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Dr. Theodore von Karman, center, Director of GALCIT, confers with members of the rocket research group who are, left to right—Dr. C. B. Millikan, Dr. Martin Summerfield, Dr. von Karman, Dr. F. J. Malina, and Captain H. A. Boushey, Jr.

RESEARCH AND DEVELOPMENT AT THE JET PROPULSION LABORATORY, GALCIT[1]

THE Galcit Rocket Research Project was initiated more or less informally in 1936 at the California Institute of Technology with full encouragement of Dr. Theodore von Karman, Director of GALCIT. The original research group was composed of Frank J. Malina, Hsue-Shen Tsien, A. M. O. Smith, John W. Parsons, Edward S. Forman, and Weld Arnold. Early phases of the research were financed by a gift from Mr. Arnold. It was Dr. von Karman who foresaw the importance of rocket propulsion and the great possibilities of Caltech research in this field. A theoretical and practical research program was conducted during the next two years, and in December of 1938, General H. H. Arnold, Commanding General of the Army Air Corps, requested a group of scientists comprising the Committee for Air Corps Research of the National Academy of Science to sponsor a program for several problems of vital interest to the Air Corps. One of these problems was the development of rocket units suitable for boosting airplanes. Dr. Theodore von Karman chose the rocket problem for Caltech and the committee appointed a sub-committee on Jet Propulsion with him as chairman. In July, 1940, the Army Air Corps effectively assumed sponsorship of the Project, and during the first two years of the war when the United States was working to make up lost time, the GALCIT Project was constantly expanding.

The many sub-contractors who were called in to lend their special skills to the success of the Project invariably gave the utmost of their ingenuity, cooperation, and loyalty.

The articles contained in this month's *Engineering and Science* were based on a release by the Committee on Publications of the California Institute of Technology for the California Institute of Technology, A.A.F. Materiel Command, and A.S.F. Ordnance Department, prepared by Professor Roger Stanton.

[1]GALCIT is a composite of the capital initial letters in the following: Guggenheim Aeronautical Laboratory of the California Institute of Technology. This abbreviation is widely used both in this country and abroad.

