

IMPACT OF INDUSTRIAL MOBILIZATION ON AIRCRAFT INDUSTRY
AND SUGGESTIONS FOR FUTURE PLANNING

30 January 1946.

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GENERAL ARMSTRONG:

Gentlemen, one of the students in this class came to my office yesterday and quite properly pointed out that the matter of air power, the Air Forces, and the aircraft industry had not been given the emphasis that it merits in the College in the weeks that you have had so far. I am in complete agreement with that point of view. I do not hesitate to say that air power, actual and potential, is the most important element in our national security; I think everybody in this room will want to agree with that point of view.

I must take some responsibility for the apparent failure to lay emphasis on the importance of the aircraft industry and air power so far in the course. It is unintentional. We intend to make it up.

But we also, I think, are more or less the victims of a failure to understand our purpose both in the Army and the Navy Air Forces. We are doing our utmost to see that some change is effected. We have a splendid representation from the Navy, and our representation from the ASF is adequate, I think. But certainly the Air Forces of the Army and the Navy are not represented at this College to the extent that we propose that they shall be represented and that they certainly should be. However, rest assured that as time goes on the Air Forces and air power and the aircraft industry will be adequately studied here in the Industrial College.

Now, the aircraft industry is to my mind a most important element in the industrial resources of this Nation for our future security. We are so convinced of that that many months ago I asked Mr. J. Carlton Ward, of the Fairchild Company, to serve on our board of advisers. Mr. Ward has been a keen student of industrial mobilization in the United States; one of the outstanding industrialists who in the years before Pearl Harbor was giving his time and his energy to advancing the principles for which this College stands. We have been grateful to him in the past. We are grateful to him for being here today. Gentlemen, it is a privilege to present to you Mr. J. Carlton Ward, who will give us a talk on the aircraft industry, actual and potential. Mr. Ward.

MR. WARD:

Thank you, General Armstrong. I would like to make my position clear at the start. I am a representative of the aircraft industry and not a spokesman for the aircraft industry. So what I say here are merely the views of an individual.

I feel very much as though it were like carrying coals to Newcastle for me to talk on industrial mobilization here, particularly before this class. I see so many Army colonels and Navy captains that it looks to me as if you professional gentlemen are away out beyond us who speak only

from industry. However, we will do our best to give you some reflections from the industrial side of the picture.

In order to arrive at that point, I have worked out a sort of philosophical approach to the question of mobilization. I can best illustrate the character of the problem, it seems to me, by referring to the old parable of the leaky roof. The gentleman who has a leaky roof is not concerned about it when the sun is shining, and when it is raining it is not an appropriate time to do much about it even if he wishes to do so. That to me seems to be the parable of industrial mobilization.

Now, since we all learn from experience, it is well to take a look at the change in war over at least our span of history. We see war emerge from largely a manpower activity with professional soldiers, to total war as we see it today, with the shift of emphasis from professional manpower into total manpower of a nation with emphasis on materiel and its further shift into the full use of applied science in place of brute force.

Of course, that is where industry comes in, you might say. Probably there was an industry in the days of bows and arrows and of spears, but it was probably on the individual craftsman level; whereas today the industrial aspects of war seem to require as much manpower, if not more, than the combat phase of war.

General Armstrong started off with some remarks about the importance of the aircraft industry to war. This morning at breakfast I was trying to work out several approaches to one or two figures that would give you a clear picture of what I want to bring out. These figures will have to be checked, but I think they give you a reasonable picture.

There were two and a quarter million men directly in our industry at our peak production period of the war. When I say "directly" I mean those folks who were on our payrolls. Obviously we had to get materials and parts and services elsewhere; and, since our total production in terms of dollars ran at a rate above sixteen billion dollars per year, it is clear to any statistician here that it took more than two and a quarter million workers to do that.

If you take that sixteen billion dollar figure in terms of the total war expenditures, which ran maybe in the order of a total of sixty-five billion at their peak for a year's period, you come out with a very easy figure that the aircraft industry represents 25 percent of the total effort. Actually I think it was nearer 20 percent. If I recall correctly from memory, Charlie Wilson, then in the War Production Board, exhibited a chart at Fort Belvoir in the closing stage of the war in which he showed to industry that the aircraft procurement expense was 21 and a fraction percent of the total cost of the war.

Now, looking at it from a totally different angle, that of the manpower and the mobilization problem involved, involving say two and a quarter million direct workers statistically, probably you could arrive at the fact that there were as many more workers from the mines through the specialized services that we drew upon in order that we could do our

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final product conversion with our two and a quarter million workers. So there must have been in the neighborhood of four or five million workers involved, as a generality; and that is probably near to 50 percent of the total mobilized Armed Services at their peak.

Now, those two figures will give you some idea of the magnitude of one industry's industrial mobilization. Since we are talking only about the aircraft industry, and that in turn is only a fraction of the total industrial mobilization, I think we have made our point--that industrial mobilization is as big a problem and as complex a problem as military mobilization.

Of course, mobilization for total war as we have it today can be easily divided into certain categories. There is the combat manpower mobilization, which is not our subject. There is the materiel mobilization, which is our subject. And there is the industrial manpower mobilization, which is a phase of the materiel mobilization. And in addition, of course, there is the civil defense mobilization, which is not our subject. So you see that in the over-all mobilization problem there are major categories; and the one we are discussing, which is the aircraft (industry's industrial) mobilization, is only one category of industrial mobilization. It happens to be a useful subject to discuss because of its major size in the total industrial mobilization, and because the problems of the aircraft industrial mobilization are acute.

The aircraft industry was the forty-fourth in size, according to the U.S. Census, before the war, and rose to the greatest industry in the world, according to the U.S. Census, during the war. There is a very able pamphlet, by Mr. Symington of the Surplus Property Administration, dated 14 January 1946, which I would recommend all of you to at least scan through. You will find there some vital statistics. In the years between 1937 and 1944 the aircraft industry, using an index, increased in size from an index of one to an index of 102. I doubt if in the history of any major industry there has ever been an equivalent growth; certainly not in such a period of time.

Now, military training, with which you are all no doubt very familiar, certainly more than I am, includes training for the applied strategy of military operations, the tactics of military operations, and for economic warfare, logistics etc. In peacetime this has been carried on professionally by your Navy and Army Colleges & Schools and applied in the War Plans Division of the Army and the Navy. However, there has never been a counterpart of that in size, scope, or rank in the field of industrial mobilization planning, without which the military planning is not complete. And that is what we are directing our attention to today.

Industrial mobilization has sub-phases, far too many for us to enter into here. The question of the financial preparation in mobilization we do not need to touch on here today. But those of us who operate in the realm of industry do not have the deficiency appropriations that we can turn to when we guess wrong. So our financial mobilization is a very vital thing for us.

Raw material planning is, of course, the first step, and a very difficult one. Available transportation facilities, the mobilization of such transportation for our industrial effort, is also a very important consideration. The location and training of manpower is a major problem equivalent to military mobilization. The construction of new facilities and the planning of such facilities, the conversion of facilities, their design and location, and so forth, are very important. And then most important of all is the scientific planning for the development of new materiel.

Those are all phases of our job. I would like to emphasize the problem of the training of manpower, which should be obvious to all of us. It is as big a job for us as it is for professional soldiers in their field. The women who come out of the kitchen and many from off the farm are not suitable material for our "combat detachment". We have to adopt methods of training them which are not applicable in peacetime, which are accelerative. We have to dispose our "industrial troops" into specialized functions. We do not have the over-all, all-round "soldier" in industry in time of war; each worker is a specialist. Those terms I am sure have a familiar sound to you in the military field.

In the past there has been only a very dim realization in America of the equal necessity for this total war mobilization planning with that of up-to-date military planning in time of peace. That leads us to the "lift ourselves by the boot strap" method that we relied upon in this war to mobilize our industry. We resorted to expediences. The very national agencies which we drew on and which the Government hurriedly organized had not been conceived of before the war. They were creatures of the war.

Some of them worked well. Some of them went through a considerable period of streamlining. They finally came out as the agencies with which you are all familiar. One of them was the OPM, later the WPB. That was really the first organized operating governmental industrial device to put industrial mobilization on an over-all nationwide plane, geared into the military needs.

It is obvious to all of you, I am sure, that governmental industrial planning means nothing unless industry plans along with you. In peacetime the Ordnance Department, that is, in the peacetime between World Wars I and II, had the best concept of industrial planning. The Air Forces had a concept which followed that of Ordnance; but it was not so advanced; nor had it been in existence so long. At least we in industry were not as conscious of it. But planning as a whole was on a very sketchy basis. It had to be, because there were no (suitable government) funds, relatively, to implement it.

Now, the Ordnance Department created ordnance districts in the United States. Many of you are entirely familiar with what I am saying. Those districts were under the actual command of reserve officers of lieutenant colonel rank or the equivalent. There would be one Regular Army officer, maybe of the rank of a captain or lieutenant, to do the executive work in probably a region where there were thousands of industries. The Ordnance Department conceived the idea of having Ordnance

officers in reserve in these industries and of having the local reserve officer sections formed to discuss the mobilization problems and of inspiring detailed plans to be drawn up for a mythical M-day.

Their failure to reach that goal, as they saw it, was due to the fact that industry was not entirely sold on the effort because there were no funds to implement it. It is a simple fact that industry has to live on the basis that it produces a profit.

To give you an example on the aircraft side: during this period I was attached to the United Aircraft organization. We were asked to make a war plan under an army directive. We made a preliminary study and came up with the estimate that it would cost \$90,000 (to make a real workable) war plan. We went to Wright Field and said we would take some of our best executives, engineers and operators and have them work on such a war plan. Wright Field said "We have no funds."

That was setback number one, because even then based on world conditions we had convinced ourselves that it was a very desirable thing to do. So we had a conference with all our top executives; and the company finally agreed to put in \$45,000 of its own funds if the War Department would match it. But that fell through because the War Department did not have the \$45,000 for the purpose. This was a large sum to us at that time and we felt our offer was a sincere and generous one.

