

A Center for Space Research

It will bring together and focus the efforts of many M.I.T. researchers in various disciplines

BY JOHN V. HARRINGTON, '58

Director of the New Center described in this article

THE legislation which established the National Aeronautics and Space Administration listed the expansion of human knowledge about the upper atmosphere and space as a principal objective. The expansion of human knowledge is also the business of universities, and their traditional role as custodians, as well as sources of knowledge, makes inevitable a strong interaction between their interests and those of the national space program. Hugh L. Dryden, the Deputy Administrator of NASA, believes that "one of the major by-products of space research has been a revitalization of education." He was referring to the process of getting young people interested in scientific knowledge again, and also reflecting the space agency's realization from its very beginning that the success of its ambitious program would depend upon the supply of highly skilled, creative engineers and scientists provided by the nation's educational system.

One of the country's most eminent space scientists, James A. Van Allen of the University of Iowa, in discussing education's role in space in 1961, said: "We have immense and rapidly growing ambitions in the field of space exploration, both manned and unmanned. Yet we must confess to a level of over-all competence which is far short of these ambitions. Only if universities are full-fledged partners in the national space effort can we develop the broad-gauge, long-term competence which the public and the Congress so ardently expect."

The Senate Committee on Aeronautical and Space Sciences, in connection with NASA's authorization for university facility training and research grants for fiscal 1964, also noted that: "The success or failure of the national space program rests directly on the skill and training of the people who undertake the effort . . . It is imperative that NASA utilize all capabilities in its intensive scientific effort designed to probe the boundary of present knowledge. In the development of this capability, the universities have a special role."

Centers Elsewhere and Here

In 1962 NASA set up a training grant program whereby 10 universities throughout the country received grants to be used for three-year doctoral fellowships in appropriate fields. Associated with this program, in fact handled by the same office of NASA, was an effort to encourage universities having the right disciplinary backgrounds, competences, and interests to set up centers which would emphasize certain fields in space research.

One of the first of these was established in Iowa, and centered around Professor Van Allen's interests in the earth's magnetosphere and the further exploration of the radiation belts. At Princeton University, a space research center emphasizes research in propulsion. Another, at the University of California at Berkeley, includes research in several fields but principally in electromagnetics and upper atmosphere physics. Building grants were given to the University of Pittsburgh and to the University of Chicago, too. At least half a dozen got under way before an M.I.T. Center was actively discussed, and there are many more today. It is fair to say, however, that one of the most general and possibly the largest is that at M.I.T.

The origins of the Center for Space Research at M.I.T. are traceable to conversations between James Webb, Administrator for NASA, and President Stratton, Vice-president McCormack, and other M.I.T. men late in 1961. In the course of these conversations, the Institute was encouraged to consider the specific role it might play in increasing the nation's graduate education and research in space-related fields. In January, 1962, a committee under the chairmanship of Provost Townes was organized to recommend M.I.T.'s response. The committee surveyed the space-related research, which was already considerable, then in progress on the campus, and further undertook to establish by survey the extent of Faculty interest in the expansion of such research.

This took considerable time. M.I.T.'s Faculty is heavily committed to many projects, and the superposition of a new problem on a busy group does not always lead to its rapid solution (the old adage about consulting the busy man notwithstanding). In the fall of 1962, nevertheless, a broad plan was described involving expansion of certain research in the space sciences and space technology, increased numbers of training grants, and improved facilities for housing this expanded activity. There was general agreement on the proposed plan, and Mr. Webb and President Stratton signed a Memorandum of Understanding in December that became essentially a charter and stimulus for increased teaching and research activity within the Institute's space-related fields.

The formula in the Memorandum of Understanding was based on: Support by NASA of a general research program in the space sciences and engineering; continuing support of many more specific investigations in this area but covered by separate proposals; joint funding by M.I.T. and NASA of a building on the campus to house the growing program of research; and

establishment of a laboratory within the Center to provide staff and research facilities for basic experiments in space. The elements of this plan were amplified in a research proposal submitted last April, and this fall the Center received its initial general research grant of \$500,000 for the first year of operation. Our next step is simply to go to work.

A Focal Point for Many

M.I.T. has been active in important fields of space research for many years. The work of Professor C. Stark Draper, '26, and his colleagues in the Instrumentation Laboratory on inertial navigation and guidance technique, that of Professor Bruno Rossi and his group on cosmic-ray phenomena, interplanetary plasma, and gamma-ray astronomy, and the experiments in space communications, radio and radar astronomy at Lincoln Laboratory and the Research Laboratory of Electronics, are examples of such activity. There are, of course, many others.

