the program.

that is laid down. We know that that type of optical glass is not good enough, though, and we have got to make better glass than we made during the World War - so there is still a problem, but I think it can be solved.

At the present time we are using quite a few forty-two inch pots where we used to use thirty-six inch pots in the same furnace. That sounds like a rather simple change to make, but it was not. It has taken years to learn how to make glass in these same furnaces in forty-two inch pots. We used to get 200 pounds of good glass out of a thirty-six inch pot, today we are making 500 pounds of good glass in a forty-two inch pot. We cannot make all types of glass in these forty-two inch pots - we are making a barium crown glass that we are using in our binoculars and that sort of thing. It serves the purpose just as well as the sort of glass that we used to make in the smaller pot.

That brings me to a point that I want to mention here. It is awfully hard to write optical glass specifications unless you know exactly how the glass is going to be used. The present specifications of the War Department are tighter than necessary. The fact that we got 500 pounds of good glass was not altogether to the credit of the glass making department. I think a great deal of it was due to the way we handled the glass after making it and selected it for the use to which it was put. This glass was inspected for stria a certain way. Through the proper cutting of that glass and proper pressing, the layers of stria, if there were any there, were in a plane where they did not do any harm for the particular purpose for which this glass was used. That brings up quite a problem in writing optical glass specifications - something we are going to take up with Frankford and try to get straightened out. Glass production can be doubled through proper selection, through knowing how it is going to be used.

The material problem I think we have pretty well licked. We are using practically all American raw material in our glass making now. The little foreign material that is used we know we can get here of practically as good quality, so there is nothing to worry about concerning material.

The neck of the bottle is the pot making. Clay has to be aged several months before pots are made, and ordinarily a pot has to be aged about six months after it is made, so unless you have an inventory of clay and pots built up you have a nine month wait

before you get optical glass. We are doing all we can to build up our pot inventory in Rochester. We are carrying plenty for our own requirements. It isn't sufficient for an emergency, though, and I have suggested that the Army build up an inventory of pots so they will be available, but the suggestion hasn't met with much favor. It has been said that the aging will not be good for the pots, that unless climatic conditions are just right the pots will deteriorate. I do not know if that statement is made as a result of real knowledge or not. To our knowledge aging will not hurt pots. We have never had a pot that was kept so long that it was ruined. On the other hand, we have not kept pots more than three or four years. Our belief is that the aging will do more good than harm, and I am still advocating the building up of a stock of pots. It is good insurance. They are not very expensive and if we had three or four hundred pots stored away (the investment would not be a great deal - thirty or forty thousand dollars) I think it would eliminate practically all fear of a glass shortage in case of an emergency, because with those pots we could soon build up to the requirements needed. In fact, I will guarantee to build up the glass production faster than the optical industry can build to consume it. I think that that covers the optical glass problem.

I just want to say a word about that school of thought that thinks that the mechanical parts of optical instruments can be built outside of the optical industry - the optics built in an optical plant and the mechanical parts elsewhere by manufacturers of typewriters or calculating machines or something of that kind. Our experience in the World War would indicate that it is not a very good assumption to make that that can be done. On the other hand, it isn't an impossibility - it can be done. It means a much better tool and gauge equipment if the instruments are built in a plant that is not familiar with that type of work. Without a knowledge of the requirements, you have to put tools and gauges into the hands of these other people that will allow them to do the work. It is a problem worthy of consideration. The procurement plan as it is laid down for fire control instruments calls for making some of these parts elsewhere than in the optical industry, and it is going to present a real problem. I think it is all right to put it in the plan, if the difficulties are realized and something done about it as soon as possible. I know it is impossible to get the appropriations to get completely toolled up in advance. I think something could be done, though - if proper pressure were brought to bear, appropriations perhaps could be secured for making gauges for the more vital parts without going into an enormous investment.

The thing that worries me more than anything regarding that phase of the work is the assembling, adjusting, and inspecting of these optical instruments. I think the plan in general calls for doing that in these metal working plants. I think in a great many instances it might rather be done in the optical plants. If the parts were built in mechanical plants it would be better to do the assembling and adjusting in the optical plants, because those people have the experience that enables them to help themselves.