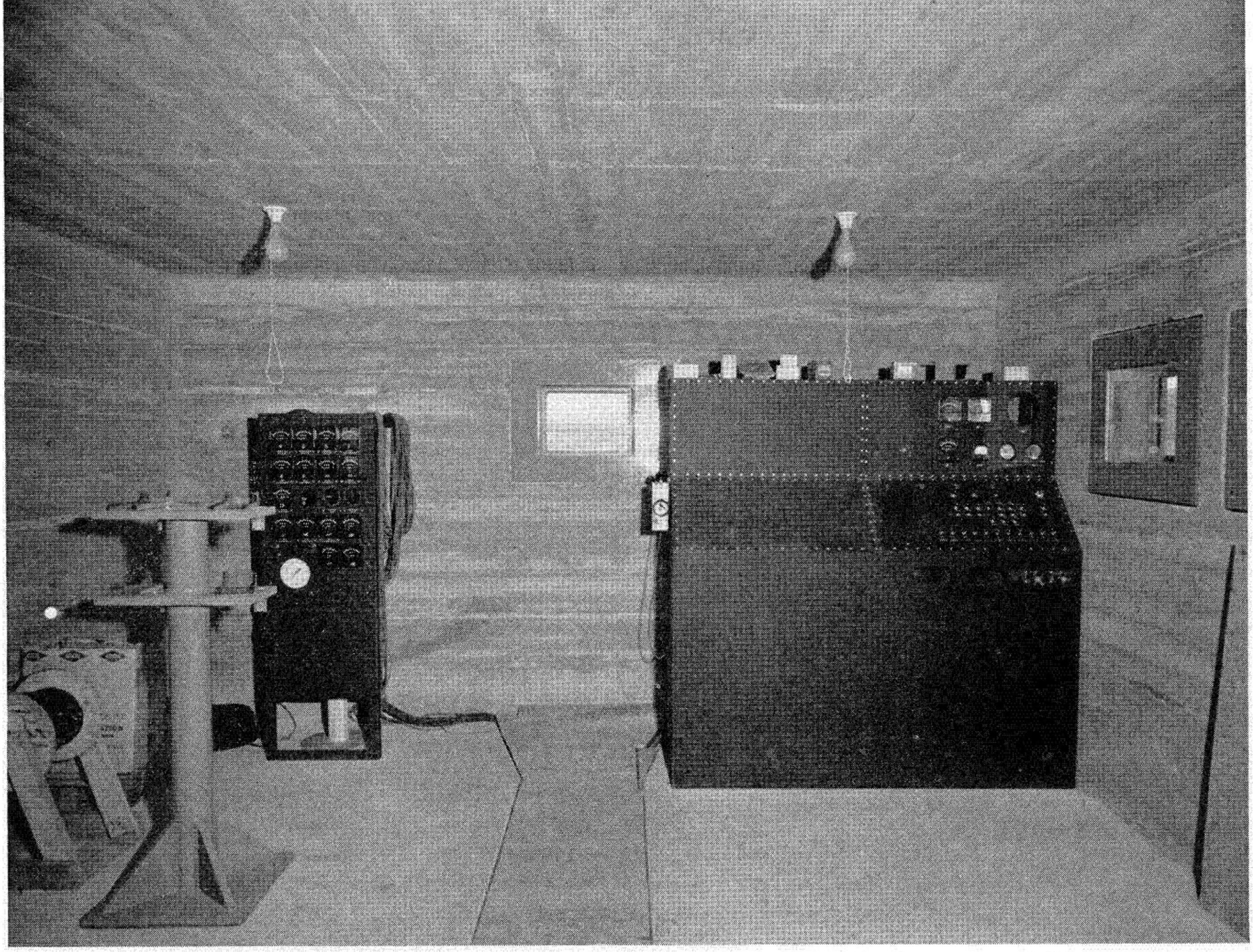

FIG. 1. The Muroc Test Station control room at the Muroc Army Air base, California.

THE Jet Propulsion Laboratory is located within a fenced enclosure covering approximately forty acres near the western limits of the city of Pasadena, California. Within the enclosure are more than eighty structures of widely-varied types. Dominating the entrance is the Administration Building. Beyond it are numerous test pits for the development of propulsion systems for solid and liquid-propellant rockets, and for ramjets and turbojet engines; laboratories for research in high-temperature resistant materials, and the processing of solid propellants; a towing channel for research on underwater missiles; and machine, sheet metal, and welding shops.

Under construction is a compressor house to supply highly-compressed air for thermojet research.

The staff at the Laboratory numbers more than 385. The facilities with equipment are valued approximately at $3,000,000.

Various laboratories on the campus of the California Institute of Technology also are utilized; for example, the 10-foot wind tunnel of the Guggenheim Aeronautical Laboratory. Expert consultation on special problems is provided by staff members in several departments. A Chemistry Group, under the direction of Dr. B. H. Sage of the Department of Chemical Engineering, has been conducting special research for the Laboratory for several years.

A test station for the investigation of large, liquid-propellant rocket units is being operated by the Laboratory for the A.S.F. Ordnance Department at the Muroc Army Air Base, California, parts of which are shown in *Fig. 1* and *Fig. 2*.

Numerous contracts under the different research projects have been placed with industrial organizations in various parts of the United States, including many companies throughout the Los Angeles area.

JATO STUDY BEGUN

The research begun in 1939 on Jet-Assisted Take-Off for Aircraft under the auspices of the National Academy of Science, continued the modest work that had been initiated in 1936. It was understood, as it continues to be, that the Laboratory primarily should be concerned with the solution of basic research problems, to enable the Armed Services to develop equipment of novel type.

One of the immediate objectives of Frank J. Malina, John W. Parsons and Edward S. Forman, appointed to carry out the research program for the first year, was to develop two types of rocket motors; one, utilizing the energy of a solid propellant, the other, a liquid propellant. Both types had to be capable of delivering a constant and sufficient thrust for a period long enough to assist a plane to take off and reach an altitude considered safe to continue its flight unassisted. The period specified was of the order of ten to thirty seconds.

The first year was devoted mainly to a survey of early experience in the field and to study of the fundamental properties of propellants. Little information was available on powder rockets with duration longer than one second. Two ways suggested themselves to solve the problem of delivering a prolonged thrust. The first was to install in a plane a group of motors loaded with fast-burning solid charges, and to fire them one at a time in quick succession so as to produce a prolonged thrust. Experiments conducted by a number of investigators were discouraging in that successive firing at split-second intervals was not dependable; hence thrust was delivered not constantly but by fits and starts, strenuous on pilot and plane alike. The second way that suggested itself