Now that was not a practical approach to industrial mobilization planning. I throw out those figures for you so that you gentlemen will have some concept of what it then cost for one particular organization to make a really workable war plan.

Actually the work that we did in making that proposal to Wright Field later on became the basis for the large expansion of United Aircraft in East Hartford, Connecticut. The seeds of a good idea were all there, but the mature plant never could grow up and flower under such an impractical approach by the Government.

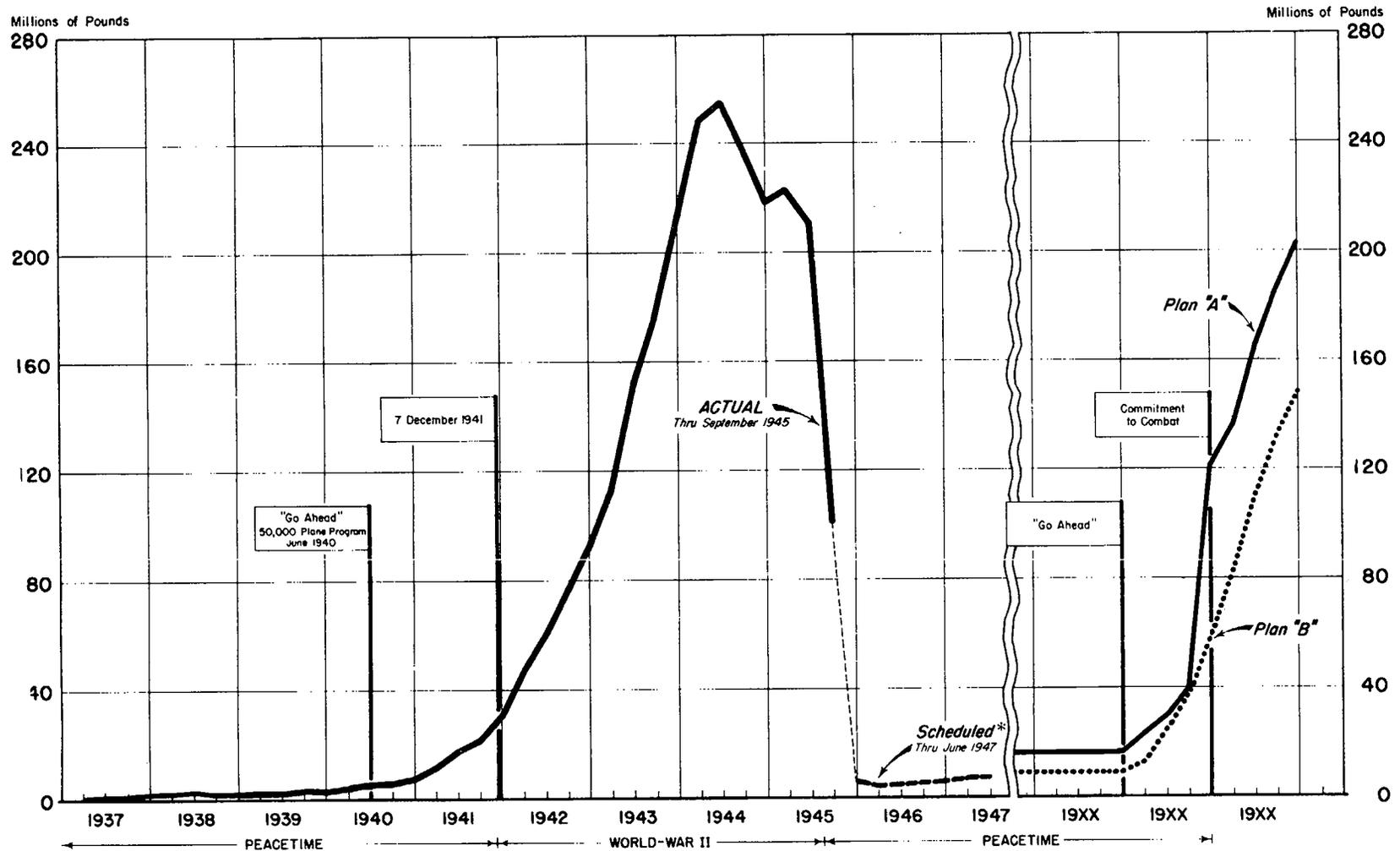
The United States actually prepared for war industrially in the two great world wars of our time by what I would call the old swimming hole technique--you just jump in and see if you can swim. If the Nation does not have the secret sources of military and diplomatic intelligence to reveal the on-rush of war before it occurs, it ought to be very clear that on combat day there is no possibility of our being mobilized industrially or militarily. Thus it should be part of our consideration here that there be an over-all national intelligence that would inform our government leaders when an international situation might lead to war in time for the nation to start the mobilization machinery operating. That is not our subject; but I think it should be a very fruitful subject for study; and the new proposals that have been made for joint intelligence between the Army, the Navy and the State Department would, of course, lead into that sort of a solution.

Now let us look at the record on this chart which I am going to show you for a moment. It is this one over here. (Chart I) The first thing that I am sure must strike you is the fact that in the prewar

years on any chart designed to show the wartime aircraft industry, the peacetime aircraft industry is so small that it can hardly appear. That is because of the 102 index expansion in Mr. Symington's report to which I referred. (Chart follows.)

AIRCRAFT PRODUCTION IN WORLD-WAR II AND PROJECTED MOBILIZATION REQUIREMENTS

In Terms of Airframe Weight (Excluding maintenance spares) - Quarterly



*JX-3 plus Navy Post V-J Production Program

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You will note that from 1937 to 1938 and 1939 we were at our peak a two hundred million dollar per year industry. It was in December of 1938 that some representatives arrived from France for the purpose of buying American tactical aircraft equipment for France, because France then was convinced that the World War was inevitable. You recall the Ruhr period, the Rhineland period, the Anschluss and Munich. The handwriting was pretty clear for what lay in the future. So the French representatives appeared under a secret status in December of 1938.

Now, that was the practical start of the American aircraft industrial mobilization. It was in February of 1939 that the contracts were negotiated. There were just a handful of companies that were involved.

War struck Europe where my finger now rests on the chart, on 1 September 1939. If you will observe the curve here, you will see that nothing much has yet happened to our aircraft industrial expansion. The world is now at war; yet America, so we say, industrially still slumbers on.

We had actually delivered to France at that time about--this is from memory--some five hundred airplanes, of which there were only fifty-odd two-engine bombers and the rest were largely single-engine pursuits. France had, as you know--you have the statistics--a very small air force of her own. So that America was really not a big contributor to the period when France was fighting in the air for her survival.

I have to tell you that our airplanes were definitely good military peacetime airplanes, but they were not suitably armed; nor did they have leak-proof gasoline tanks or many of the necessities for good combat aircraft. The result of this was that France had some unfortunate experiences in attempting to use tactically particularly the two-engine bombers. So military-wise and industrially-wise we really had not oriented ourselves into the factual situation that war was on our doorstep and that the country should necessarily prepare for it.

Now, the war swept on to June 1940, at Dunkirk, where the average American believed, (a) that France had collapsed and was out of the war, and (b), that England was next on the list and it would not be long; and a great many Englishmen thought that too.

If you will look at chart I again at the time of Dunkirk, you will find that almost nothing has yet happened to the American aircraft industry. That is after nine months of World War II. So the lesson we are seeing is that we certainly did not mobilize through any informed intelligence that a world war was breeding. It is the "swimming hole technique" that we are still following.

When you come to this period of June 1940, a very significant thing happened in the United States. President Roosevelt announced a fifty-thousand-airplane program. That staggered the industry, because we had been accustomed to thinking in hundreds. It was called an

astronomical program by the press at that time. But, anyhow, that was in effect the practical beginning of an approach to volume mobilization by the aircraft industry.

Many of us in the industry had fully indoctrinated ourselves in what was going to come and had been using proceeds from the French and English aircraft orders to build our initial factory expansions, which became the models from which our subsequent mobilization expansion and training efforts were carried on. Our chart, because of the scale, reflects very little in this period. Actually a great deal was going on in the thought processes of the industrial leaders during this era, in that, in the later sayings of the war, we were "buying time" with French and English money.

Now, you will notice the chart shortly after Dunkirk begins to dare up hill. At first it is at a reasonable pace, although it seemed astronomical to us at the time because we started from such a small base. You will find that it was not until Pearl Harbor, when we were hurled into the war, that we really had any world significance as aircraft producers. That was a year and a half or more, a year and a quarter at least, after the world was at war.

Now, you see the curve really starting to go places, and what you see is the industrial power of America harnessing our industry; and thus our industry made those production records which it is more or less fond of pointing out in the press and in other suitable places as what it called the miracle of aircraft production in the United States.

But this period should never be reviewed without an analysis of what went on before, because by itself it is unsuitable for an overall analysis. It has no separate significance. It was the planning, the money and the time in the three years before, starting in February 1938, in a small way that made the miracle, as we call it, of 1942, 1943 and 1944 possible.

Those are some of the significant things that you can take off the chart, which, I am very happy to say, was prepared by the industrial planning groups of the War and the Navy Department in their very excellent presentation to the appropriate committees of the Senate last 6 October. If you have not been given that report, I can imagine no document that would have more value to you than this hearing before the Surplus Property Subcommittee of the Committee on Military Affairs of the Senate and the Industrial Reorganization Subcommittee of the Special Committee on Economic Policy and Planning. That report is dated 29 October 1945. It contains this chart and several of the other charts which you are going to see here today. The discussion and the presentation in it are excellent, including the testimony of then Colonel Baker of the War Department, who subsequently went to the State Department.

There is one last thing on this chart that I would like to have you look at for a moment. That is the reverse aspect, or the down-hill aspect of the production curve after VJ-day.

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Now, imagine that you are an industrial leader in our industry, and you are faced with that demobilization program. What will be the morale of your organization and what will be your morale when you find your market shrinking something in the order of six percent of what it had been?

