

N64-30328

THE SPACE PROGRAM AND NEW ENGLAND INDUSTRY

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Travel to the Moon is itself unimportant; it is merely a milestone in man's exploration of space. Landing on the Moon and establishing a research base and small colony there will merely be evidence that man has acquired sufficient knowledge to do so, and, more important, has applied it to his needs with effectiveness. But, more important—and more germane to this conference—is what he does with his newly acquired knowledge on Earth. Certainly in our time, not many of us will make the lunar journey or beyond; but the effort that our Nation makes to get someone there will—or can—have great importance to New England—if we are prepared to take advantage of the opportunity.

There is no magic formula to meet these opportunities; they will not drop into our laps; we have to work to find them and to take advantage of them.

We have been reading and hearing more and more of late about how defense spending is tapering off. Economists have been putting in long hours studying what the effects of this will be, and how we can keep them from being more serious than they at first appeared to be. While executives of defense industries are well aware of the need to convert to producing for the civilian economy, they are finding that it is not an easy job. The defense market has different requirements and requires a different kind of selling, and the science and engineering for the defense market respond to different motivations and require different practices.

It is possible that the space program may provide an alternative to the defense market. Certainly its growth in terms of dollars seems to indicate that the space effort promises to fill in behind the decline of the defense effort. For the fiscal years 1955 to 1962, appropriations for all space programs totaled \$7.5 billion, while the present budget request for NASA

is for \$5.3 billion; and some have predicted that the 1970 NASA budget might amount to \$9.5 to \$10 billion.

Because reaching the Moon and beyond does not carry with it quite the urgency that characterizes national defense, these predictions may prove illusory. Many of the skills, practices, and requirements of this market are like those of the defense industry. It can be expected, then, that those companies skilled in the defense industry will receive many of the benefits of this younger effort. By the same token, the skills appropriate to the space program are not easily convertible to the civilian economy.

But other than as a substitute for a waning market, what is the significance of the space program to the New England economy? There are three very clear advantages.

The first benefit is counted directly in terms of dollars and cents. In fiscal year 1963, NASA awarded \$53 million of prime contracts to New England firms—a fivefold increase in 2 years. And subcontracts coming to the region in the calendar years of 1962 and 1963 added another \$70 million. Another \$35 million in prime contracts were awarded during the first half of the current fiscal year. The subcontracts for that period, in addition, brought the space program up to a \$50-million industry for New England companies for that 6-month period. Recently we learned that construction on the new electronic research center depends only on site selection and the appropriation of funds. This will mean over 2,000 new jobs during the next 5 years, with some \$35 million in annual salaries, and operating costs, of which \$18 million will be for purchase of goods and services.

When the Manned Spacecraft Center went to Houston, that city experienced a significant surge in its economy—\$147 million in construction and equipment,

over 3,000 NASA employees receiving about \$3 million in monthly salaries, some 85 aerospace firms sending another 2,500 representatives, and new jobs appearing to serve these new citizens have amounted to the addition of a sizeable new community in 2 years. During these same 2 years, almost the same figures were being chalked up because NASA established facilities related to the Saturn program. These are exciting figures to conjure with; but remember that New England already has the scientific and engineering talent, the experienced companies and the academic resources that made it the preferred location for the electronic research center. We cannot count on a comparable phenomenal growth.

But we can use our reservoir of talent and experience to attract an increased share of the space contracts, and so far we have obtained only 2 or 3 percent of the total each year.

The second benefit is that of the generation of new knowledge and technology in the course of solving the problems encountered in the space program. The military services have provided a wide variety of products for our society over the years, from clothing to food processing, as well as techniques such as operations research and systems management. It is not surprising that we should expect similar byproducts from the space program. The great disparity between the requirements of travel in outer space and our daily lives, however, means that these byproducts are not always as readily available. Several studies have been made to identify them, and the research organizations from my own company here in the Boston area to Stanford Research Institute on the west coast are engaged in a continuing effort to make them available to industry.

In this connection, James Webb has announced:

It is our objective, in accordance with the directives given by Congress and the President in creating NASA, to insure that developments resulting from NASA's scientific and technological programs be retrieved and made available to the maximum extent for the nation's industrial and consumer benefit in the shortest possible time. . . .

Now, in order to accomplish this directive, NASA has created a Technology Utilization Division to locate, record, analyze, and disseminate the developments resulting from the program. Officers are continually working to uncover such developments and to make them available.

By waiver of the Government's rights, contractors may be permitted to own and to patent inventions

made in the course of their work if they will agree to take steps toward commercial development within a reasonable time. And NASA readily grants licenses on its patents provided the licensee will endeavor to put them to use within 2 years. Every effort is being made to get these new developments out to those who can make good use of them. As part of this effort, news of new techniques is published in "Application Notes" and "NASA Tech Briefs" that are prepared by NASA's Technology Utilization Division.

