1954 Triennial Inspection
Lewis Flight Propulsion Laboratory
June 2-4, 1954

WELCOMING REMARKS

Dr. John F. Victory

Ladies and Gentlemen:

It is my very happy privilege this morning in the name of the National Advisory Committee for Aeronautics to extend to each of you a cordial welcome. It was 39 years ago that the Congress of the United States established the NACA and gave it the function to supervise and direct the scientific study of the problems of flight with a view to their practical solution. The NACA was also authorized to direct and conduct research and experiments in aeronautics in such laboratory or laboratories in whole or in part as might be placed under its jurisdiction.

The NACA has 17 members on the Main Committee. They are appointed by the President of the United States, acting in the capacity, you might say, as a representative of the stockholders. Those 17 members have the normal function of a board of directors, only they meet more frequently, about once a month. They elect annually their chairman and vice chairman. They appoint the head officers of the corporation, so to speak, corresponding in our case, a director, an executive secretary -- yours truly -- and an associate director for research. We have a typical American business-like type of organization, fairly unique in the government. The director is a one-man administrative head of the organization corresponding to the president of a corporation. Advising the Main Committee are four major and 22 subordinate technical committees. Their job is to plan, in a timely manner, the research programs in their respective fields in order, as far as possible, to assure that America's aircraft and missiles shall never be excelled in performance and over-all effectiveness by those of any other nation.

You are here today because you and we share in varying degrees some responsibility for the security of our country. The masters of the Soviet people are dedicated to the proposition that our way of life must not be allowed to prevail. We must take all measures appropriate and within our means to maintain our way of life. This meeting we like to think of as our opportunity to give an account of our stewardship to the people of the United States. For three days now large crowds have come to see what we have been doing. We make an annual report to the Congress, and this is our annual report to the stockholders. Now we want to work together with you. We want to solicit your advice. We want you to feel free to give it, either orally today or in writing later. We need all the advice we can get.

We are all in this thing together. You know as well as I do that the Soviet plans amount to the calling of the tune to which the world is dancing. We know that they have many airplanes and they are not limited to old-fashioned airplanes either. They are building new models all the time. The race for air supremacy is on. The scientific war is on. These are the days in which we will lay our plans for survival or build our own tombs. We must realize the seriousness of the situation that confronts us. I think it is fair to say, and I think we should be proud to recognize that in our branch of national security -- the air branch -- there is an effective teamwork in which all the stockholders can take pride. There is a real unity of effort between science, the military, and industry in our country and that is really spelling progress.

Now we are not making the progress we feel should be made because the problems connected with the remarkable advance in aeronautics are getting more complicated, more interrelated, and more expensive. The taxpayers, as you know, are shouldering with patience and with trust the tremendous burden. We owe to them, as we owe it to ourselves -- for we are all taxpayers -- to do what needs to be done as economically as possible. But it is sad to say, for this is true, there are many problems that should be attacked that must be deferred. There simply are not enough funds to provide for prompt attention to all of the problems as they are developing in these hectic days. So in the spirit of unity of effort, we welcome you, we ask you to be conscientious, fair and strong in your criticism and your suggestions to us. In the spirit of true candor, we ask your advice and your assistance.

As you go around today, you will note that we are giving you samplings of how we work, the nature, the broad nature of the problems we are working on, but in the interest of security we are not giving figures, not the details -- you will understand, I am sure. So finally, I say thank you for coming. I trust you will have an interesting, a profitable, and enjoyable day. Thank you very much.

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INTRODUCTION

Eugene J. Manganiello

Almost 3 years have passed since the NACA Lewis Laboratory staff last showed you their research facilities and discussed with you the researches underway. Aeronautics has made considerable progress during this period. Research airplanes have attained Mach numbers of 2 and 2.5; rockets have reached new heights in the upper atmosphere; additional knowledge and understanding of aerodynamics, structures, and propulsion systems applicable to high-speed flight have been acquired in the research laboratory. The industry and the military services, capitalizing on research information, have constructed and demonstrated supersonic tactical aircraft. Several guided-missile types have successfully qualified for active service. Indeed, supersonic flight has progressed from the "wishful thinking" and "hopeful talking" stage to reality.

But what now and what of the future? The future of aeronautics is the research laboratory's project of today and the research worker does not weep for lack of further frontiers and new horizons. He recognizes many problems to be solved and he sees many advances to be made. Indeed, never in the history of aeronautics have there been so many fruitful ideas to be explored by research and never has there been a greater need for exploitation of those ideas. In aircraft propulsion, in particular, many significant improvements lie ahead - improvements and gains which promise revolutionary rather than just evolutionary steps forward in the progress of supersonic flight.

A brief discussion at this time of some of these advances and associated problems may provide background and a framework of reference to help you interpret and integrate the various researches, facilities, and techniques you will see during today's inspection.

But first, just what is the problem of supersonic propulsion? In very simple and general terms, the problem is that of providing a tremendous amount of thrust or power in a small size, light-weight power plant. And, as a little spice for the broth, another ingredient, namely high efficiency or low specific fuel consumption, is added.

There are three engine types that are applicable for supersonic propulsion. These are the rocket, the ram jet, and the turbine engine. Each of these engine types fulfills the requirements for supersonic propulsion to a varying relative degree, and each engine type may be considerably improved or advanced.

