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THE PROCUREMENT OF NON-COMMERCIAL MATERIAL IN WAR.

Lecture by
Major-General C. C. Williams,
Chief of Ordnance,
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During the past two/or three years, the Supply Branches have been capitalizing the lessons of the war in plans for the utilization of industry in the event of another war. Such plans naturally group themselves into two categories:

1. The problem of the procurement of commercial articles.

2. The problem of the procurement of non-commercial articles.

The former includes materials or articles normally required in peace times by people of the country; the latter articles which have no commercial counterparts.

Of the two, the procurement of non-commercial articles is the more difficult. Such articles are normally not produced in time of peace, are usually difficult of fabrication, and sometimes involve processes which are unknown to peace time industry. This being the case, it is apparent that a considerable problem is faced by the supply branches charged with the procurement of such articles.

The Ordnance Department is charged with the procurement of a great many non-commercial articles. It is also a fact that the material produced by the Ordnance Department demands an exactitude of fabrication and a production in such quantity that the problem of planning in advance for its efficient production becomes an important peace time consideration for the Chief of Ordnance.

Let us now visualize the problem faced by the Ordnance Department in time of peace in making preparations to meet war time responsibilities. In order to decide on the ways and means for solution, it is first necessary to determine the nature and scope of the problem. A consideration of the requirements of the military program of the War Department is the only practicable definition of the nature and scope of the problem and, as a consequence, an estimate of requirements forms the initial point of departure in all Ordnance war plans.

Requirements can be grouped naturally into personnel requirements and material requirements. A consideration of both phases is essential. On the personnel side, we must determine our needs for military and civilian personnel to meet the basic program before steps can be taken to plan for the procurement of such personnel. In the quantitative sense, this estimate should include the numbers and grades of the officers and enlisted men required for the Ordnance troops, and similar information for the military and civilian elements of the procurement, supply and technical features of the problem. But a qualitative estimate is also necessary. The qualification of the personnel for the various duties in the organizations required must be established as a fundamental phase of personnel requirements. With this brief reference to an important and essential part of the problem presented by the basic program of the War Department, I desire to pass now to a consideration of material requirements.

All of our material procurement plans hinge on the computation of requirements. Before any production can be scheduled we must know what we need

and in what quantity. In turn, the requirements computations depend on the following data:

1. The official War Department Mobilization plan indicating the man power to be summoned, the organization of the man power into units, the points at which the units will be assembled and organized, and the requirements of material for issue to these units for training.

2. The official War Department plan for the employment of the troops mobilized, including information on the probable theaters of operations and the rate of entry of troops into the combat area.

3. The approved tables of organization, basic allowance tables, official information on probable rates of fire in combat, and training allowances. All of this information is furnished by the War Department.

4. Requirements factors determined by the Ordnance Department, including the wastage rates, the spare parts needed and such other facts affecting the procurement problem as may be dependent on Ordnance experience.

With the foregoing data the requirements may be computed. For lack of time, I will not discuss the details of the computations. Suffice it to state that we have computed the requirements for 1200 items of issue, that this number covers the field in typical fashion, and that this total involves over 95% of the funds which would be required for the Ordnance program. Of course, the number of issue items computed does not solve the whole problem. Each item must be traced back through its components and semi-finished materials to the mine and the forest before we may say that we have completed the requirements task. Such a study involves requirements for the many basic materials which enter into an item of issue and forms a continuing task for future years.

After the requirements have been established, the next step is to develop plans for the procurement of the materials needed. Such plans involve a variety of considerations, the most outstanding of which I will now attempt to discuss briefly.