Again, such figures are outside the ordinary scope of industrial experience. It is just the same as if you took a whole division of troops and you let fifteen of them go to every one that you kept. Your division would not be a serviceable division, and I am sure its morale would not be very high. The demobilization problem is not for discussion here today, because it is the reverse of the problem in which you are interested. But it has this significance for your problem, and that is that we, in reaching this new demobilized state, must still carry on emergency mobilization thinking and planning if America is going to be ready for what might be another world emergency.

Now, put yourself in the place of the average of us, asked to think in terms of mobilization while we are being demobilized at a fantastic rate. And yet if we do not think in those terms, we are liable to miss a great political opportunity; and that is an opportunity that I believe exists now, whereby an orderly approach to a future emergency can be set up within the framework of our American form of government. And so this is a timely subject for all of you, because we in industry can obviously only play a very small part in such a problem.

I am afraid we have spent a lot of time on chart No. I, but there is a separate portion of the chart which we should review, and that is the right-hand section of it. You see these "19XX," "19XX," "19XX" years at the bottom. They are supposedly the first three imaginary years of the next emergency mobilization. In this Army and Navy report there is a very able discussion of the factors and the bases for those curves which should be studied.

You will notice that there is a curve for Plan A and one for Plan B. We have not the opportunity to discuss them here, in detail. You will find them ably set forth in this report. For our purpose here today let us say that the War and Navy Departments examined, or more exactly the Coordinating Committee, which is War, Navy and Commerce Departments, examined the fundamental basis for industrial mobilization on various assumptions. One assumption was that we had maintained some stand-by plants during peacetime. The second is that we have had this new form of world intelligence, previously referred to, to warn us twelve months in advance of "combat" day. The third one is that we have nothing at all; that we just start all over again merely with the experience of this war.

Now, Plan B is that low dotted line, and it illustrates what happens when all of those factors of preparedness, including reserve factory space, are not available; what it does to your war potential in point of time to prepare.

Like all parallel curves that are drawn slanting, it is very important that you measure the vertical height between the two curves A and B, because the eye does not always pick up the actual difference between two such curves and that difference is very great in terms of the war potential. It might be extremely critical and serious.

Now, we will not spend any time on why this country did not more quickly become politically alive to the effort that it was going to play in this world war. But as citizens we now should all think in terms of, "Will we be allowed to repeat that mobilization phenomenon in the face of another world war emergency? If not, what new factors will allow us to avoid a slow realization on the part of the country that it has a military effort facing it and that it will take a lot of time to get ready for that military effort?"

That is a very important aspect in any democracy, because inherently our form of democracy is such--I say "our form of democracy" since there are other forms of democracy which we read about--that it is going to react more slowly than any totalitarian form of government, where one man or group of men may determine the national policy without obtaining political support for it first. Since we must work the other way if we are going to be true to our form of government, then it is more important that we in our democracy have an informed public opinion in time to put our government machinery in motion. Even if we do a good job, under our democratic form of government we will not be as quick to sense the need for a reorientation of our military potential as could any enemy totalitarian government. And that is something that should be food for our best thought, as to what approach we should use to take its place, because we certainly do not wish to change our form of government.

Now, I would like to bring out one instance of popular misconception that stands in the way of, or stood in the way of, setting up a practical approach. I do not know that it will in the future.

In June 1940 the Detroit papers screamed in headlines at least four inches deep -- that Henry Ford could build a thousand airplanes a day if the Army would tell him what kind of an airplane was wanted.

Now, let me make it clear that I am not in any sense pointing my finger at one of this country's greatest industrialists. His reputation stands secure and supreme in his field of mass production. But there is no such thing as an expert in all fields of endeavor. How well-intentioned that statement may have been or from what source it came--it may not have been Henry Ford, or, it may have been a newspaper correspondents' interpretation--nevertheless the news went abroad through this country like a bolt of electricity and had its repercussions throughout the world. I was in France at the time on an official mission and an important French Industrialist said to me, "Could this be so?" If so, he said that it would change France's morale and its military approach toward the dying phase of the war, in which it was then involved.

Well, now, if you will all do this for yourselves: You know that a thousand pound airplane of that day was a very small airplane, out of

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which at least two thousand pounds would be aluminum. If you multiply that by a thousand, you have two million pounds of aluminum a day. Multiply that by three hundred and you come up with a very large amount of aluminum, namely, six hundred million pounds, in fact, more than the whole country was then producing.

The second thing that you come out with is that to make an airplane of that size it takes a certain number of man-hours per pound of airplane, as we found out during the war. This brings about the necessity for several million workers. Henry Ford then had one hundred thousand. The entire state of Michigan would not have sufficed!

Now, the only reason that we are exploding that kind of easy thinking is because there is a tendency to think of our mass production industries as being something that we can immediately turn into the war effort and on the next Monday or Tuesday out come guns, tanks, planes, vehicles or whatever is necessary without regard to the factors of planning and the specialized approach to each one of these pieces of materiel.

It is the old bird gun theory--that America has only to hear the clarion call of war to reach up over the mantelpiece and take grandpa's bird gun down and shoot the Red Coats. But that pretty picture has no more application in industry than it has in the military field.

I would like to add another observation, which is meant to be wholly constructive as is the previous one. That is, that there are many professional soldiers and sailors and air men who have seen industry in this so-called miracle phase doing such an amazing job of production, and industry itself has not been backward in pointing out to them what an amazing job it has done--so that they have a blind faith that leads them to believe that industrial planning for mobilization is not so important as military planning. Hence they unwittingly apply the bird gun theory to industry in believing that it can meet the emergency demands of the Armed Forces overnight. I would like very much to explode that theory.

It is always interesting to point to a fact and not to an opinion. I have endeavored to let you compute for yourselves why I do not think anyone, or even the whole United States, could have produced a thousand airplanes a day in June 1940.

But let us look at the record, as Al Smith used to say. The Ford Company built and operated that remarkable plant, Willow Run, the theory being that it would produce B-24 bombers by the "mass production method," so admirably worked out by the great American Automotive Industry.

We in the aircraft industry must pay tribute to what we have learned from the "mass production" industries in this war effort. Nevertheless while we talk about the "mass production" of airplanes, any student knows that we never did any such thing. "Mass production" means such a quantity of production that even the smallest of operations can be specially assigned to individual workers, who need only to be trained on that specialized operation; and that assumes rates of production which have never been attained even at the height of our aircraft manufacturing

program. But we like to call it "mass production" because somehow or other our public relations people, in fact all our people, like to think of it as "mass production."

Thus, "mass production" as practiced in the automotive industry, where they made ten thousand vehicles a day in one firm alone, finds no counterpart in our industry. We never did that for all types of airplanes for the whole industry in one entire month, let alone one automotive firm doing that for only one model of car in a single day. In drawing on their technique we have learned much, but we cannot take it right over and transplant it.

There was at the start such an approach in that direction at Willow Run, which was a very salutary example to students in the art of aircraft manufacturing. Their approach was, "fixed tooling; no engineering changes and let us get the damn things out fast." But you gentlemen know that the rate of design change on aircraft is terrific. Therefore that was the first thing that interfered with their plan, and hence Willow Run was longer in coming into production than was originally anticipated, and by that good old American system that you all know about came to be unfairly known as the "Will it Run Factory." Actually it came through in time, but it came through after this approach had been altered by what we call the simple facts of the aircraft industry. So I would say that the mass production industry learned something and so did the aircraft industry out of that particular experiment.

Now, that brings me to another conception which I would like to clarify by quoting from Secretary Lovett's testimony to the Senate Committee in the same report to which I have already referred. He makes the statement therein that 90 percent of all "airframes" built in America during the war were built by the aircraft industry itself. (As you know, "airframes are the structures themselves and are assembled with engines, propellers, instruments, etc. furnished by others.)

We in the aircraft industry did not figure quite that high. I am quoting Secretary Lovett's statement to impress on you the fact that, in spite of Willow Run and many other fine contributions by the automotive industry, it was the aircraft industry, raised from a level so low one can hardly find it on a chart, that had to grow up into something that would perform the so-called "miracle" that is shown on that chart. Thus when the need develops, the aircraft industry must be existent and must be supplied with time to expand according to well-laid plans. It is not a practical substitute to count on reaching over into another existing industry and to depend on its having the experience and specialized techniques needed to do a job so different from its normal lines of endeavor.

It is also interesting to note that America was still building consumer goods as late as 1942 such as stoves, home appliances, plastics and automobiles, if you like.-- Thus if you look at world events at that time you will see how long it took to convert such mass production industries into war production in the face of war.

Now, another thought may interest you before we leave this chart. That is the fact that all of the airplanes produced in the whole period that you see there were essentially of prewar design. We think of the B-29 as the latest of all the great war bombers. I have another chart here that will make that clear. You will see that it was in 1938 that the B-29 was started. If you look at the previous chart you will see that that was the period when American aircraft industry was still slumbering. (Chart follows.)

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It went through two model designs on the board, in that year; and it went, as you can see, through seven model designs in 1939. By 1940 it went through the final two and became what was known at that time as the XB-29 original model. In 1940, the time of Dunkirk, it went through its wind tunnel test. In 1941 before Pearl Harbor it started in construction.

You will notice that in 1942 it had its first test flight. It was still not a combat airplane. You now come to 1943 when production began, but you who are interested in aerial bombardment will realize that it did not become a major factor in the war until 1944. This is a striking example of how the headlines can confuse one for it is commonly believed that that airplane was a war-born airplane. It was a war-developed airplane. Just as the Germans developed their war airplanes in the Spanish War, we hammered the combat features of this airplane out in this World War II.

We could talk about other airplanes that you are familiar with. It does not matter whether you take the Hell-Cat or take the Corsair on the Navy side or whether you choose the Mustang or the Thunderbolt or what Army airplane you choose. We can trace them back into prewar design phases in all cases. This is evidence that, if we are not preparing in time of peace, we will not be around to prepare in time of war. Of course, that was France's difficulty when she was attacked by a prepared enemy.

