ANNUAL INSPECTION OPENING ADDRESS

By Abe Silverstein

The members of the staff wish to extend to you a hearty welcome and express our appreciation for the friendship of your visit. Also we are appreciative of the advice and criticism that many of you tender us through the medium of the Committees and Subcommittees of which you are members. As your host today we hope we repay your kindness in part by providing an interesting and enjoyable day that we hope will be instructive and not too wearying.

In introducing the Inspection of today let me first tell you what we are trying to accomplish. As you know the Lewis Laboratory is primarily devoted to the study of aircraft propulsion. Our task is that of understanding the basic nature of the propulsion process and the phenomena encountered in transforming, for example, the chemical energy bound up in a tank car of fuel into a propulsive energy sufficient to propel for a distance through the air a 100,000-pound airplane at speeds of 300, or 500, or 800, or 2000 miles per hour.

In this brief statement of our general research aim I put stress on the word "understanding." I define understanding as the obtaining of a general over-all concept of the physical processes that occur because of the inherent nature of the phenomenon under study. I differentiate the meaning of the word understanding from the meaning of learning, which is the acquiring of knowledge; and from measuring, which is the research art or technique; and from theory, which depends on assumptions regarding the true physical nature of the problem. These latter words describe separate steps that are combined into the broad reasoning process that leads to understanding.

Understanding in science, as in all other branches of philosophy, may be reached either by inductive reasoning from specific factual evidence that points undeviatingly to the existence of certain broad laws relating the ordering of nature, or from deductive reasoning in which assumptions are made concerning the nature of the phenomena based on intuitive insight or from analogies with related phenomena. Broad laws are then deduced from the assumptions. The assumptions must be proved experimentally before the reasoning is verified.

With either method of reasoning the same research methods are required. The core of all research is experimental measurements and their analysis. Theory enables separate and isolated measurements to be integrated into a broad picture and provides the language for expressing the laws of the process. Experiment and theory must move forward hand in hand to build up the reasoning processes leading most rapidly and most economically to understanding.

In our field of science, propulsion, all of the classical branches of science, for example, physics, chemistry, metallurgy, etc., are applied and they must be greatly extended to provide an understanding of problems that are unique to the propulsion field. For example, physicists and chemists have studied for several hundred years the oxidation or combustion processes occurring in gases at rest, and have derived certain laws regarding the process. The nature of combustion in a moving stream of gas such as occurs in a turbine or ram-jet engine has received little attention in the past and now must be energetically studied. Similarly, the physicist and metallurgist have studied in detail the properties and characteristics of structural materials for use at room temperatures, however almost all knowledge regarding the characteristics of structural materials for operating at temperatures of 1500° F is of very recent origin. The necessity for extending the classical branches of science exists in all the fields of the research in which we are engaged.

Today it would not be fruitful to attempt to lead you through the development of our reasoning on the subjects which we are now studying. Rather we shall attempt to interpret for you the research that we are doing in terms of its application to our ultimate objective, that of creating more effective propulsion systems. While doing so we will exhibit for you some of the techniques and equipment used in our studies. This method of presentation aligns itself with our belief that the ultimate goal of all research is <u>understanding of sufficient scope</u> so that research concepts can be rapidly and economically applied to engineering projects.

We shall try to show how fundamental aerodynamic and heat transfer studies lead to the development of more efficient compressors and turbines and thereby to propulsion systems of higher thrust and lower fuel consumption. We will discuss the operational problems of engines, introducing basic studies on ignition spark energies and fuel sprays. Our work on the chemical and physical properties of fuels will be illustrated by referring to their applications in the turbine and rocket engines. Research on materials for use at high temperatures and methods for their application so as to obtain engines of minimum weight and maximum availability will be reviewed. A telescoped view of the many problems associated with flight at supersonic speeds will be presented along with a demonstration of the operation of the new

8- by 6-foot supersonic tunnel in which active research on supersonic propulsion problems has been in progress for the past several months.

Recognizing the physical weariness and mental indigestion attending over-exposure, we have decided to showyou only a small but representative sample of our equipment and research. An attempt has been made to present our material in the plainest of English, omitting the professional jargon that is so dear to our hearts. If in this way we lift the veil of mystery and reduce the allure, perhaps we will be compensated by increasing your understanding.

If your appetite is whetted by the sample you will see, we will always welcome your return for more. We are deeply interested in being of service to you in particular problems on which we are qualified to help. Will you please come and see us.