Optics can not be made to specifications that allow throwing them together, just assembling them according to a procedure. As your thicknesses of lenses, your curves and your indices of refraction vary in your glass, it is necessary to change the spacing of your lenses in their mounts - the relation of your objectives to the rest of your optical system, and it is pretty hard to teach that knowledge in a short time. That is one of the tricks of the trade and I think you will find that it will have to be done in the optical plants. However, there is no harm in giving thought to the other problem because, as I say, it isn't impossible, it is simply a matter of proper handling.

I have touched a little bit on the labor situation as far as training goes. There are other controversial phases of the labor problem, but I do not know whether or not there is much use discussing them. Powers higher than ourselves are probably going to decide on some of those phases, such as whether we can use incentives in time of an emergency to speed up production. There are tendencies that make us feel that the next emergency might find labor conditions in a position where it is going to be harder to get out requirements than it was during the last war. We thought nothing of working twelve hours a day then. It is true we paid time and a half over 48 hours a week, even back there, but there weren't many restrictions beyond that, and that was not a restriction - that was only common sense to pay a man more money for over time, but we were able to give incentives and to do different things that brought up the production in a way that it might not be brought up a few years from now.

From certain points of view, we manufacturers do not like this new tax on surplus. We are already beginning to see what it means in industry. We are not expanding, we cannot afford to expand any more as far as equipment goes. We are getting the idea of putting on two shifts of people in departments rather than buying equipment and building up a plant capacity that could be used in case of an emergency. That is a very controversial question - I do

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not want to discuss it very much. I know there are good reasons for this new tax on surplus, but I do not think it is good for the War Department. I think the forty hour week is probably good for us because it is forcing us to train more help than we would ordinarily. Instead of working forty-eight hours we are working forty, and that means that we need more people and we are training them. We do not object to that. However, if they go any further it is going to be very bad, I think. If we have available people that sort of thing is all right, but in our industry there are not people available and the shortening of hours is going to be bad for our industry.

We think that the War and Navy Department's policies in general in encouraging manufacturers are good. Manufacturers do need encouragement to get into the making of military instruments, as it is uncertain business that does not justify building up a personnel for.

There is one objectionable phase that I might mention here and that is the tendency in development work to try to get too many contractors interested. In some cases that is probably necessary, that you do not get gouged, but usually two competitors bidding on the same job prevents that sort of thing, two or three certainly do. This working up of a design of a new instrument and then letting a half dozen people bid on it isn't encouraging. It is hard to bid on new work. You do not know what you are going to run into. If there are five or six people bidding, one of them is going to make a mistake - he is going to bid too low. He will get the job, but he will lose money on it, and that is not going to do anybody any good. I think something can be done there in the way of encouraging by not getting too many people in on new developments.

We who went through the World War know the terrific troubles we had with contracts, closing up of contracts, and that phase of the work. I think real progress has been made in trying to draw up standard forms of contracts for an emergency. We have reviewed the suggested contracts and in general we think they are pretty good. They are flexible enough so they can be made good - let me put it that way. Your alteration clause in the new contracts is such that with proper administration I think that that phase of the work is pretty well taken care of.

I have other notes here that I could talk on for quite a while but I am wondering whether or not it would not be best to stop and endeavor to answer any questions you may have in mind.

Q Is it impracticable, instead of having a war reserve supply of pots to have a war reserve of optical glass.

A. It would be more expensive.

Q. No danger of deterioration and no controversial question?

A. No Glass will keep forever I think I can say positively that the older glass is the better it is The surface of glass breaks down. There isn't any such thing as a perfectly staple glass. Some glasses are practically weather resisting, others are very susceptible to weathering. None of them are entirely free from it, but that does not do any harm - it is only on the surface of the glass and when you make lenses from it you do not use that surface. Therefore, an inventory of optical glass is a sure safeguard but much more expensive than an inventory of pots.

Colonel Jordan Captain Smith, could you say something to the Class about the amount of optical glass we have at Frankford Arsenal? Does it amount to any considerable figure?

Captain Smith We are trying now to get a stock of optical glass for the first six months of an emergency figured on the basis of the requirements of the 1933 Mobilization Plan, minus field glasses With the field glasses in stock and the possibility of buying a great many more, we do not feel that we should invest money in optical field glass at this time, so we are trying to build up a reserve for approximately six months, and that is being added to from year to year. A hundred thousand dollars would be just about the works excepting field glass That glass cannot be used, however, in the first six months - there aren't enough grinding facilities to use it. If you put the money value down around sixty or seventy thousand dollars it would probably be a closer estimate. We have been getting around ten thousand dollars worth of glass a year.

