AMES 1950 INSPECTION

July 10 Session in Auditorium

John F. Victory

Gentlemen: The voice you are listening to is that of John F. Victory, Executive Secretary of the National Advisory Committee for Aeronautics. It was my honor and privilege to extend the invitations in the name of the Committee to you gentlemen, and pursuant to this acceptance we are assembled here today.

I now present to you the Chairman of the National Advisory Committee for Aeronautics, Dr. Jerome C. Hunsaker.

Dr. Jerome C. Hunsaker

Friends and colleagues: It's my happy position to welcome you on behalf of our Committee to this visitation and inspection. We like to believe that even though we are a civilian agency of the Government, we are much concerned with national security. It is an obvious fact, but I like to mention it, that the quality of our air force and air power depends on the application of the results of scientific research. The future security of the country may well depend on the superiority of our aircraft. We ought, therefore, to have pressure behind research, especially that of the long-range and original character which may be the determining influence on our future weapons for use in the air. This Laboratory, as you know, consists of magnificent equipment and a magnificent staff of research workers and their supporting people. We want you to see what this equipment is, to see what the people do, to hear from them something of what seems to be coming out in the way of new knowledge which may affect new aircraft. I believe this is fair enough, and I would like to put in a disclaimer that if there is any analogy to the Jack Horner in the nursery rhyme, it's truly coincidental, and remember that Jack Horner put in his thumb and pulled out a plum and said "What a good boy am I." Our staff today has been asked to put their thumb in and show us a little something of the fruit that might be coming out of the pie.

I'll ask Dr. Dryden, Director of Research for the Committee, the man who heads our three great laboratories, to speak to you now. Dr. Dryden - -

Dr. Hugh L. Dryden

Dr. Hunsaker and friends and visitors: It's a great pleasure to see all of you again. By the way, how many of you are visiting us for the first time at one of these inspections? I'm curious, some of you are curious, how many? Well, a greater percentage than I would have guessed. I will talk only in very general terms about the work of the Committee. As we see it, we have jobs of three different kinds to do - they differ principally in the time scales. We hold ourselves at the service of our military and civilian friends to help them with their troubles. That's usually short-range jobs. We do the best we can with the knowledge that we have accumulated with investigations which can be carried out in a hurry and to deal with troubles. Our principal job as we see it is to lay the ground work of scientific design data which make it possible for the industry to design airplanes for specific purposes. All of you know, I think, what that means. All airplane design is a compromise, and if you are going to make an intelligent compromise you have to know the effects of your choices; and it is our job to try to lay as broad a base as we can with the facilities and personnel and money that is given to us, so that these compromises can be made intelligently. And finally we have a responsibility to look far ahead, to try to anticipate the kind of knowledge that is going to be needed in the future so that the facilities which are required can be planned and obtained in time, and so we are dealing with some matters which some of you may think to be very far in the future; but as we look back at the development of the aircraft, we in the research business are convinced that they're not as far as some people may think. And you will see, I think, in your tour today work which illustrates these various tasks that are before us. Our product is solely information in one form or another. It's given to you in many ways. This inspection is one way of giving you information as to what we're doing, what kind of answers you may hope to get from us, and whether it's worth your while to come around when there isn't such a big crowd and talk in more detail about the problems that interest you.

I will now present Mr. DeFrance, the Director of the Laboratory, your host, and you will get down to details now very rapidly.

Smith J. DeFrance

Thank you, Dr. Dryden. We at Ames Laboratory are always glad to have our friends of the industry, the armed services, and the educational institutions visit with us. Some of you have visited from time to time in the last two years in connection with the specific problems that you had to discuss, and some of you probably have not visited the Laboratory since our last inspection two years ago. I noticed in response to Dr. Dryden's inquiry that many of you are making your first visit here today. On behalf of the staff, it is a pleasure to welcome all of you to this inspection, and I hope that we will be able to give you some of the scientific work that has been carried on both at this Laboratory and at the Langley Laboratory in the last two years. You will also have an opportunity to inspect some new equipment. I hope that the entire trip will be of value to you and pleasant throughout the day.

At this time I would like to introduce the Commanding Officer of Moffett Naval Air Station, our neighbor, with whom we have had very close cooperation and without whose assistance it would not be possible for us to carry on our work here at Moffett Field. Captain Harris, Commanding Officer of Moffett Field Naval Air Station --

Captain J. W. Harris

Ladies and Gentlemen: I am glad to see that we do have two or three ladies with us here this morning - As you know, in fact, I am sure that all of you know that NACA is an independent agency. Moffett Field provides certain facilities for the Laboratory such as protection, security, a flying field, and items of that nature to the laboratory here. I think Mr. DeFrance and I have achieved pretty good unification. I know you've heard that word mentioned a little bit here lately. I think Smith and I have reached the ideal. Whatever he asks for he gets. Whatever I ask for I get. As the Commanding Officer of Moffett Field, we are very happy to be associated with a fine Laboratory as the Ames Laboratory here under Mr. DeFrance. As Commanding Officer of the Field, I bid you welcome to the Air Station. We are at your command if we can add anything to the pleasure of your short visit here.