Now, let us look backward for a moment. We had no practical approach toward industrial mobilization before this war. We had no funds to carry on industrial mobilization planning prior to this war. We had no funds to place educational orders, to develop subcontracting sources. The subcontract system as you all know, was the reason we could do this "miracle" of production that you see over here. The subcontractors did not know how to work with our tolerances. They were not used to our system of drawings. It would have been very valuable in peacetime to have educated them and it would have served to shorten the industrial mobilization time. But there was no money for such educational orders. There was no money to make practical industrial plans, which each separate industry ought to have just as much as each segment of the military branches had for its mobilization.

Certainly no steps had been taken by the time World War II arrived to prepare American industry for these coming events. Research and development proceeded at a snail's pace. You may think that is a strong statement to make after pointing out the B-29 development. But if you could look inside of our works at that time and see the small group of engineering personnel devoted to such big projects and the restriction of laboratory facilities and funds, you would realize that the whole system of technical procurement for new development was then archaic and impractical.

The congressional and Senate Committee records are filled with testimony by industry and by the Military Services as to the impractical form of procurement that we had at that time for the encouragement of these new articles of war. In fact, as a representative of industry I

LEADING THE WAY TO SUPERSONIC

1938

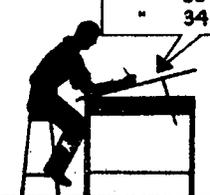
MODEL 316
" 322



DESIGN

1939

MODEL 333
" 333 A
" 333 B
" 334
" 334 A
" 334 B
" 341



DESIGN

1940

MODEL 345
" XB 29



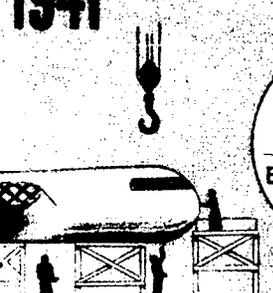
DESIGN

1940

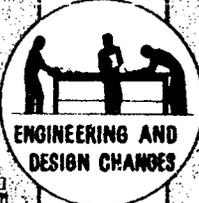


WIND TUNNEL TEST

1941

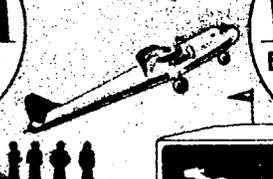


CONSTRUCTION XB 29

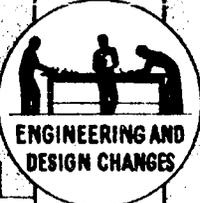


ENGINEERING AND DESIGN CHANGES

1942



FIRST TEST FLIGHT XB 29

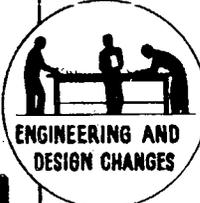


ENGINEERING AND DESIGN CHANGES

1943

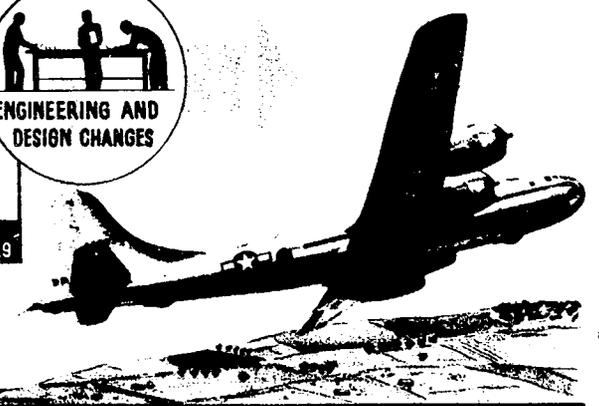


PRODUCTION MODELS B 29



ENGINEERING AND DESIGN CHANGES

1944-1945



can tell you that we, along with other firms, never dreamed of getting our money back on an experimental development. And yet we competed for those developments with other firms. It was the firm that would take the biggest loss that had the best chance of being designated to do that development.

Fortunately, there are always men in the Military Services, with the vision and courage which it takes, who will frequently see that a new development is placed, not necessarily where the lowest bid is made, but where the individuals who can do the best job in that field are together as a team; and they can often make out a case for such a contractor. But it is like flowing-water-up-hill to work under the framework of procurement that was then in vogue. Our point in looking backward and bringing this up is that I hope in future peacetime eras--and I have reason to believe, in this peacetime era--industry will not have to operate under any such similar handicap. New procurement legislation is needed to thoroughly resolve this problem.

Now, I have already mentioned Mr. Symington's remarkably clear and able report to Congress, dated 14 January 1946. I hope you will all scan through it. It is full of statistical exhibits in the plainest of English. It is written in large, readable type. If you do no more than read the first two pages of the summary, you will find a lot of light on an important part of the problem we are discussing today.

Now, I would like to touch for a minute on these two aircraft industry location maps. They are also in the testimony, previously mentioned, before the Senate. (Charts follow.)

[Faint, mostly illegible text continues on the page, including a date stamp at the bottom: 15]

You will notice the discs. Their size is representative of the magnitude of the existing facilities. You will notice that in the aircraft industry you had in and around the Los Angeles area, including San Diego, a terrific concentration.

It represented, not half of the aeronautical industry, which you are often led to believe, but it is a highly important segment of the industry and should never be underrated. If that area were ever put out of action, a very important segment of our overall production would suffer.

Above are the Boeing facilities and nothing much between. Then rapidly crossing the central portion of the United States and all that is found are some relatively smaller facilities like Beech and Continental. There was practically nothing in this big area before the war except the Indianapolis plant of Allison, a new unit in Nashville, and the Curtiss unit in St. Louis.

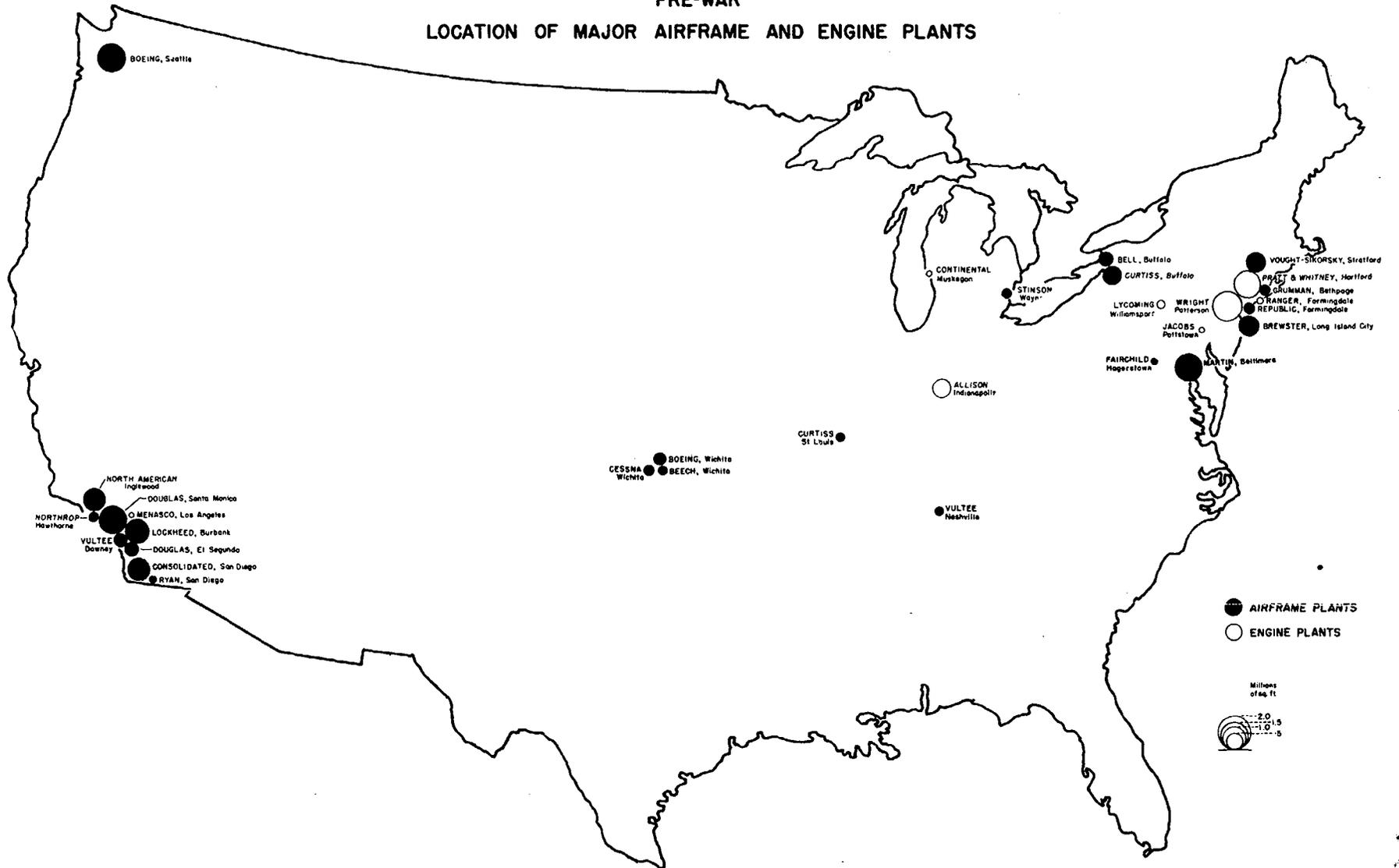
Then go to the east coast. There is found a pattern not like that of the west coast. It is like it in one particular--that in the northeast area there is a concentration of aircraft facilities. Here the industry is more spread out and more diversified and is larger in total size.

Now, that is the prewar pattern. That report to the Senate on the testimony of the Coordinating Committee clearly sets forth what was considered to be a danger from the mobilization point of view of that prewar pattern. By government direction and necessity to tap new manpower sources we now find after the war all through an area, which would be just east and west of the Mississippi line, a great dispersion all over what would be the central northern area--Michigan, Ohio, Indiana, etc., and an axis from Dallas, Texas, to Chicago, Illinois, the new units of the industry. In addition, there are the new eastern and the new western ones. That pattern is the present pattern before demobilization.