Colonel Jordan For how long?

Captain Smith About five. That makes perhaps in the neighborhood of fifty thousand dollars worth of glass. Three or four more years will put us in a pretty good position.

Q. Concerning your first statement about the requirements coming to you piecemeal, have the procurement sections yet gotten to the stage where you are getting all your requirements at one time, or where you can consider them at one time, or are they still piecemeal?

A. They are still piecemeal. We are getting requirements from the Air Corps separately and we are not getting any requirements from the Navy Ordnance or C. & R. (Submarine periscopes come under C. & R.) I do not know whether or not we will be expected to build submarine periscopes.

Colonel Jordan Colonel Eglin, will you please say something from the viewpoint of the Army-Navy Munitions Board on this topic that has just been broached.

Colonel Eglin. First, I would like to tell Mr Bausch that as far as his statement about reserving fifty per cent of normal capacity for civilian needs is concerned, that it is one of the directives of the Army-Navy Munitions Board, both of the Army and the Navy, that fifty per cent of the normal capacity will be reserved for civilian needs to meet the situation. In regard to requirements, I would like to ask Mr Bausch if he has the total requirements of the Army and Navy in optical glass - not instruments but optical glass?

A. Two years ago we were given some figures, but not at all officially. They were unofficially handed me when I attended a meeting down here on the subject of optical glass that was sponsored by The Assistant Secretary's Office. There were some questions about it, and I understood at the time that it did not include the Bausch and Lomb requirement. At that time our instrument requirement was not very well fixed, so I have had the feeling that since we are doing such a large proportion of the instrument work that it isn't as complete a requirement as I would like to see. However, on optical glass I haven't much criticism to make because I think we understand that requirement pretty well.

Colonel Eglin One of the allocation subjects which will come up in the very near future between the Army and Navy will be on the question of optical instruments, and I am sure we will get that before very long.

Commander Hendron I regret to say that the Navy Department has been remiss in presenting our requirements to the Army-Navy Munitions Board because of several reasons. We haven't been

in this procurement planning game as long as the Army arms and services, but we feel now that we are getting to a point where we can state requirements. The Bureau of Ordnance has been approached on the question and has turned in to us a lot of what we feel to be very useful information - also the Bureau of Construction and Repair for submarine periscopes, Bureau of Navigation for such instruments as they use binoculars, other navigational instruments, small range finders, etc., and the Bureau of Medicine and Surgery on such optical instruments as they will require. Our plan in that respect now is to have a meeting of representatives of our own bureaus with the idea of ironing out our own difficulties in the Navy Department and then to have a meeting with the Army representatives with an idea of attempting to allocate the existing optical facilities of the country of which, of course, Bausch and Lomb is very prominent in the picture. We will attempt to allocate the program of work that has to be accomplished for optical instruments and optical glass to the various concerns that might be in a position to produce these things in time of war. We know that we have been remiss in this regard but we hope we will be able to present a clear picture through the medium of allocations sometime in the not too distant future, probably within the next few months.

Colonel Jordan: Mr. Bausch, I hope that is good news to you, sir.

Mr. Bausch: Thank you very much.

Q. The Army has considerable trouble with optical instruments due to their fogging up. At Frankford Arsenal I think we find it necessary about every fourth year to recondition even new instruments, in spite of good storage conditions, and it is very costly. The humidifying and temperature control equipment has been installed but it appears that that does not do a great deal of good, and there is a tendency now to believe that possibly the conditions which cause fogging exist in the instrument at the time it is manufactured. If that is the case, you might consider it to be the responsibility of the manufacturer to give an instrument that is free from that condition. Could you tell us something about that, sir?

A. Well, I answered part of it when I said there isn't such a thing as a staple optical glass. All glass breaks down to a certain extent. We are endeavoring to make our glasses more staple, and some progress has been made. Our barium crown glasses today will last three or four times as long without weathering

as they did ten years ago. More, probably should be done on the materials for coating the inside of instruments. You have to have a non-reflecting black surface, usually, on the inside of optical instruments to prevent reflection. The lacquers used probably break down and cause some of the trouble. At the present time on aluminum instruments we are using a particular process where the aluminum is oxidized and then stained black. We think that is about the best sort of a black finish that can be put on the inside of an instrument, but it can only be used on aluminum. A lot has been done in an effort to find a way to cover brass with a black non-reflecting surface of a permanent nature. There is real research work to be done along that line, and I will admit it is up to the manufacturer. Experiments have been made on filling instruments with inert gas, i.e., making them air tight and putting inert gas in in place of atmosphere. Some success has been had along that line, but it is hard to do on many types of instruments.