Smith J. DeFrance

Thank you, Captain Harris. We have a brief summary of some of the work that has been done at the Laboratory - and introductory remarks that will familiarize you with some of the things that you will see today. I would like to ask Mr. Russell Robinson, Assistant Director of Ames Laboratory, to present that summary. Mr. Robinson - -

Russell G. Robinson

Our best guess as to why you as individuals, and as representatives of industry, military service, and organized science, travel to these NACA inspections is that you are interested in, or at least curious regarding, the aeronautical research man's view of these questions: What are the significant accomplishments of the past year, and where are we going? You will assemble these views during the day in succeeding discussions. We hope that you will obtain a clear picture.

Aerodynamic progress is significant to the national welfare. We may understand this significance in a direct way if we try to visualize the cost of increased performance of aircraft in the absence of further aerodynamic progress. Competition, both military and commercial, dictate increased performance. If this can be obtained only by increasing engine power, our aircraft become heavier, larger, more costly, and greater fuel burners. This process may be recognized for the vicious spiral that it is; costs compound rapidly when we increase the power and size of aircraft for a given mission. We cannot afford progress obtained by brute force - by increased power alone.

The alternative - which makes the spiral work in a beneficial direction - is to obtain improved performance with more efficient aerodynamic forms. This has been happening in the past decades, and has been a powerful factor, as we all know, in making higher speed economical. Actually, progress has come through a combination of propulsion progress and aerodynamic progress. Aerodynamic progress in the transonic and supersonic speed regions is paralleling the rate of progress made in the lower-speed regions. If still higher speeds are obtained by improving the efficiency, the return is gratifying. Military aircraft will be less costly to operate or, alternatively, will be able to travel farther, carry more military equipment, and hence be more effective. Commercial aircraft will satisfy the constant demand for faster flights, will be able to make more frequent trips, carry more passengers, and produce more revenue over a given period. We conclude that aerodynamic progress is significant, both as regards national defense and national economy.

The NACA divides its research responsibility into four parts pictured in this simple diagram: Aerodynamics, propulsion, aircraft (Slide 1) construction, and operating problems. The dividing lines have never been hard and fast and they are in fact becoming fuzzier and less distinct. At the inspection today we will focus on aerodynamic research with some overlap into the other three fields. We will inspect results and ideas that originated in the NACA Langley Laboratory and in the NACA Ames Laboratory. We will inspect facilities of this, the Ames Laboratory.

Having oriented ourselves among research fields, let us orient ourselves on a speed scale. The length of the scale pictured has been chosen to cover the range of data that you will see today. The numbers (Slide 2) along the top of the scale are Mach numbers, that is, multiples of the speed of sound. To the left of 1 is the subsonic region. The region in the neighborhood of 1, the speed of sound, is the transonic region. The region to the right is all supersonic. As a convenience, and not because the word has an inherently different meaning, the label "hypersonic" is often used for speeds more than 5 times the speed of sound. The corresponding airspeeds in miles per hour at sea level are shown along the bottom. On the scale are noted the 30 mph speed of the Wright Brothers airplane in 1903, and the current world's record speed, 670 mph, made by an F-86 in 1948, 45 years later. Of course, research airplanes have flown above Mach number 1 and missiles up to Mach numbers of about 5.

We may have diverse reactions to this look at our position on the speed scale. We may project into the future our average rate of progress in the past and say that many problems must be solved, that we have the admittedly difficult transonic region in front of us, and that it will be a long time before man doubles his flight speed in regular operation. Or we may say that progress has taken a spurt recently, that we are now exploring into and beyond the most difficult region and that supersonic speeds will be commonplace before long. In either view we realize that there is no limit in sight and that the result depends on the effort that, in the future, will go into research, into development, and into operational trials.