There are a lot of social problems involved in the recommendations of this report as to what will be done to the industry facilities after demobilization. The testimony of the Coordinating Committee brings out that they would like to preserve these new units and let many of the old ones go out.

One point that should be brought out at this time must be clearly understood in any such approach. We are dealing with human beings who in many cases are going to live where they want to live and work where they want to work. The designing staffs which created these airplanes exist in the original areas, not in these new areas. As demobilization takes place we run into that fact--that if all the facilities are moved into these new areas, the designing and parent organizations will still wish to live in their original quarters. In addition, the research and development facilities are in the original, not the new, locations. so that there is a very definite problem in what will be the geographical pattern of the industry and what will be the mobilization pattern for the future.

MAP I
PRE-WAR
LOCATION OF MAJOR AIRFRAME AND ENGINE PLANTS



Speaking as an individual, I have been in hope that many of these new large facilities, as is shown in the chart, would be retained as stand-bys in the Government. That will then contribute toward realizing Plan A on mobilization on our chart No. 1 instead of Plan B.

Without going into detail, they can be used arbitrarily for government purposes, such as the storage of surplus materials. Or certain forms of manufacturing can be carried on in them on a partial scale, which industry would be glad to accomplish. But industry would resist, as I have gathered in talking with my associates, any attempt to force a new living pattern on all of these design staffs into districts where they do not have the affiliated services that they have been accustomed to having.

For instance, we can live in this area of the Northeast and contact all the affiliated manufacturers and vendors that we need to deal with. Also the representatives of the bureaus here in Washington, including all the important government people who direct our thinking and from whose practical experience and constantly changing tactical plans we create our new designs. If we get out of step with their tactical thinking, we have nothing to offer. So that the necessity for close liaison between the tactical thinking of the Army and the Navy experts and the creation of many of these new aircraft devices, which are so complicated, including now the new field of electronics and maybe atomic power and what-not, and for being where the steel and metallurgical industries have these great laboratories, must be considered before a decision is made to move into this other pattern.

You might think that I have been making out a difficult case for these gentlemen on the west coast. In some ways I have, and they know it.

They have developed advantages of their own. They have the advantage that all of them live nearby together, so that their engineers are like typhoid carriers. They just keep circulating around among the plants, and the integration of ideas that come out is terrific.

Now, I agree that these things can be done by other means. But it is just idle talk to speak of moving some of these base staffs across the country into other areas, because many of them will get jobs in other industries and will not be moved.

The Coordinating Committees' report also shows the results of a study of an atomic bomb pattern for the Los Angeles area on a special map. If you notice those little grayish areas you will see that six atom bombs could blow that whole Los Angeles aircraft industry pattern out of existence, according to the study. (Chart follows.)

Dr. Smythe, who wrote the Atomic Power Report, pointed out in a comm that they had made a study in which they showed that a foreign nation with a thousand to two thousand atomic bombs could kill thirty-two million American people and that that is how they could knock our country out in about two hours--of warfare if they could get through with their bombs. The theory was that if they could hit us without advance notice, they could knock us out by the staggering losses of manpower and the disorganization of communications and so forth through destroying our industrial concentrations in large cities. Thus in discussing aircraft plant location or any kind of war plant location, it is my personal opinion that I would rather have a plant thirty miles out in the country than to have a war plant in any big metropolitan city no matter where the city is. Thus it does not matter whether it is Dallas, Texas, or St. Louis, Missouri, or Denver, Colorado, or wherever the city is, because atomic warfare, we are told, is a warfare on people and not on things. It is said that we would not waste a bomb on a target such as a battleship or a plant but on cities where masses of people are to be found. So I would rather think of safety for myself and family and a plant in the woods in Connecticut than one in the heart of Kansas City. Thus I think we shall have to take new factors into any dispersal theory of plant location. Obviously this is a personal opinion.

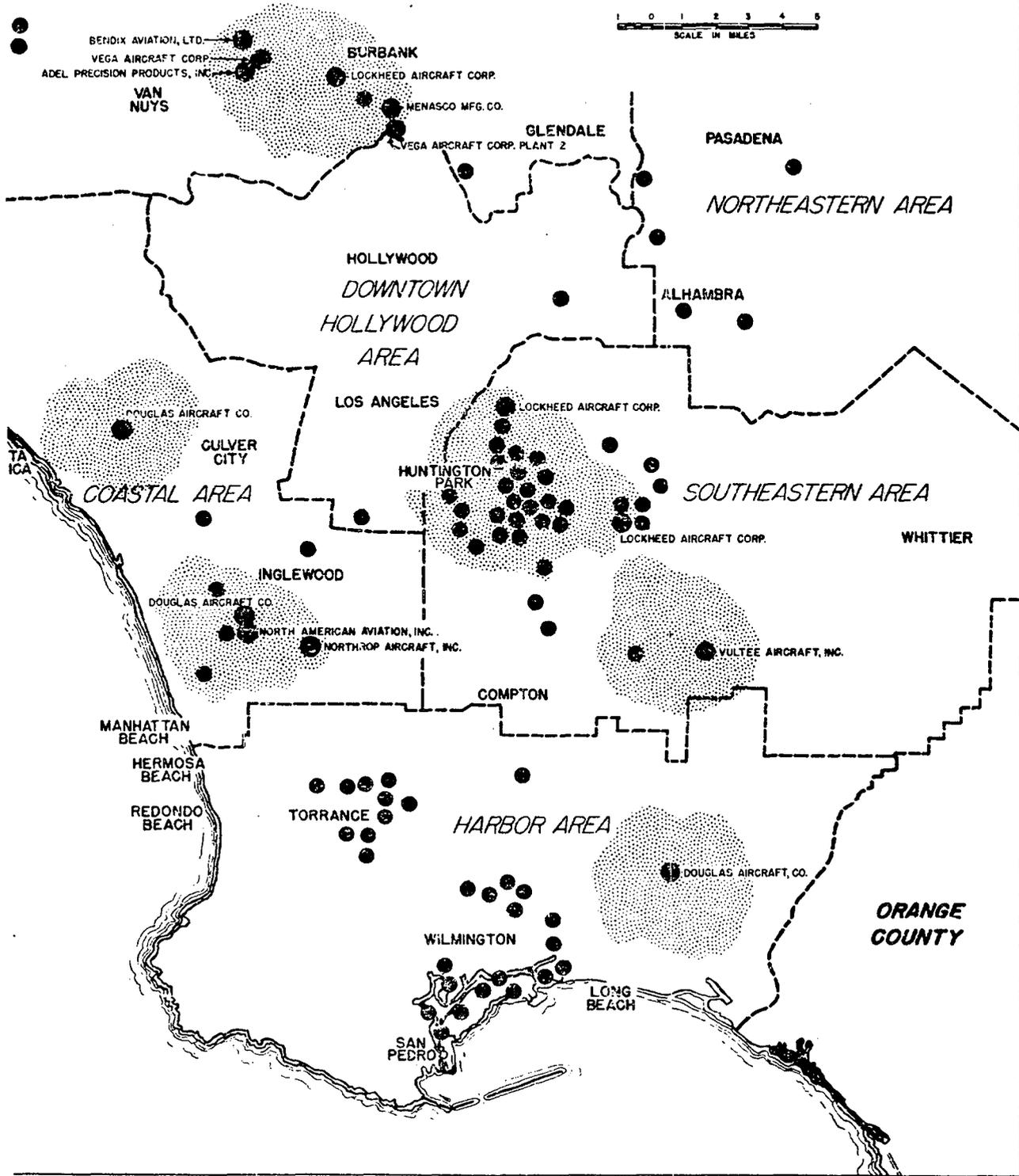
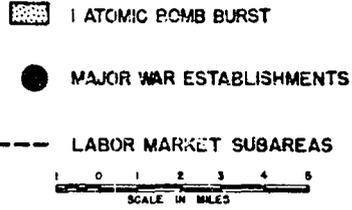
There will be a lot of other factors about plant location which we will not get into here. But we will be exercised about subcontractor sources and we will be exercised about raw material sources. We will be exercised about skilled labor and exercised about the volume of labor and the transportation relationships. Those are a few factors that must be thought of in terms of evaluating the location of a plant.

Let us look at the chart showing the segments of specialized effort in bringing an aircraft design through to production. This represents clearly one of the factors of mobilization with which we in industry are deeply concerned.