For example, the thrust of the turbine type engine may be increased in direct proportion to increase in air flow through the engine and further considerable gains in thrust may be realized by increasing turbine inlet gas temperature.

In present-day turbine engines, air flow per unit frontal area has been limited by several basic considerations. First, aerodynamic problems have limited the amount of air that could be efficiently handled by both the compressor and turbine components of the engine, and second, combustion difficulties have limited the air flow that could be burned efficiently in both the primary combustor and the afterburner components of the engine. With regard to increased gas temperatures, here the limitation is the ability, or rather inability, of heat-resistant alloys to develop the high strength required by the turbine component.

Our recent researches have provided methods for significantly increasing air flow through these engine components and for increasing turbine inlet temperature. We have built and tested improved compressors which not only have greater air capacity than current development units but, in addition, develop higher pressure ratio and have higher efficiency. Experimental combustors have been constructed which maintain high efficiency at appreciably higher air flows, and our turbine-cooling research promises engine operation at increased turbine inlet temperature.

The integration of these individual advanced component developments into a complete turbojet engine would result in considerably greater thrust output and lower weight per unit frontal area of engine. Such an engine is the key to the successful development of tactically effective supersonic aircraft. We are gratified and encouraged to note that the engine manufacturers, both in this country and abroad, are following up on these research leads and ideas in their component development work. In his naive enthusiasm, however, the research worker is somewhat impatient with production considerations which somehow seem to prevent the rapid rate of progress he so anxiously expects.

Attaining supersonic flight speeds is admittedly a difficult task, but maintaining it long enough to achieve the long range or radius of action required by the military services poses an even greater problem. The enormous amount of thrust required to fly supersonically involves an excessive rate of fuel consumption. And even a two tank-car load of fuel such as might be carried by a large bomber does not satisfy for long the voracious appetites of jet engines. A fuel with a higher heat content than the gasoline or JP-4 type of hydrocarbon would, of course, provide extension of range; range being directly proportional to heat content. Examination of the chemical handbooks give some encouragement to this possibility, for in addition to hydrogen there are some metals and metal hydrides that have somewhat higher heats of combustion than the hydrocarbon fuels. Many research problems must be solved, however, before utilization of such fuels is practicable.

In the case of rocket engines the heat content or specific impulse of the fuel-oxidant combination is of even greater importance to aircraft or missile range than it is for air-breathing engines. Here significant improvement in rocket performance and missile range is anticipated through use of higher energy propellants than the currently popular alcohol-oxygen combination. The NACA has been concentrating its rocket research effort on the high-energy propellants and, is anticipating acceleration of this research.

A discussion of "things to come" in aircraft propulsion would be anachronistic without some mention of nuclear energy. The energy released by fission of U-235 is about 2 million times that obtained from combustion of gasoline. This energy potential truly makes nuclear power the "shining hope" for increasing aircraft range at supersonic speeds, far and beyond the values obtainable with chemical fuels. Indeed the successful application of nuclear energy to aircraft propulsion raises aircraft range possibilities to values that are limited only by human desire and human endurance.

Analyses, feasibility studies, and research work in aircraft nuclear propulsion were instituted the day after Hiroshima, if not before. And in the past few years military contracts have been awarded aircraft and engine companies for the development of nuclear propelled aircraft. The support of the Atomic Energy Commission and the military services of programs in this area is indeed praiseworthy. The NACA along with other organizations has been engaged in this activity from the beginning and a considerable amount of research data on the problems of nuclear propulsion has already been accumulated. But much additional vital information remains to be obtained and, in our opinion, the national security requires that the nuclear power application to the airplane be expedited with a sense of extreme urgency and necessity.

Returning now to the immediate business of the day, we have arranged, within the time available, an inspection of representative facilities and researches that are directed towards the accomplishment of the advances and improvements we have just discussed. The problems and means of improving compressor air capacity and performance will be explained in detail. Combustion research aimed at maintaining high efficiency at increased air flow will be described along with discussion of the so-called combustion screech phenomenon.

We do not propose to qualify you for a PhD in nuclear physics, but we will discuss the possible methods of utilizing nuclear energy for aircraft propulsion, some of the principal problems involved, and the research being conducted on these problems.

In the recently activated Propulsion Systems Laboratory, research is conducted on complete turbojet and ram jet propulsion systems, at simulated conditions of high altitude and high flight speed. You will have an opportunity to inspect these facilities and learn about the problems being solved through the use of these and other full-scale engine facilities.

A brief review of our work on some aircraft operating problems such as fire prevention, crash survival, and engine thrust reversal is also included in the day's itinerary.

At one of the stops members of the NACA Langley Laboratory will describe the aircraft structural problems associated with the aerodynamic heating effects of high Mach number flight. And for illustration of aerodynamic research, members of our Ames Laboratory will review modern techniquesof flow visualization.

In an attempt to transcend, in part, the time and space limitations that prevent us from showing you more than but a small and incomplete sample of our research, at one of the stops we will bring to you, through the media of motion pictures, glimpses of a number of miscellaneous experiments that are in progress, in various parts of the laboratory.

We hope that today's inspection will prove interesting, and instructive, and not too tiring. We are appreciative of this opportunity to show you our laboratory and we will welcome any questions or suggestions you may care to communicate to us as a result of this visit.