What is the prospect of efficient flight at speeds considerably greater than the present 300 to 600 miles per hour of transports and bombers ? It is well-known that current supersonic airplanes are relatively inefficient and carry little more than their own fuel and some instrumentation. However, because high-speed airplanes could cover more ground in a day than slow airplanes, they are of practical, economic interest even if their efficiency in lifting is less than current low-speed airplanes. And Mr. R. T. Jones of this Laboratory proposed three years ago that certain aerodynamic features could be combined to give much improved lifting efficiencies at low supersonic speeds. Ames Laboratory is engaged in research relating to this proposition that an aircraft can (Slide 3) lift ten times its own thrust and travel at about 1,000 miles an hour. This goal might even be exceeded. It is considered somewhat conservative and certainly not the ultimate. It is obviously worth working on.

What are the problems that stand between us and the accomplishment of some of the goals we have mentioned and what is their urgency and difficulty?

Speaking from the research viewpoint, a number of these problems are old and familiar; they have merely assumed new aspects and rearranged themselves in importance. For instance, air inlets must operate over a wider range of speed and flight conditions. They must operate with less loss and handle from 10 to 20 times more air. The allied problems of internal air ducts and jet engine exhausts have changed correspondingly. In every respect, internal aerodynamic research has assumed an entirely new order of importance. The old problem of buffeting increases in complexity and seriousness near the speed of sound.

The solutions are no less elusive and the problem threatens, in some cases, to limit airplane performance. A few years ago propeller efficiencies were impracticably low at speeds above about 550 miles per hour. Today, however, propellers in new forms are promising good performance at considerably higher speeds if certain problems associated with them can be solved. We will see something of propeller progress and problems today.

Wings are characterized by rather radical changes at present. However, once the most efficient forms for different speeds have been determined - and this will require more detailed study than has been completed yet - wings will perhaps demand less attention than other subjects we have mentioned. They are certainly less in evidence on some (Slide 4) high-speed experimental airplanes! On the other hand, control surfaces will demand even more intensive research. The problem of making them effective at all flight speeds, and of making their force and speed characteristics to the liking of pilots or autopilots is one that will require multiple approaches and imaginative research.

Especially important among the problems of high-speed research is the relation between aerodynamic loading and the elastic properties of the aircraft structure, where load changes induce structural deflections and vice versa. Aeroelasticity, as this phenomenon is called, is an important consideration in the design of swept wings and there is an urgent need for basic information on the subject. Recent progress will be described today.

The nature of very high Mach number flows needs to be explored; these flows are of interest to designers of high-performance missiles. Today we will see new facilities that permit detailed studies to be made of problems of unwanted heating at high speeds, of skin friction which controls the range of missiles at very high speeds, and of the effect of shape at high Mach numbers. These are receiving attention because they will become of practical importance in the future. We will be able to consider some of these problems today.

In all fairness we should state that this inspection required us to abbreviate and perhaps over-simplify the discussion of most problems. We ask that you bear this in mind today.

A number of important research steps precede the step that is best known: obtaining experimental data. These include the development of an idea, the conduct of fundamental or background research, the development of theory, and the development of experimental techniques. It will not be possible today to trace the contribution of these essential steps in individual cases. We wish, however, to indicate the importance of this more general, long-range work and to state that the NACA carries on such work in its own laboratories and supports a program of research in universities that is largely of this nature.

The principal product of NACA is its research reports. Our product (Samples) is not aircraft, engines, or missiles; not even experimental or research aircraft, engines, or missiles.

NACA uses these but only as a means to an end. The end is the investigation of "problems of flight with a view to their practical solution" and the research job is not finished until the results are analyzed, a satisfactory explanation obtained regarding the controlling factors, conclusions drawn that will assist designers in general, and the whole accurately reported. This flow of research results is the starting point for the design and technical development of our aircraft, and therefore is a basic factor in the excellence and effectiveness of American aircraft. The relationship of research to application is illustrated in this diagram; the product of NACA: ideas, design data, an increase in our knowledge is (Slide 5) concentrated in the form of technical reports. Such reports are the basic technical input to the aircraft industry which in turn produces aircraft, engines, and missiles; and to the military services and airline operators who specify and use aircraft.

The NACA supplements its formal written reports with other more personal means of conveying its results. One of these is the kind of laboratory inspection we have today for a general resumé and on-the-spot look. Another is technical conferences, arranged from time to time to report and discuss results in a restricted technical field with specialists from industry, the military services, and others. These conferences now rival inspections in attendance. Another means is the consultation with individuals or technical groups concerning particular problems on which NACA can assist. The NACA is ready to respond to requests for such discussions if they are in the national interest and if the request is addressed to the Director, Doctor Dryden.