Since all of this space research is well established and making good progress, why does M.I.T. need a space center? What additional purpose will it serve? The answer lies in the focusing and more stable support of the needs of smaller space research activities. Such research tends now to be scattered and diffuse, and in many cases it can be strengthened by better facilities and collaboration with others in allied fields.

There are now no common facilities and there is no common program to stimulate workers in various disciplines to join together in pursuit of complex objectives pertinent to the national space program. The need for a building to house such a multidisciplinary program is quite acute. So is the need for general research monies to avoid the inhibitions and inefficiency encountered in writing proposals for quite modest investigations. The principal function of the Space Center will be to stimulate education in the space-related disciplines by providing the physical and financial means to give focus to the on-campus space research program.

The Center will encourage the Faculty and students in the life sciences, the social sciences, the physical sciences, and the various branches of engineering to communicate with and to support one another in the common pursuit of complex research objectives. The breadth of disciplines involved will be the characteristic distinguishing the M.I.T. Space Center from space centers at other universities.

The new Space Center will certainly not attempt to incorporate all of M.I.T.'s NASA-sponsored research, although it will undoubtedly have ties to all such activities. The Center is expected to emphasize the more fundamental aspects of space research and to encourage suitable doctoral thesis research, but leave to the larger, better-equipped laboratories at the Institute the responsibility for more extensive experimental and engineering enterprises.

Features of Its Program

In its day-by-day operations the Center is to be administered by a director and Lawrence E. Beckley, '42, its administrative officer. They are to be assisted in the development of the technical program by a committee drawn from members of the Faculty whose own

work is within the Center's program and who represent the principal disciplines involved. Pertinent activities and interests of the School of Engineering, for example, will be represented by Professor Erik L. Mollo-Christensen, '48, of the Department of Aeronautics and Astronautics and by Professor J. Francis Reintjes of the Department of Electrical Engineering.

No attempt is being made to cover all of the subjects possible in the large field of space technology but a few important themes have been identified which match the interests and competence of the Faculty. For example, some basic studies in fluid mechanics are being sponsored which include analyses of the interplanetary gas flow, flow in turbulent media, and the gas dynamics of supersonic combustion. Another group of studies is concerned with space-propulsion systems and includes some investigation of momentum transfer in low-density gases, several kinds of particle accelerators, and some basic studies related to nuclear propulsion systems. A third theme is centered on investigation of space-vehicle power sources and includes some fuel cell research and energy-conversion studies involving solar and radioisotope sources. The Faculty involved in these studies is from the Departments of Aeronautics and Astronautics, Mechanical Engineering, Chemical Engineering, Electrical Engineering, and Nuclear Engineering. A fourth topic, receiving the attention of the Department of Metallurgy, is concerned with the behavior of materials in space, particularly the long-term effect of the high vacuum and radiation environment on such materials.

Also associated with this general research program, but funded separately, are fundamental studies of interplanetary navigation, research on space communication techniques, various radio astronomical studies of terrestrial and planetary atmospheres, and the early consideration of a new radio technique for probing the extended solar corona.

From X-Rays to Foreign Policy

In the physical sciences, represented on our Technical Committee by Professor Rossi, the interest is centered about investigations he and his colleagues have had under way for some time. These include measurement of the properties of the interplanetary medium, and work in gamma-ray and x-ray astronomy. The general research program also will sponsor study of meteoritic phenomena by members of the Department of Geology and Geophysics, and hydrodynamical studies of the solar atmosphere by members of the Department of Mathematics.

The life sciences are represented by Professor Nevin S. Scrimshaw, Head of the Department of Nutrition and Food Science. The emphasis here is mainly on nutritional studies believed pertinent to the long-time support of man in space, but a secondary objective closely associated with these is the investigation of closed-cycle, life support systems; and, there is also some early activity in space biology by members of the Biology Department.