PROBABLE EFFECTIVENESS OF ATOMIC BOMBING OF THE LOS ANGELES AREA

SAN FERNANDO

SAN FERNANDO VALLEY



Each Technical Achievement More Costly and Difficult to Attain

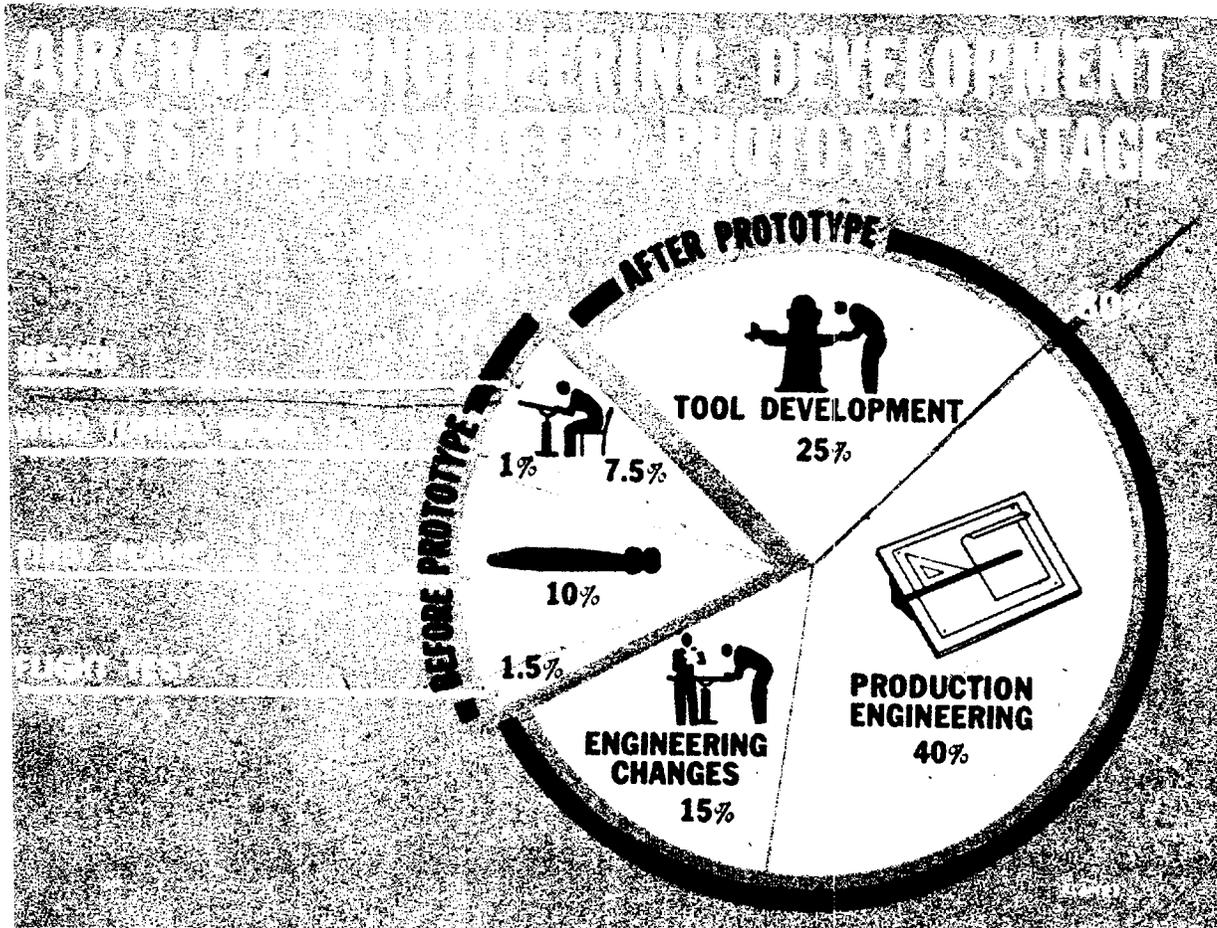
Each major engineering advance in military and civilian aircraft is successively more costly and difficult to achieve.

A West Coast manufacturer reports that it has required 10 times the engineering development effort to bring a current superbomber to production than it did preceding standard 4-engine bomber.

The earlier model had a top speed of 250 miles per hour. The

superbomber advanced this speed to more than 350 miles per hour. This gain of 100 miles per hour was at the cost of 1,500,000 man-hours of engineering, roughly equivalent to the work of 750 men, 40 hours a week for a full year.

It is clear, industry engineers point out, that the 450 mile-an-hour bomber when it is designed, may cost 15 million man-hours or 7500 man-years.



It is a far cry from wind tunnel model to the flight tested prototype the modern military aircraft, but, as this chart illustrates, it is even longer road from prototype to battle-tested production model.

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The chart shows that we start off with a design representing seven and one-half percent of the total effort before production followed by a wind tunnel model costing one percent. Next a prototype airplane is built in the experimental shop by expert all-around mechanics. This phase represents another 10 percent, and then comes the flight test, which requires highly specialized engineers and pilots, costing another one and one-half percent. If you pull that group out, it represents about 20 percent of the total up to production. That portion is what took such a long time as shown on the B-29 chart. It has been very difficult to expand this type of effort to meet the war mobilization requirement.

Note from the chart that engineering changes subsequent to the prototype represent almost as much effort as the conception of a new design, the production of a prototype and its subsequent test. Then follows the tooling at 25 percent and the production engineering at 40 percent, thus making the 100 percent total. Thus from memory, certain airplanes which have required about 250,000 man-hours of engineering up through the prototype have cost as much as one million six hundred thousand man-hours to do the subsequent production engineering.

That is production engineering for war, not for peace. We do not have the same pattern for peace. It was in part brought about by borrowing from the methods used in the mass production industry.

Similarly, it should be noted that tooling represents 25 percent of the total and again our industry found it expedient to reach out and obtain tool engineers from the mass production industries that worked along with our own tooling engineers who already knew how to make aircraft tools, which are distinct entirely from machine gun tools or automobile tools or tractor tools or in fact anything else.

The next chart is interesting, because it shows the relationship between two much discussed subjects--governmental basic research and private industrial research and development. As you see the Government's effort represents 15 percent of what goes into the over-all finished designs. The private aircraft industry contributes statistically the remaining 85 percent. (Chart follows.)

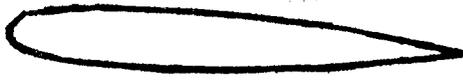
The next chart is one that I chose because it shows something that is generally not too well understood. It shows by indirection how rapidly an airplane in war becomes obsolete. This is brought out by the black lines showing the year to year change in airplane weights by types. Look at the black curve down below. Thus you will see that in 1941 the average pursuit plane had an airframe weight of 3,600 pounds. In 1942 it had an average airframe weight of 4,420 pounds, in 1943 of 5,120 pounds, and in 1944 of 5,560 pounds. The lesson here is that certainly the pursuit plane of 1944 did not look like that of 1943, and that in turn did not look like the one of 1942, and the 1942 model did not look like that of 1941.

You had a similar change occurring in the bombers, where we start off with 9,870 pounds in 1941, go to 12,900 in 1942, to 14,470 in 1943, and to 17,470 in 1944. Of course here we have the effect of the B-29, superseding the B-17 and the B-24. The B-24 and B-17 superseded and supplemented the B-26 and the B-25. The chart shows what happens and why the continual change of aircraft materiel has to be taken into consideration in any plan. I have not bothered to illustrate the trainers because their changes were very much slower, for reasons which should be obvious. (Chart follows.)

ASIC RESEARCH
GOVERNMENT 15%

APPLIED RESEARCH
85% INDUSTRY

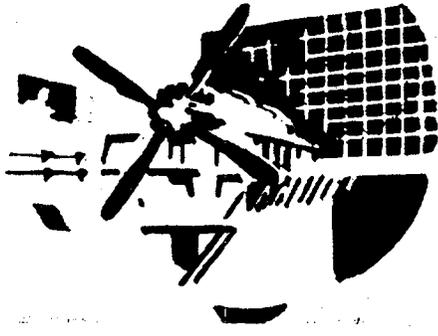
CONCEPTION
5%



DESIGN
10%



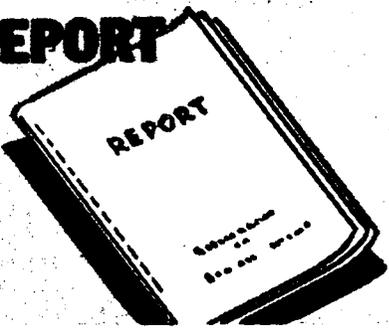
TEST
5%



FABRICATION
70%



FINAL REPORT
5%



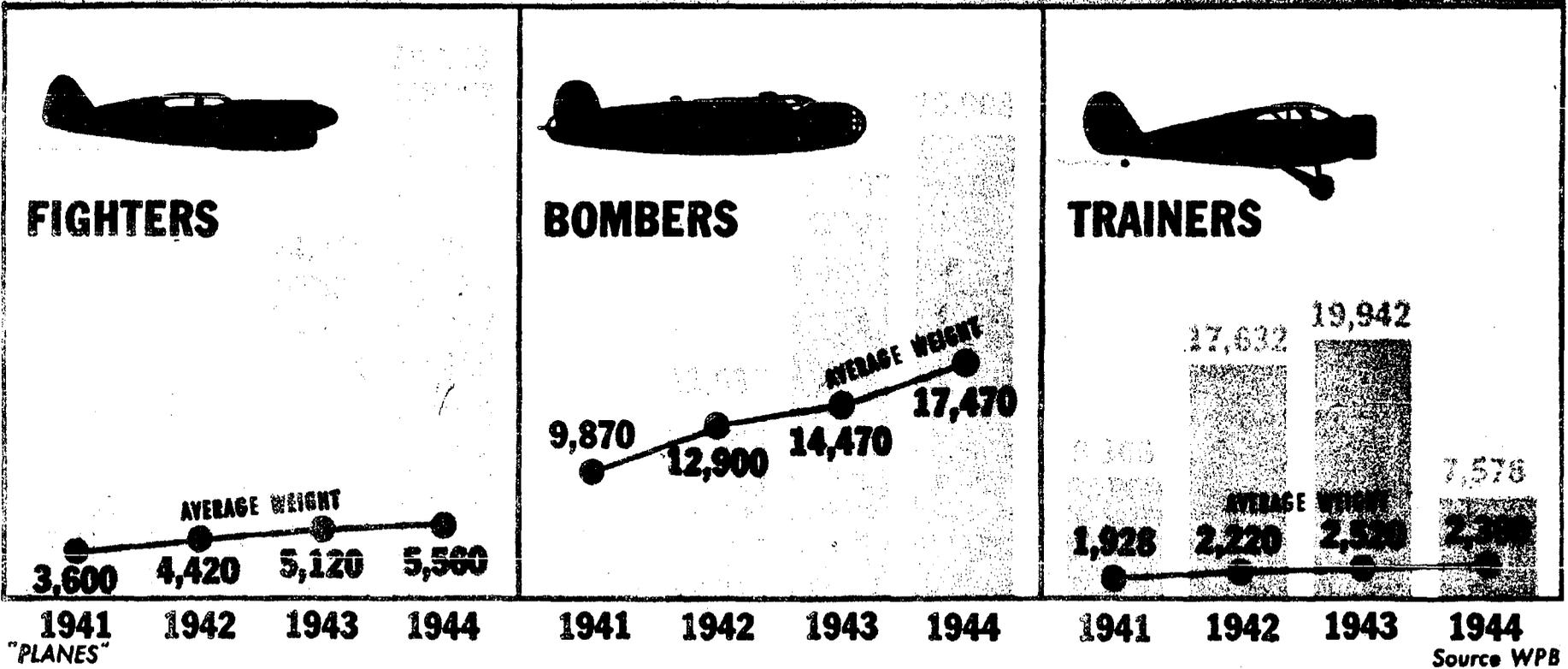
TEST FLIGHT
5%



"PLANES"

Private aircraft industry provides vast majority of research and development time, money and skill in making Uncle Sam's aircraft the best in the world.