The first question which arises is that of the organization for procurement which should be prescribed to permit of the efficient management of the problem. The World War was a helpful teacher in this respect. We experimented with several systems of organization with more or less disastrous results and, in passing, I want to remark that one of these was the so-called functional system. Under this system, production, inspection, and the other functions of the Ordnance Department were grouped into divisions for carrying on the separate functions for all Ordnance items. There soon resulted considerable confusion and lack of coordinated effort among the functional divisions and, toward the end of the war, we passed to an organization along commodity lines in which each division of the office assumed the various functions pertaining to items allocated to the division for procurement. For example, the artillery division assumed production, inspection, and all other functions pertaining to artillery material. We found this arrangement so satisfactory that we have adopted it for our peace time organization for the Department.

The peace time organization is so constructed that the transition from peace to war is one of expansion, not of reorganization. Previously assigned reserve officers will be called in successive echolons to fill positions in the peace time skeleton organization until the full developement is attained. Civilians for key positions are also listed for call when needed. For M-Day there remains only the problem of recruiting civilians for clerical positions in the organization, a task which should be easy of performance since there should be no shortage of such personnel. There are so many advantages to expansion from the peace time organization by absorption that it is needless to dwell further on the subject.

Another cardinal principle recognized in the organization plans of the Ordnance Department is that of decentralization. The Ordnance problem is of such magnitude that it will be impossible to attempt the procurement of the thousands of items required from a central office in Washington. At the outset of the last war the Ordnance Department actually attempted to procure all of its material from Washington but the problem so outgrew the Washington force that decentralization to territorial districts was the logical result. Our district organization fulfilled its purpose during the war and the inference was natural that if established in time of peace it could again assume the burden in case another war should become necessary. These districts, as you all know, are now known as War Department Procurement Districts and are engaged at present in war planning activities for the procurement of material. In time of war it would be the duty of the Ordnance districts to expand in conformity with definite plans from the existing skeleton force to a war basis and care for the different Ordnance functions incident to the procurement of the material assigned to the district. By means of the district system, we believe that we are accomplishing a decentralization which cannot fail to simplify the problem of procurement in time of war and to insure the supply of the necessary munitions when needed and where needed.

I have said that sound organization is the first question which should be decided in time of peace by the Ordnance Department. There are other phases of the problem of almost equal importance. Perhaps the phase which is demanding the greatest attention in our present plans is that of the designs of the articles which would be provided for the troops under a war procurement program. The history of the World War is replete with examples of cases where changes in design produced a disastrous effect on the production of material. I have in mind a classic instance at the plant of one of our most successful producers of field gun shrapnel. This firm was given a contract at the outset of the war for the production of 3" shrapnel and began the production of this item on scheduled time. Then came the decision to change the light field gun from the 3" type to the 75 mm French type. The Ordnance Department immediately took steps to turn over the production of 3" shrapnel at this plant to that of 75 mm shrapnel. The only difference between the 3" shrapnel case and that of the 75 mm shrapnel is a minor change in the machining process. The plant made extensive plans to change over with a minimum of delay, but so demoralizing was the effect of this change, minor as it was, that before the plant could get its operators trained to the new dimensions, nine full days of production had been lost. This is an example of the effect of a minor change on a production program. You may imagine for yourselves the effect of other more radical changes of design which developed as the war progressed.

With this lesson in mind, we are taking steps in time of peace to settle on a standard design for each item to be produced for the troops in time of war. It would be our purpose to place this design in production at the outset of the war and then give consideration to a possible rearmement program with a better type later. Such a rearmament program would require the maintenance of the production of the original standard model until the new design could be gradually brought into production by use of other facilities. The original production of the standard model would then be tapered off as the newer type increased in rate of production and the latter would be supplied to troops as rapidly as possible. Of course it would be necessary to continue the old standard in production for maintenance purposes as long as any of the type remained in thehands of the troops, but it would be our plan to give the troops a new and improved weapon as quickly as possible without impairment of the supply of the older model in the interim of nearly two years before sufficient numbers of the new type could become available.

Another important feature of our plans is the insurance that drawings and specifications for the standard designs are on hand and are up-to-date. It goes without saying that any procurement program would be impossible without these essentials for manufacture. The drawings are, as a general rule, on hand, but the specifications require further work. It is our desire to have a post war specificationfor every standard item and we are making substantial progress in that direction.