Lastly, we have a modest (in terms of money it is modest, but in terms of its impact I believe very great) activity in the social sciences and industrial management under the general direction of Professor Robert C. Wood of the Department of Economics and Social Science. This is an aspect of the space program in

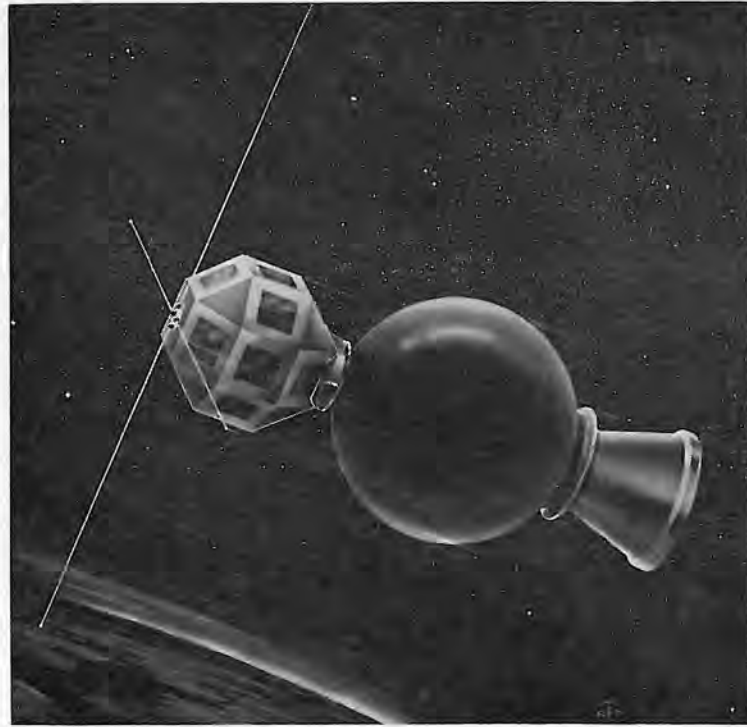
which Mr. Webb takes a deep personal interest. It is asserted that, in addition to the major scientific and technological challenges inherent in the national space program, it is likely to bring economic and political benefits to the nation and world. It is of great importance, therefore, that nontechnical aspects of the program be studied by social scientists in close association with their colleagues in technical and scientific disciplines. There is a particular interest in the study of the space program as an instrument of foreign policy, and one of the contributions a university might make would be to promote co-operation in certain projects with foreign scientific groups. There are some specific possibilities here that should be studied, and co-operation with foreign scientists is one of the objectives listed in the National Space Act.

We have managed, then, to set up a broad program of space-related research which is consistent with the interests and availability of the Faculty. The diverse membership of the Center's Technical Committee has already, in the course of its deliberations, stimulated interdisciplinary communication and established certain areas of mutual interest. The situation will be better when we have our own building in which representatives from these different disciplines can be housed in close proximity.

In October, 1963, we received an initial research grant of \$2 million to be spent over a three-year period; \$1 million of this was for the Center's general research program, and the second million for special projects. The annual rate of the general research program for the first year will run at \$500,000. The remaining funds are so-called "longevity funds" and provide for the continuation of the research program in subsequent years. The original plan anticipated that during the second and third years of operation further general funds would be provided to about double the initial level, although the present views of the Congress make this far from certain. Over and above the general funds, there will be funds for specific investigations which are expected to total some four times the general funding. The total program of the Center, several years hence, may involve a budget in the \$5 million-per-year range and will probably stabilize at that point.

The Building Plans

The building to house this multifaceted activity is being designed by the architects, Skidmore, Owings and Merrill, who are studying the development of the northern part of the campus. The building will cost \$4 million, of which \$3 million will be provided by a NASA facilities grant and \$1 million by M.I.T. In addition, M.I.T. will provide for its maintenance and upkeep. The building is to be owned by M.I.T. and be on a site now occupied by one-story buildings on Vassar Street.



A probe to orbit the sun and measure properties of its corona has been proposed by workers in the new center.

Architectural plans for the Space Center, and indeed for several of the other buildings that are expected to be erected in the northern part of the campus over the next several years, are well along. The Space Center building will contain about 100,000 square feet of which some 70,000 will be useful or net space. The building is to be five stories high and its exterior probably will resemble that of the Compton Laboratories. The building will be largely light laboratory and office space. The schedule calls for plans to be completed late next spring and construction to be under way by next summer. The actual construction will require about two years, so our growing program will have a permanent home about three years from now.

The problem of housing some of our activities for the intervening three years is an acute one, and the Institute now has plans to rent space nearby for some of the special laboratory activities that the Center requires. Space will also be rented for the Center's administration, and perhaps one or two projects, but many researchers in the program will simply have to make do with what space they have until our new building is completed. This will not help very much in emphasizing interdisciplinary communications, but by the time the building is finished we should be able to move in with a really good, going program.