AIRCRAFT INDUSTRY FOR VICTORY



The war production record of the aircraft industry cannot alone be told in numbers of airplanes. The record is one of increasing quantities of bigger airplanes.

Significantly, the 85,250 airplanes currently scheduled for 1945 will have a total airframe weight in excess of that of the record 96,356 airplanes produced in 1944.

111

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The next chart is the final one of this group of charts. It shows what our picturesque friend Mr. Kindleberger likes to call the period of gestation. At the top is the single-engine airplane up to 10,000 pounds weight. You will notice that the chart illustrates the number of years it takes from the first design conception until we have what it calls the production peak, which really means that some of them may be going into combat, because the first airplanes seldom go into combat. They have what we call bugs in them.

As shown on this chart the single-engine airplane takes better than two years, the twin-engine airplane three years, and the four-engine airplane four and one-half years. Similarly engines take four years. That is why if we wait until combat day, we just will not have modern materiel useful for fighting purposes. Development must be going on in peacetime.

The last chart is from that very able report of the Coordinating Committee. It is certainly worthy of a lot of study by this College. They have done a very clever job in showing this material. Thus the gray area shows the difference in mobilization time if we are without industrial reserves and stand-by facilities. It also shows in the lower line the difference in production that we would obtain without twelve months of preparatory planning. Lastly, it shows what we actually did in World War II, without any of either.

Now, imagine our fighting a new war with that World War II curve, when the actual requirement is for the upper curve. The chances of a nation surviving would be very small if attacked directly. These curves and the report are certainly worthy of study; and definitely will convince, I think, any open-minded person that we cannot go back to the type of mobilization planning for the future that we had in between World Wars I and II.

Now, to close, it is my belief that many professional Army and Navy people have too much faith in what I call the bird gun theory for industrial mobilization. It is my belief that war plans should include not only combat strategy and tactical planning, but scientific research and development planning and industrial planning.

I would like to emphasize again scientific research and development planning. (Charts follow.)

We had OSRD and NDRC during the war as war scientific development agencies. We had the National Academy of Sciences as sort of a peacetime agency. We have bills before Congress now for a research council. I am very hopeful that we will come out of this war with a much better conception of the necessity for scientific research and development planning, properly implemented.

There are three phases of this problem which I would just like to call your attention to as we go along. The first is the basic research stage, which in our industry is the 15 percent shown on the previous chart, and is done by the Government. Then there is the development stage or phase, which is the phase to be done by industry represented by 85 percent on the previous chart. Here, we take the basic data emanating from such laboratories as are provided for by public funds operating under government direction, and by private laboratories designated for research work under government direction; and we put this basic scientific data to work.

Private industry develops and produces the articles and then they flow into the third stage--to the Army and Navy facilities, where they are evaluated in their great laboratory facilities. Here they are evaluated first technically, and then later in maneuvers where they are rated tactically and for combat.

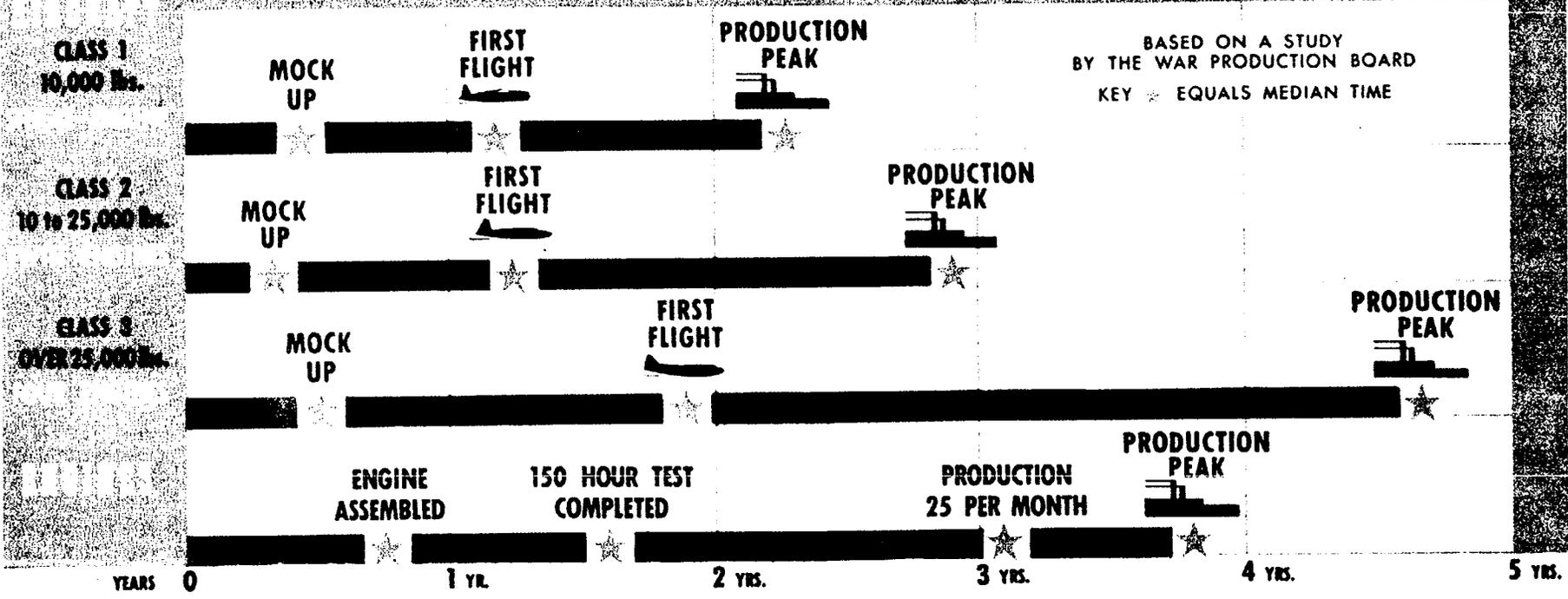
So each one of this three-man team has his part to play. Each of us should always be conscious of the other fellow's part, because it is so easy to overlap such closely allied activities. It is so easy to become the father of an idea and to want to hang on to it too long in any one phase. It is as wrong for industry to hang on in the field where industry reigns supreme as it is for a government laboratory to hang on to research data too long before turning it over to industry for development.

I believe that all three functions should have the same rank. I do not think that industrial mobilization and planning should be subordinate to military planning or that planning for scientific research should be subordinate to either. I think one should be its right arm, and the other its left arm, if you will.

I hope that some day this Industrial College, which is engaged in the study of these industrial problems, will have an equal rank with the senior Army Staff College and the senior Navy Staff College. I think that as your problem of industrial mobilization in its relationship to military mobilization becomes clearer, the necessity for having the same caliber of distinguished Army and Navy men assigned to it in the advanced phases will be equivalent to the necessity for similar assignments to the professional Army and Navy senior War College. I think that research and development should also be carried on in universities where there is the organization to do it as well as in government laboratories such as N.A.C.A. etc.

I think that basic research and development should be the function of the Government, but that the development of the article itself

ELAPSED TIME FROM START OF ENGINEERING TO PRODUCTION OF MILITARY AIRCRAFT AND ENGINES



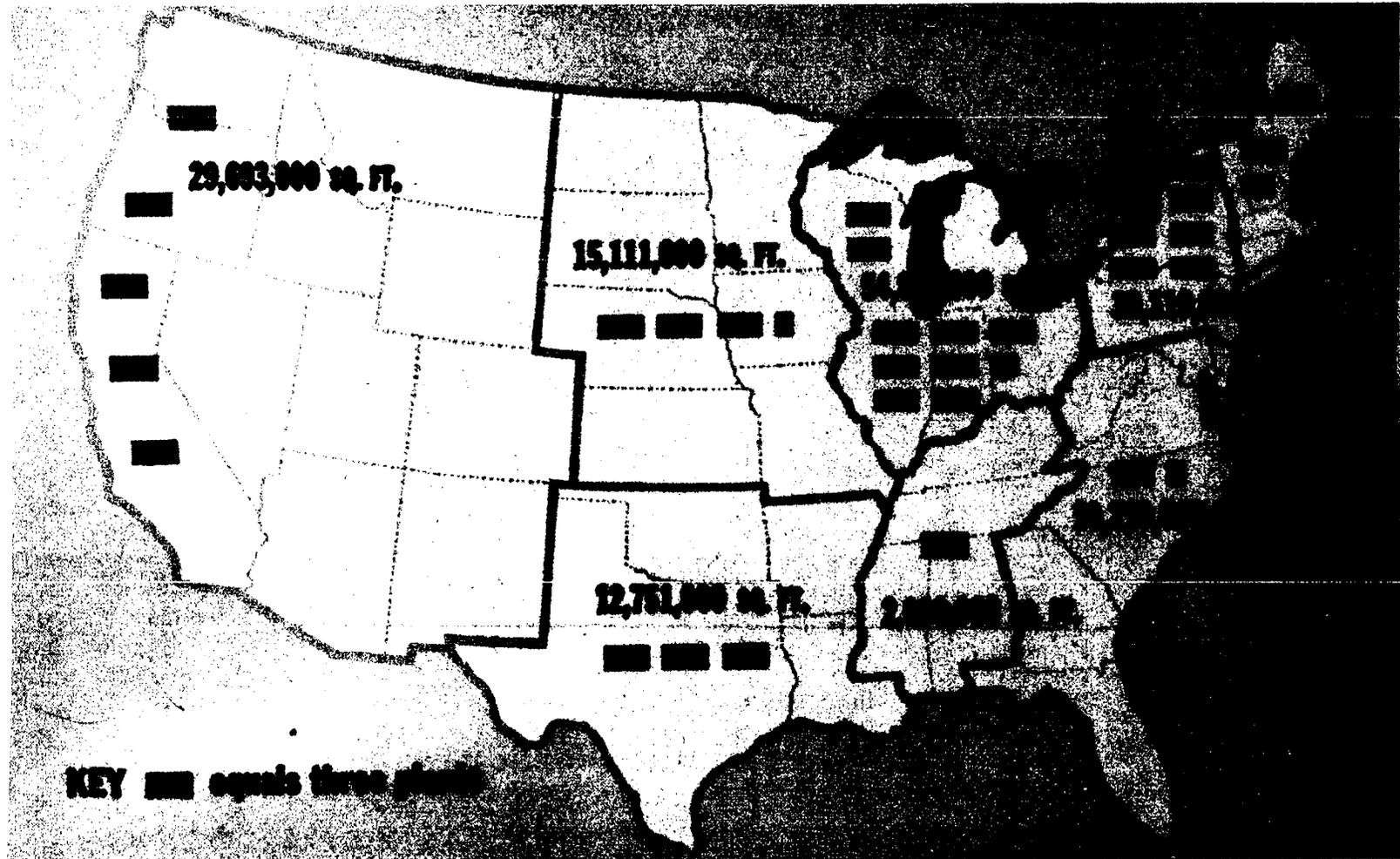
Aircraft design must stay at least four years ahead of production. For this reason design engineers must think in terms of the future while considering current practice.

