INTRODUCTION TO THE AMES 1958 TRIENNIAL INSPECTION

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On behalf of NACA Headquarters, I welcome you to this annual presentation of some of the results of recent research of the NACA staff. You are representatives of the groups we serve, the military services, the aircraft, missile, space craft, and related industries, the Congress, and the taxpayer. We are pleased that you have given us this opportunity to report to you in person, and we hope that you will find the day interesting and instructive.

This has been a year of fast-moving events. The year has brought great changes in the technology which concerns us, including the coming of age of the long-range ballistic missiles which have been under development for some time and the appearance in the sky of the first man-made satellites of the earth. The NACA is in process of great change. As you know the final decisions are being made by the democratic processes of our chosen form of government that will result in the establishment of a new National Aeronautics and Space Agency built around the present NACA with responsibilities for the non-military aspects of space activities, including space science, technology, and exploration as well as its present responsibilities in the aeronautical field. Because of the imminence of this action, we have devoted this Inspection primarily to the reporting of NACA research applicable to the space field.

Under any circumstances we could not in the short time available report on all the work in progress. But since we have chosen to emphasize the space aspects for the reasons stated, I wish to assure that much work is being done on airplanes and missiles, including low speeds as well as high speeds, civil as well as military aircraft, and operating problems as well as advanced research. In fact, within the next few months we will hold technical conferences for the specialists on the X-15 research airplane and on aircraft operating problems.

In our Inspection today we shall describe some of the research to learn more about the environment in which space craft will operate, i.e., the atmosphere at great heights, and of the behavior of the air under the impact of vehicles moving through it at satellite speeds. New tools have been provided to study these problems in the laboratory. In actual flight the artificial satellite itself is a very versatile tool for the study of space science and of the universe around us. For the more complex tasks the control of attitude and stability of the motion become essential.

Another presentation is devoted to the problem of the stability of space vehicles during motion in the atmosphere at high altitudes during re-entry and descent.

For manned satellites during re-entry a host of piloting and control problems appear, many of which can be studied by simulators. Studies of this problem will be described.

The study of the behavior of materials for use under the severe heating conditions of re-entry will be reviewed. Here also new tools have been devised, including an atmosphere entry simulator and the arc-jet wind tunnel.

Another stop is devoted to methods of dealing with the intense heating through aerodynamic design and cooling.

One presentation is devoted to supersonic airplanes intended for long range, such as the North American B-70 bomber and possible future supersonic transports.

In addition to presentations of work in progress at this, your host laboratory, there are examples of the work of the Langley Aeronautical Laboratory and the Lewis Flight Propulsion Laboratory. In the Langley presentation you will hear a description of a research technique that we have pioneered and used since 1945. In that year, the NACA began firing rocket-propelled models from Wallops Island, not far from the Langley Laboratory. "Off-the-shelf" solid propellant rockets were used, and the top speeds first reached were only about 600 miles per hour. Instrumentation was simple, almost rudimentary. Over the years, this rocket-powered model technique has been improved, and its use has been extended beyond studies of such problems as lift and drag and stability and control. We have learned how to use staging -- how to fire a sequence of rockets to attain higher speeds and altitudes. Today, you will see a full-scale five-stage rocket that can exceed a Mach number of 16 (10,560 mph) and can reach an altitude of several hundred miles. In this manner, at a cost of only a few thousand dollars a "shoot," we can study, under actual flight conditions, many of the problems of the ballistic missile. Incidentally, I believe that the NACA was first to use a five-stage rocket arrangement.

The presentation of the Lewis Flight Propulsion Laboratory includes a demonstration of the principles of an electric propulsion system which is being investigated as a possibility for use in space flight. There will also be discussions of chemical rockets and nuclear propulsion as applied to space flight.

The growth of aeronautics has been a revolutionary one marked by continually increasing speed and altitude of aircraft and missiles until now we are on the frontiers of space. This performance improvement has been made possible by a gradual increase in knowledge in aerodynamics, propulsion, and structures punctuated by several large step-like, or as the physicist would say, quantum jumps. Thus in aerodynamics we learned to reduce drag by proper location of engine and propellers, and to postpone compressibility by proper shaping and reducing the thickness of wing sections. We had the "breakthrough" of the area rule. In propulsion we gradually increased the power of reciprocating engines, added more cylinders and improved fuels. Then came the sudden step-like increase in power and decrease in weight available in the jet engines and the rockets. In structures we advanced from wood-and-wire to metal with more and more sophisticated design, and were able to reduce the fraction of gross weight required by the structure in spite of tremendous increases in speed which imposed greater loads as well as introduced aeroelastic and flutter problems of great difficulty. All of these advances were interdependent. Jet engines were useful only at the high speeds which became practical only after structural developments which permitted the thinning of wings to reduce drag. In the over-all performance curves the large improvements are somewhat smoothed out so that the curve is fairly smooth. But the sharp rise in the annual rate of increase of maximum speed when jet power was introduced is plainly evident.

We now have the very great increase of performance made possible by the large rocket engines which can boost our vehicles into the regions of space where air resistance becomes minute and the forces of gravitational attraction and inertia are predominant. Here too, although the slope changes, the curve will have a continuous upward trend. At first, before we put large space stations into orbit, we will be dealing with vehicles which are launched through the atmosphere and which must re-enter the atmosphere, be slowed down without destruction by heating, and finally land. The major problems of these vehicles are akin to those of present airplanes, differing only in degree. Their solution requires only an extension of research into new regions of speed, temperature, and pressure. These vehicles will always be needed as will our present type of airplanes.

As space technology advances, the true space or interplanetary vehicles will appear. In the development of these, new problems will have become dominant. The structures no longer will be subject to large forces over large areas, they will use light structural members, and involve new materials which seem strange at present. Some of our present ideas will be discussed during the day.

Once space vehicles have completed the first phase of their journey, propulsion will no longer require large thrusts and fuel economy will be the dominant consideration. Some type of electrical propulsion system, ion or otherwise, becomes attractive. Our engineering compromises will move toward engines of thousands of pounds weight per pound of thrust. However, fuel consumptions of as little as one percent of those associated with present powerplants will be achieved.

The provision of internal power from nuclear reactors or solar power, navigation, guidance and control, communication, suitable environment for man -- these and many other problems will require very different solutions from those we now use. The greatest demands will be made on our research and development capabilities as we venture farther and farther into space.