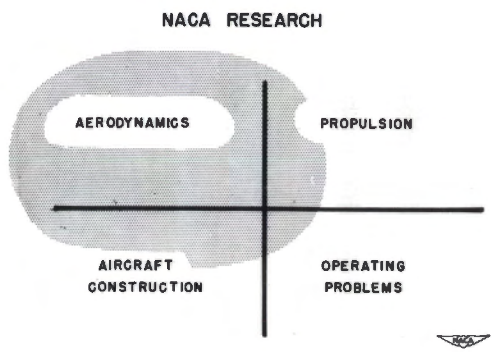
The NACA organization reflects the fact that research and application are activities that are mutually dependent. First, although research must not restrict itself to problems of assured application, it should be influenced and guided by the thinking and practice of users. For research is sterile if there is no eventual application. In the same way, it is most important to progress that the accomplishments of research, and its potential accomplishments, be generally understood. Otherwise research progress is not translated into material progress. We feel that NACA has a good working relation with the builders and users of aircraft. We welcome the present opportunity to explain where we are and where we are heading and hope that you will feel free to communicate to us suggestions and recommendations that may be generated by today's visit.

Thank you.

Smith J. DeFrance

Thank you, Mr. Robinson. With this introduction - introductory talk - I hope that you will be able to coordinate the exhibits that are going to be shown today and make a complete research picture of it. At this time, I would like to introduce some other gentlemen who are on the stage: first, our Associate Director of Research, Mr. John W. Crowley; and the Director of the Langley Laboratory, Dr. H. J. E. Reid; and our Executive Officer, Mr. Edward Chamberlin.

We have a close schedule to meet today and you have been divided into groups according to color as shown on your badge. At this time we will all proceed as one group and get into the busses at the rear of the auditorium and proceed to a grandstand where a picture will be taken, and from there on we will be divided into groups. At this time I would like to ask everybody to leave the auditorium and proceed directly to the busses. Thank you.



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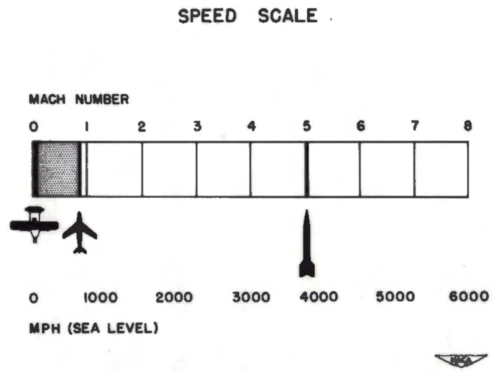
Slide 1.— Introduction to Inspection



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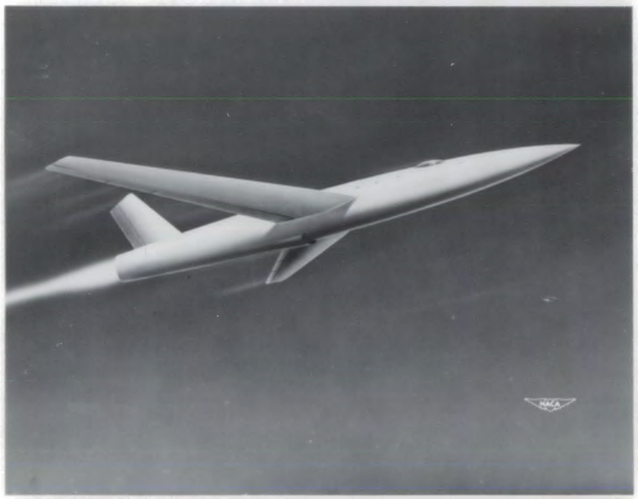
Slide 2.— Introduction to Inspection



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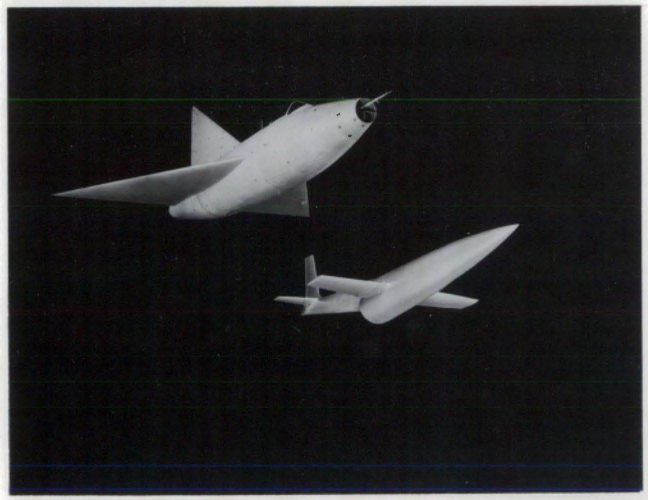
Slide 3.— Introduction to Inspection



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Slide 4.— Introduction to Inspection

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Slide 5.— Introduction to Inspection