Aircraft design is a continuous process following the aircraft through

its production life. Modifications incorporated in the production lines are necessary to meet ever changing tactical requirements and to give our pilots an ever mounting edge in performance over the enemy. It takes about 45 months to mass-produce a new engine.

THE AIRCRAFT INDUSTRY COVERS THE NATION

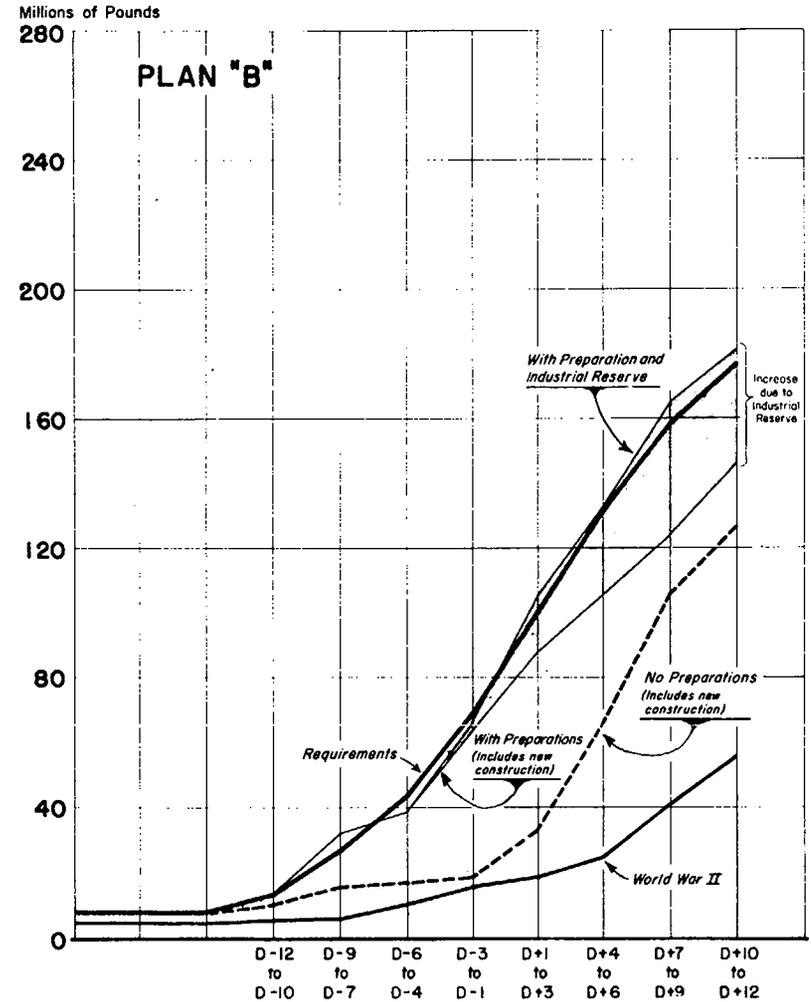
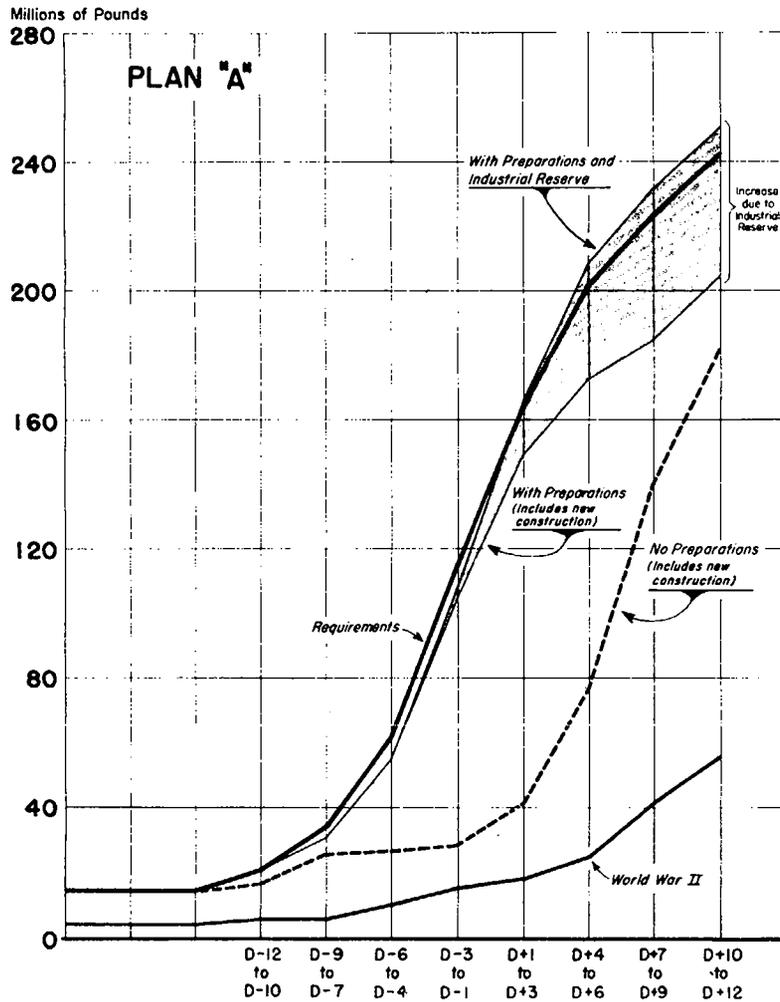
Airframe, Engine and Propeller Plants



In 1939 aircraft manufacturing ranked forty-fourth in the list of U. S. industries. The war has skyrocketed it to a position as the nation's number one industrial giant. Truly nation-wide in distribution, the industry consists of more than 100 plants containing more than 171 million square feet of floor space.

174

In Terms of Airframe Weight (Including maintenance spares) - Quarterly



NOTE: U = Commitment to Combat Day
D-12 = "Go Ahead"

78559 O - 45 (Face p. 56)

should be the function of private industry. Succeeding that, its tactical evaluation and evolution should be the function of the Military.

We have a special problem with all industries that are important in wartime, but relatively inactive or nonexistent in peacetime. That is a phase of the problem that we do not have to discuss here, because it does not impinge too much, on the major portion of the aircraft industry. But it certainly does in the field of ordnance and in the field of special war mechanisms, naval ship design, and in portions of the field of military communications, etc.

I believe that military cognizance should be provided for competent engineering groups engaged in such activities to be part of your peacetime establishment, and not be completely demobilized, as they were after World War I.

I think that industrial mobilization should reach down into the individual plant level, and that every plant that is going to be an important part of an industrial mobilization plan for national defense should each have its own war plan. Further that each such war plan should be a war plan created to meet the required quantities and the technical specifications for its military products. Such a war plan should be paid for by the military, so that they will have the say as to whether they accept it or not and whether it is competently done or not, because private industry, left to its own devices, will not whole-heartedly put its top talent on planning for something which it does not see as a source of profitable income. Therefore it has to be done by the request of the military branches and to specifications issued by them as part of their top industrial war mobilization plan.

Obviously funds should be earmarked for procurement of such plans, for educational orders and the like.

Such plans obviously should be maintained up-to-date. They can no more be filed away in a safe for use years hence than military plans, because your materiel changes rapidly and the production requirements that you have seen reflected on these charts vary equally rapidly with changes in the field of international relations. Similarly, the techniques and processes of production today are out of date tomorrow. Plans should be kept up-to-date to have any practical value.

Finally, the problems of maintaining needed research and development and of keeping alive the potential facilities for industrial production for war become increasingly important relative to being prepared to meet a national emergency requiring an all-out effort for total war and thus should be consciously raised in status to be dealt with on the top level of our Government.

Thank you.

GENERAL ARMSTRONG:

Thank you very much, Mr. Ward.

Gentlemen, I know that we could keep Mr. Ward here for a long time asking him questions. Mr. Ward is part of the Army Industrial College; perhaps he will get back again before this course is over as part of his duties and responsibility to the College, so that we shall have more time to discuss with him the many interesting and valuable points that he has brought out this morning. So much of what he has said about the aircraft industry is, of course, applicable to all war industries.

Mr. Ward, I want to thank you in behalf of the students for the contribution you have given us this morning. We are very grateful to you.

(23 February 1946--200)