Q. I would like to ask what progress has been made in the improvement of the cement used in optical instruments?

A. We haven't found anything better than Canadian balsam. We have improved our methods of handling Canadian balsam. We have gone into that and found where the best Canadian balsam comes from - we know what the age of the tree should be to give the best balsam. We have a man on this job who is going around the country looking up sources of balsam. Balsam from different sections of the county varies. The age of the tree is very important, as is also the way of handling it. We have just fitted up a new room in which we handle our balsam cement work. It is air-conditioned and proper filters keep out objectionable dirt. All the purifying and bleaching is done in this room. We are making progress but we are still using the same type of cement - trying to make it better.

Q. I would like to ask a question about the labor situation. You stated that it would be desirable to train young men. As an idea of reconciling your demands with Selective Service demands, if you could be allotted an appropriate number of men in the vicinity of forty years old, about how long would it take you to train them - men of forty, forty-five years of age?

A. I do not think I can answer that quantitatively. We know that in general we can take a fellow around twenty, twenty-one years of age and train him much quicker than we can a man of forty, but I would not want to answer that in terms of months or years.

Q. He is the man who makes the best combat soldier.

Q. Why wouldn't price index be a good enough index to your capacity instead of taking tonnage or units or work hours?

A. Because the equipment to build a binocular is altogether different than the equipment necessary to build a fifteen foot range finder or height finder, then again there is some equipment that is common to both and how are you going to allocate that unless you have the whole program?

Q. Your cost system must show up your machine charges. If you do ten million dollars worth of business this year, that is your normal business, and we could place an order with you for five million dollars worth of instruments according to your estimate of what it cost to make them, using roughly half the facilities.

A. Yes, if the type of work is about the same as we are doing now.

Q. It is optical work.

A. But there is a big difference - lenses vary in size from a half mm microscopic objective to sixty inch mirrors. There is such a wide range of sizes and that all takes different equipment.

Q. What is your index? You report to your directors how good your business was this year compared to five years ago - what is the index you use?

A. Dollars and cents.

Q. The steel business says "we are running a tonnage of seventy-seven per cent"; the automotive people do it in units, and you use dollars and cents.

A. When the automotive people talk about a unit, they are making one thing only. When they talk about doubling their production, it is a very definite problem with them. We can talk about doubling our production if we are talking about doubling everything we make and do it in a very intelligent sort of way, but we do not know whether or not the Navy is going to call on us to make twenty-six foot range finders or two and one-half meters, and the equipment needed to make a twenty-six foot range finder is different from that used on a two and one-half meter. That is, a great deal of it is - there is some common equipment. That is where the problem is - in classifying equipment.

Q. I would like to ask whether it is cheaper to import optical glass than to manufacture it, and whether you have any figures on about what percentage of the optical glass is imported? I was unable to get anything from the Department of Commerce on that.

A. Imported glass costs vary considerably, I believe we compete favorably. We have gotten figures on imports that we do not believe are correct. The trouble probably lies in classification. You can do trick things in recording imports into this country. We have made several investigations lately on certain types of instruments coming in, trying to find out what is being imported, and it does not check up with our market study at all. I can say this, of your big optical manufacturers the largest one in this country outside of ourselves is importing maybe eighty per cent of their optical glass. Smaller concerns, a lot of them, are getting glass from us. My guess would be that we are making about half of the optical glass that is used in the country now, but it is a guess.

Colonel Jordan: When we went up to the Bureau of Standards you all met Dr. Briggs. The Bureau of Standards is interested in the manufacture of optical glass for the Navy, and we are lucky to have here today a representative of Dr. Briggs - Dr. Finn. Would you please say something, Doctor? (Discussion by Dr. Finn not included.)

Q. There is one comment I might make which I think may be of some interest in this connection. It is a far cry from optical instruments to ammunition, but we had a very serious problem in ammunition which I think has some relation to the problem that has been mentioned with regard to fogging or weathering of glass. We had certain propensities which went bad in the service and after a great deal of study and investigation we came to the conclusion, which I think was hinted at here, that we had sealed up moisture and perhaps some other undesirable elements in the components when they were manufactured. We went to a great deal of effort to develop a system of assembling under air conditions such that we would have a minimum amount of moisture sealed up within the units. That has just recently been done - some very expensive items. We knew they were thoroughly sealed, so the trouble could not have come in from outside, yet deterioration occurred, and we knew it could not occur except in the presence of moisture.