As time passes the personnel who gained valuable experience in war production are being scattered and, in fact, many have since died. Within a few years knowledge of munitions production in civil life will be lost completely by this process of attrition. It therefore becomes as essential feature of procurement planning to insure that a careful record is kept of the methods of manufacture for non-commercial items which were found to be successful in the last war. The Ordnance Department is engaged in collecting and putting into book form successful methods of manufacture. It is believed that by having this information on hand it will be possible to start the war manufacturer of some years hence with full information covering the technical features of the problem with which he is expected to cope.

This phase of our plans is considered by many manufacturers who had war experience as the most important planning activity in which we are engaged. It is so important that I cannot refrain from going into the subject more fully. Suppose that we consider the case of a manufacturer who is engaged in the production of drawn brass articles as a normal peace time activities. We go to him in time of peace with the information that we expect him to produce 15,000 brass cartridge cases per day in time of war and ask him to make a factory war plan. He wonders how much it will cost him to prepare such a plan and perhaps decides that he cannot afford the expense. This does not help our war plans very mcuh if we have not other resources to marshal for his assistance. His wonder about costs will disappear at once if a book showing a desirable method of manufacture is then produced. In it he will find a detailed description of the operations, a list of machinery required, a complete plant lay-out, data on personnel, power and raw material requirements, and many other useful details. He would note at oncethe variations from the standard scheme which would have to be made to accommodate his own plant, and could specify his requirements for machine tools and other

necessary aids to manufacture. His factory plan would be relatively simple of solution and would entail little if any expense, He might even file a standard method without change if new facilities for the particular item should be necessary.

Suppose that after war was declared we had to go for cartridge cases to a manufacturer who had not, for some reason, made any peace time plans. If we could present to him along with the drawings and specifications, a book showing the methods, I think it might safely be said that an inertia and experimental period of two months on a cartridge case order would be eliminated. The manufacturer would probably flounder in a maze of experimentation for such a period in a search for the best way to turn out this simple item in quantity. A carefully compiled method would be a life-saver under such circumstances, particularly since time is of the essence in war and little of it can be spared for experimentation on methods.

If one asked a foreigner to express an opinion as to the most outstanding feature of American industry, he would probably answer that the mass production so common in American factories is to him the feature of the greatest interest. Mass production is unusual in European factories, much of the work being done by skilled artisans who have learned a definite phase of production by long experience and actually fabricate each article without reference to possible interchangeability in assemblies with other articles of the same kind already manufactured. Mass production in the United States is directly due to the developement of the art of interchangeable manufacture. Interchangeable manufacture, in its turn, is made possible by the use of gages. Gages are simply precision instruments for insuring that every piece turned out in a given operation is similar to every other piece. By the use of such instruments any piece going to make up the whole can be inserted in its proper place in any assembly without impairing the functioning of the finished article. A valve for a Ford car bought over the counter will fit perfectly in any Ford engine. This would not be true if gages to insure uniformity were not used in their manufacture.

In time of war, quantity production of munitions is an important factor in securing an early decision, especially since the outcome of modern war is so largely dependent on the munitions power of the respective belligerents. Since munitions power is so important it is pertinent to the issue to examine into the relation of gages to a program for the development of such power. Of course it is not argued that munitions cannot be made without gages, since the French demonstrated during the war that it could be done. Other measuring instruments can be brought into play but the rate of production will always be much less than that which would be attained with the proper complement of gages.