About 5 or 6 years ago, as I considered the significance of the space program, it seemed to me that the fallout benefits to our consumer product economy might be very worthwhile. At the time we were concerned with the heat barrier, and as we sought to solve that problem, we tried to think of commercial uses for the highly resistant materials we were experimenting with. We also, of course, were dealing with materials for the engineers as well as many of the other missile components. We were looking, too, for lightweight, high-yield energy sources, and as we sought solutions to our many pressing problems, we explored the extremes of the temperature spectrum for new processes and new materials. From all of this, much has been devised that will be useful in our civilian economy, but so far one of the most interesting aspects of this experience has been the amount of information uncovered that has immediate application to the human being, himself—to biology, to bioengineering and to biochemistry. Many of the sensory devices, data processing, and presentation systems have proven useful in diagnostic and surgical practices as well as other treatments of biological problems. This, to many, has been somewhat of a surprise and rather serendipitous. But it is an indication of the value of the unexpected in this type of basic and applied research in new areas.

The *New Yorker* has just finished a series of articles on the scientific and technological community here in Greater Boston. The editors entitled the series, "Center of A New World." It was Oliver Wendell Holmes who called Boston the "Hub of the Solar System"; now Christopher Rand has refurbished the old title. He wrote these three articles about the astonishing pool of talent; this pool of talent is the third benefit the space program can bring to New England. It is true that Harvard, Yale, MIT, and the other schools and colleges of the region antedate the space effort; indeed, Dr. Goddard did most of his pioneering work with rockets right here at Worcester. (We might al-

most claim that this area is the cradle of the space effort.)

The work of NASA should add significantly to this resource. The growth of "science-based" organizations around here has been described as being analogous to the phenomenon of a "critical mass." After a certain point, the reaction carries on by itself—like begets like. With the start in World War II of scientific projects like the forerunner of Lincoln Laboratories, such organizations have grown at an increasing pace here, attracting others along with the service companies that supply them. Clearly this pool of talent was a determining factor in the contested decision to establish the NASA Electronic Research Center here and to keep the Air Force research activities at Hanscom Field.

But by the same token, these activities attract still more such talent here. Similar growth is beginning in the Houston area and is well established on the west coast. So we can expect to benefit from the addition to our talent pool as a result of the space effort.

We are fortunate in that this talent clearly has applications to our life on this Earth as well as to our efforts to reach into outer space. My predecessor as president and chairman of Arthur D. Little, Inc., Earl Stevenson, has been carrying on some very interesting research into the convertibility of new knowledge and talent from research activities for governmental programs to the needs of the civilian economy. He believes that in many ways they are two different worlds. There is much justification for this conclusion of his, and something similar may be true in the industrial scene, where defense-oriented companies are finding it difficult to move into the civilian economy.

This can be a real long-run danger. However much we may welcome the growth of first defense, and now space projects, if we cannot keep such work balanced by civilian production, we shall find our regional economy dangerously lopsided and a victim of future changes in national policy. That is why we are fortunate in having "transferable" talents here. As one example, the second *New Yorker* article discussed the computer "industry" as it is seen at Harvard and MIT. Much of our special talent lies in electronics, an essential element in computer technology. This is but one way in which electrical engineers will be able to contribute civilian needs. The universities may provide the means by which much of this talent can be used, since their work is as pioneering as that of the

space effort.

In a recent list of 35 major defense-space contractors, only 2 large New England firms were heavily involved in comparison to their total sales. We should try to keep a good balance between civilian economy and space economy so that our civilian regional economy also contributes to and benefits from the space program. I noticed with pleasure a newspaper story about the David Clark Co., of Worcester, which makes knitted garments but is also working currently on a contract for NASA on the space suit to be used in Project Gemini. For quite a while now, some of the products of a small, Boston electronics company have been the computers in satellite guidance systems orbiting in space, but these devices and the technology that produced them also find many uses in civilian products and processes. Here, it seems, is the basis for a viable growing economy for our region.

We need the long-term strength of selling to the everyday market here on Earth; but we also need the stimulus in dollars and challenge and new knowledge that contributing to the space program can bring. For it is a challenge, this dealing with problems posed by conditions we have never met before. And it is a challenge to learn to use these new developments and ideas to their fullest advantage. Most people attend carefully only to experiences which are immediately significant in their own everyday life. They perceive in terms of their preexisting values and attitudes; they try to mold new experiences into old contexts; and thus the new experiences frequently lose their unique implications and power. If the experiences do not fit this standard context, they are likely to be ignored altogether. It is to avoid this happening that our businessmen must be responsive to the challenge and sensitive to the nature of the rapidly changing technological environment in which we work.

As a corollary, that is why we welcome the challenge that the national effort to reach the Moon can supply. New conditions bring new problems, some of which can be solved only by seeing them in a new way. We shall benefit from the talents brought by NASA to our region just as surely from the contagion of their new perspectives as we shall from the new dollars they bring to our stores and the new products they can make possible for us. Max Lerner, in writing about the social implications of the space effort last year, concluded with this thought:

The knowledge generations in our time succeed each other every decade, each decade bringing with it some-

thing like a doubling of what is known and must be mastered. But the emphasis will have to be not on piling up new knowledge upon new knowledge, but on knowing the implications of what we know.

In the history of science the leap of intuition has always played a greater role than the stodgy men have been willing to admit. The orbiting mind is not the

answer to the problem of a spacious society: to swing endlessly in the same groove is only another way of standing still. The task of our generation, even more than the breakthrough into outer space, is the psychological breakthrough into the inner man in order to escape the circle of rigidity that still holds him in thrall.