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REFLECTIONS ON GOVERNMENT SERVICE

II. Goal Setting and Feedback in Large Scale Endeavors

by

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Second of Three Lectures Presented in the
McKinsey Foundation Lecture Series

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II. Goal Setting and Feedback in Large Scale Endeavors

Throughout our history questions have been raised as to whether our American decision-by-vote process can stand up to the great tests required for survival and advance. Involved in these questions are tests as to our ability to effectively organize, administer, and reorganize as needed the large scale endeavors required for the demanding jobs that our pattern of development and circumstances thrust upon us as our nation goes forward. Some thoughtful observers have called our system "government by crisis." In the process of meeting many crises, our nation has made many advances. But the large scale effort approach cannot always be a response to a crisis. Its use in many cases must be more deliberate, more carefully planned, and more inter-related to a large number of other activities than crisis conditions will permit.

DeTocqueville focused on this area of doubt in a penetrating commentary a hundred and forty years ago. He did not doubt the resolve and the capability of Americans. He had no doubt that we would push on to the limits of this continent and build a civilization unparalleled in its wealth and material well-being. Nor did he seriously doubt our ability to take action to meet an external threat

or a physical diaster. His doubts were more sophisticated, more fundamental. He could not assay what would happen when no crisis existed, and sovereigncitizens were called upon to vote on issues so complex and so far removed from their day-to-day needs and interests that they could hardly understand their nature or their implications.

Today modern technology is a ubiquitous and powerful force in all decision areas, individual and national. To predict the time, cost, and performance parameters of multi-billion-dollar projects requires an assessment of how well the effort can be organized and administered, as well as whether scientists and engineers will leave other things of high priority to join the effort. The limits to which engineers can use higher temperatures and higher pressures to achieve higher efficiencies is constantly changing. These kinds of considerations are difficult for the voter to understand and make judgments about.

Some governmental agencies have developed non-profit organizations and contractor-operated laboratories to help them make analyses; to develop information adequate for decisions; and to present the facts supporting those decisions in the forums that condition voter judgments. NASA has used a different method. We have worked hard to create in our specialized staff groups and in our laboratories the ability to arrive at judgments based on facts; an in-house technical and administrative competence that will enable us to reach correct judgments on the matters for which we have responsibility, no matter how complex. We thus are able to move these matters forward to the voter-judgment arena with confidence that they will stand up under scrutiny and debate.

Before and after the Civil War, during the period of near economic anarchy in the last decade of the nineteenth century, and the period of growing social consciousness in the early twentieth, de Tocqueville's question recurred again and again: Is our democratic system capable of handling the complex and difficult problems that our growth and progress generate with such force? This question became particularly pointed during the Great Depression of the 1930's. Faced with a catastrophe of unknown origins, almost imcomprehensible in its workings, and incapable of being met head on, as would have been a menacing foe or a natural disaster, our citizens became profoundly disturbed. As the historian Arnold Toynbee has pointed out, they "were seriously contemplating and frankly discussing the possibility that the western system of society might break down and cease to work."

As we face today a new series of tests at home and abroad, doubts again are heard. The overtones are perhaps even more somber than before. A general theme seems to be building up that we are over committed as a nation; that we have exceeded the limitations of our power; that we must either lower our goals and reduce the scale of our activities or risk the breakdown of our free system. Some question whether a government of divided powers such as ours can in any event meet some of our problems.

At the same time doubt is being voiced as to the buoyancy of the American people, as to their desire to continue pioneering on new frontiers, as to their willingness to carry on with great undertakings. Archibald MacLeish expressed the view in the Saturday Review of

October 7, 1967, that we no longer trust ourselves to carry on with the great goals that have long marked our society. He states a paradox in "the contradiction between the triumphs of human achievement on the one hand, and the profound uneasiness of humanity on the other . . . There is . . . a terror in the world . . . Under the hum of themiraculous machines and the ceaseless publications of the brilliant physicists a silence waits and listens and is heard. It is a silence of apprehension. We do not trust our time, . . . we do not trust ourselves."