Our plans for the next war contemplate thorough preparation to insure a supply of gages in order that mass production may be secured as rapidly as possible. Such a program involves a considerable problem, the high points of which I will now endeavor to outline. We have on hand as a war reserve nearly half a million gages which become the property of the Government after the World War. The gages are carefully catalogued and stored in the various arsenals. Theoretically they form a stock which we could issue

immediately to manufacturers to tide over the gap until production of gages could be secured. I should remark, however, in passing that our gage stocks have disadvantages. Miscellaneous designs, unbalanced sets, and other elements decrease the value of the war reserve stocks as a stop-gap for the early months of an emergency. We are, however, attempting to round out in the war reserve complete sets of gages for the quantity production of the Ordnance material normally carried by an Infantry Division. A beginning is being made on this project at the present time using $50,000 which Congress appropriated in the 1925 appropriation act for gages.

For divisional material we have established the requirements and know the composition of the gage sets necessary for war production on a six army program. The next step is to determine where the gages will be secured. The large gage manufacturers are, of course, the natural sources and are willing to take on war orders. But these manufacturers are definitely limited by the number of gage-makers in the country. Gage-making is the highest form of the toolmaker's trade. In fact, the gap between a toolmaker and a gage maker is almost as great as that between a house painter and a portrait artist. The gage maker must possess infinite patience and skill since he is working with dimensions expressed in thousandths of an inch. The slightest slip of his tool may ruin the work of a month. Some gages require the services of a gagemaker for such a period for their completion. By reason of the special qualifications necessary it is natural that there are not very many gage-makers in the country. In fact, it is said that there are only about 30,000 in all, and it is probably also true that not 10% of this number could qualify as artists in the work. Under the circumstances, the supply of gage-makers is the limiting factor in the production of gages. If the manufacturer having an order for gages should, for any reason, lose andy of his gage-makers, he probably could not replace them and his output would be curtailed accordingly. So far as the Ordnance Department is concerned, the solution of the gage problem lies in the proper distribution of gage-making personnel, their exemption from the draft, and the possible development from intelligent tool-makers of additional gage makers during the emergency. By proper handling, it is believed that all three of these factors could be solved and that gages could be made before the factories to use them could finish their conversion to war production.

The production of munitions would be impossible without machine tools. Of course the country is well provided with the standard machine tools required for commercial industry. Each industry also has its complement of special machine tools in adequate numbers. But when we approach industry for the production of non-commercial items in large numbers, the supply of the special purpose machine tools which are so necessary for mass production becomes a critical issue. In fact, the supply of such tools would probably be the factor limiting the time when mass production could be obtained. Machine tools of special design normally require months for their fabrication in time of peace, and it is reasonable to assume that in the confusion of war conditions the time required would be lengthened.

The machine tool problem is engaging our attention at the present time. We are securing the requirements of the various types needed and it is our itention to advise aventually the Machine Tool Builders Association of our needs with the request that the Association recommend the firms from whom the tools should be obtained. The next step will be to approach the desig-

nated firms with war orders. Particularly will it be necessary to supply these firms with as much information on the special purpose designs as can be assembled. There is a considerable quantity of information on these designs on hand which, if assimilated into proper factory plans by machine tool builders, will exercise a considerable influence on the time necessary to provide such tools in time of war.

No program for the procurement of non-commercial items can be carried on without mongy, and government money must come from Congress. Appropriation acts in 1917 carrying adequate funds did not issue until October of that year and such procurement as was carried on in the meantime was handicapped at every step by the uncertainty of the supply of money. The effects of this delay during the World War can be evaluated approximately in the statement that we probably could have reached our maximum peak two months sooner if the uncertainty concerning appropriations had been relieved immediately after the declaration of war.

Consequently it is of great importance to secure promptly from Congress the funds necessary to carry on production. We can do our part in this problem by preparing in time of peace our estimates for funds. This estimate can more or less be completely worked out since it is dependent only on studies which can be made in the Ordnance Office from war plans already completed. We have such a study at the present time and could submit it within 24 hours as a preliminary estimate. The detailed defense could then follow before the appropriations committees.