The question I want to ask concerns personnel, which I believe you indicated is a very critical situation, with regard to the draft. You say you want young men World War experience indicates, of course, that out of every hundred men that are drafted you will find a fairly material percentage who are not suitable for combat service, nor are they even suitable for limited service, that is, less active duty in the Army. Is the nature of the work that these men would have to do in general such that you could use men who are physically handicapped? I would gather that it is rather light work and that you would not need big, strong backed, able bodied men?

A. That is true - physical handicaps do not do much harm as long as they are mentally alert.

Q. It might be possible to get your requirements from those who were rejected by the draft but young enough to meet your needs?

A. That is true.

Colonel Jordan. That is a good point. I am glad you brought it out.

Captain Smith. I have two comments. One - pots. The question was brought up several times and we considered it. It is a matter of buying these pots from firms, transporting them to military posts, and keeping them under storage four, five, or ten years, and the question arises as to how good they will be at the end of that time. Then they have to be transferred back to a glass plant and the glass made at that time, and it was felt that the money should be put into glass in the form of molded disks, or slabs, rather than into pots. Two - is the old question of capacity and instruments being manufactured by the manufacturer of the optical element. Of about sixty-three Ordnance instruments only twenty-six have optical elements in them, the other thirty-seven are purely mechanical components. Of course, there isn't anywhere near sufficient mechanical capacity, to take care of all these instruments. We have thirty-seven without optical elements and we put those out to plants that are not engaged in the grinding and finishing of the optical elements. We tried, with the twenty-six, to assign those to plants which could make the elements and the mechanical components, but as there are very few grinding plants we found that that was impossible, so the only alternative left is to plan, in the case of a few instruments, on putting them out to those plants which can make the mechanical components and trust to

luck or to good judgment in manufacturing processes that they will be able to assemble the optical elements in them even though they have had no experience.

Q. I would like to ask whether or not Japan has an optical industry, if they have not, whether or not they import their optical instruments, and if so where from?

A. Japan is building up an optical industry very rapidly. They are beginning to do some fairly good work and commercially we are beginning to worry a little bit about them because they are importing instruments in here now that sell at half the prices of our instruments (I am talking about commercial instruments now), and although their quality is inferior they have improved to such an extent over the last five years that we are very much concerned. As far as our fire control instruments are concerned, we have never sold Japan anything but I think they get a lot from Germany. They are getting into that sort of thing quite extensively and making very rapid progress.

While I am on the floor I want to clear up a little bit what I said about Army glass specifications. I agree that for an emergency stock it is probably better to have absolutely the best glass you can get. I agree one hundred per cent that the glass which is stored cannot be too good, and we appreciate that the specifications they are putting on us are to force us up to that quality. I want to say this we are not so much concerned as some people are about standardization of glass. The fact that the Navy has five glasses and the Army has five doesn't worry us manufacturers very much. Standardization isn't going to help us a great deal. I think it will help the Army and Navy, though, to standardize. We can make twenty different types of glass almost as easily as we can make five different types, provided they are types that we have had some experience with. We do not want new types thrown in to us in a hurry and be asked to get them out. One more thing on Army and Navy specifications. The Navy is supplying glass to optical people and when the index varies they change their formula to take care of the variation in index. The Army, I think, is trying to get glass of such a precise index so that will not be necessary. If this glass they are getting can be used without change of formula, O.K. - we question it. If our glass varies, we change our formulas. It is easy for us - we have the computers there and if the glass does not come through right on the dot we change our formulas to get perfect optical performance. The Air Corps specifications are tighter than the Army and even there we question whether they are tight enough if

they want to work right to a formula. So although these tight specifications are aimed at the elimination of recomputation - recomputation is still necessary in order to get perfect optical performance, although for an emergency you might not worry about that little falling off in optical performance.

I am really glad the Army feels that they want an inventory of glass rather than pots. I would rather see an inventory of glass. My fear is that it is going to take too long to get that seventy-five thousand dollars worth that they want, but when they get it they will be "sitting pretty." My thought was that the pots would give insurance for less money, but I prefer the other scheme if that takes care of your needs.