Enough has been said so far to indicate that non-commercial items are difficult to procure and that because of varying limiting factors, and appreciable period must elapse before industry can be converted to produce such items in quantity. In fact, it is almost axiomatic that quantity production of most non-commercial items will require a year for development. This being the case, it is necessary to hold in time of peace stocks of munitions to tide over the period until new production can be secured. Such stocks constitute the war reserves.

The World War left us with large stocks of munitions which ware, in the interests of retrenchment, reduced materially by salvaging processes after the war. There were withheld from salvage ample stocks of important items to constitute war reserves. Principal among these items were the various types of artillery ammunition and all of our artillery stocks. We now find that we are facing larger maintenance charges for the proper upkeep and turnover of these stocks than we can hope to obtain from Congress in the annual appropriation acts. Paricularly is this true of ammunition where deterioration plays such an important part. An annual appropriation of $17,000,000 would be required to keep up our authorized ammunition reserves alone and this is $10,000,000 more than we are getting for all purposes in the annual budget. While we believe that the required financial outlay is a modest premium on a good insurance policy, it is at the same time realized that the retrenchment policy of the Government will probably prevent for some years to come the appropriation of the necessary funds.

No discussion of the procurement problem would be complete without a word on transportation as a limiting factor. Our railways are normally nearly saturated with traffic in time of peace to move the ordinary output of our

mines and farms, and of the factories working about eight hours a day. The effect on the transportation facilities may be easily visualized if the normal activities of the country should suddenly change to a 24 hour basis to accommodate the intensified demand in time of war. Congestion and perhaps complete tie-up in certain areas would inevitably occur, and when this condition is reached manufacture can not proceed. It has been said very aptly that the railways are the aisles in a factory consisting of the whole country. The production plants are the machines in the factory and in order to keep the factory going it is necessary to keep the aisles clear so that raw materials can be moved to the machines and finished articles away.

If the limiting effect of transportation is appreciated, procurement plans for non-commercial items, particularly where new facilites are concerned, will always rest on the basic premise that these facilites will be placed near the required raw materials, and the finished article installations near those of the components or semi-finished materials. A machinery plant should perferably be adjacent to the forging plant and the latter as close as possible to the billet source. Common sense as this view may be, it is surprising how often this simple principle was violated in the last war. In our present plans, we are endeavoring to limit the transportation factor by the simple expedient of placing the production orders as near their sources of raw or semi-finished materials as may be possible. This is particularly true where new facilities would be involved.

Under normal peace conditions we have only six arsenals and two nitrate plants capable of the early production of about 5% of the necessary munitions. The question might then arise as to the necessity for considering the arsenals at all in the production of the non-commercial items which they can turn out, particularly since the quantities would approximate only 5% of the demand. The answer is simply expressed. The arsenals have an important place in time of peace as centers for the art of munitions making. If we did not have the arsenals, the art would speedily die out. They also serve as technical centers for our district planning, giving assistance on the technical phases of the peace time planning activities when called upon. In time of war the arsenals will produce as quickly as possible the war orders which we have given them and, while the quantity will not be great, the effect of their output, if early, may be of utmost importance. Of more importance will be the training functions of these establishments in time of war. Inspectors for the bulk of the production coming from commercial industry will be trained at appropriate arsenals. Personnel from war manufacturer's plants will be received for training in methods of manufacture. Technical information will be prepared and disseminated to war contractors. Difficulties in manufacture will be studied and solved for the manufacturer. In short, the arsenal will be expect to aid in every way the main production program for industry and at the same time to turn out such quantities of munitions as may be possible without extension of present facilities.

I have touched here and there the main features of the procurement problem for non-commercial articles, which is in itself only a phase of industrial preparedness. There are various other angles which I do not feel qualified to discuss at this time. Suffice it to say that we are merely scratching the surface at present, and it will be years before we have followed to a logical conclusion the various leads which the problem will present. It is my sincere hope that the small bud which we are tending so carefully at the present time may continue to develop into the full blown flower of true industrial preparedness.