David Brand, a British journalist writing in the Wall Street Journal of August 27, 1967, sees America as "boarding up, slat by slat its hopes, its trust, its technicolor illusions and even its sense of humor." He says: "The shadows are creeping in. And too many Americans are concluding that being American is not the best of all possible worlds."

Less than a month ago, Malcolm Johnson, Editor of the Tallahassee (Florida) Democrat, said much the same thing: "We have become a fearful people, we Americans--intimidated by the power, even the virtues, of our nation and its institutions. We seem to seek ways to emaciate our culture and our politics, dilute our faith, diminish our superiorities. . . . At home and abroad, we let humble motives run past humility to humiliation. Self-criticism has shattered self-confidence. Self-restraint is strangling self-reliance. We are like Curt Walters' old maid Aunt Sally--so afraid she'll do wrong, she can't do right."

For myself, I question the validity of these assumptions. Is our present situation really so bad? Is our spirit as a people so broken? Does this nation at the pinnacle of its power need to trim its sails and heave-to far short of the ends we have been seeking? Are we at a point where we must abandon our aspiration for a secure world community of free states, or our aim to use technology to bring to the service of ourselves and mankind the great continuum that begins with the ocean floor and extends through the air and on outward into the reaches of space? Can we do what is needed to save our cities?

Our resources today are at a level hardly dreamed of a few years ago; our gross national product is approaching the trillion dollar mark; our productivity in every field is reaching higher and higher peaks.

The knowledge we now command staggers the imagination. We have at our disposal large numbers of highly educated men and women; vast new technological resources; an almost miraculous capability to use existing technology to create new technology as needed. On an almost fixed time schedule, we are able to meet new needs or to effect desired improvements in our situation as a people and as a nation. And we have the ability, if we but use it, to organize ourselves, our knowledge, and our resources to accomplish almost any task or group of tasks we may set for ourselves.

As an illustration, what we have done in space may point the way. Some of it now seems commonplace. But let me recall how it was before. In 1958 we decided that we could not relinquish the control of space to another nation. We embarked on a program to seek pre-eminence as a space faring nation. As we proceeded toward this major goal we continually refined our projects and sub-goals. Within a ten-year period, we developed a capability to operate with both men and machines to perform in space scientific investigations of the earth, its environment, the moon, the sun, our neighboring planets, and the stars; to observe from space and to predict terrestrial weather phenomena; to use space machines to improve our ability to communicate on the earth; and to prepare for further exploration and application of this newly opened medium of space. We vastly expanded our knowledge of the air and how to use it as we learned to attain the high speeds necessary to overcome its limits and escape into the space beyond. We developed, refined, and added to the plans for attaining these goals. We began to work on many elements within these plans that would not become parts of an operational system within half a decade.

The development of the 36-story tall Saturn V with a thrust of seven and a half million pounds was begun in FY 1962 when the largest operational rocket we then knew how to build, the Atlas could produce less than 400,000 pounds of thrust.

Here I might add a point that is little recognized. We conceived, developed, and will carry out this ten-year program in terms of a relatively small impact on our national resources. Total cost of the entire space program in this first ten years equals less than six percent of what we have spent on defense during the same period. The costs of space have amounted to one half of what we spent to develop an intercontinental missile capability. They accounted for less than three percent of the total of our federal expenditures during the period involved; they represented less than five one thousandths of our gross national product. Of the funds used, over 90% went to pay for work in the laboratories and factories of 20,000 prime and subcontractors and for research and training on the campuses of 200 universities. NASA provided the in-house base that enabled this large endeavor to develop its power. But the technology was developed, tested, and perfected in non-governmental units that were doing other work--serving other customers. The know-how spread out into large areas of industry. Efficiency was increased. Large parts of the public investment were recovered in taxes.

Is there any good reason why we cannot do in any number of other areas what we have done in space and without having to throw overboard other programs--at home and abroad--essential for our security, our progress, and our well-being as a nation?

My answer is that man's destiny is a product of his intellect. He appears to have no recourse if he is to progress but to engage by

all means available in the endless search for new food for thought--new information which he digests to form new knowledge and on which he builds a better understanding of himself and his environment. This process is man's greatest continuing adventure. It is uniquely suited to constructively consuming all of his resources, mental and physical. But if knowledge and understanding are to be of maximum benefit to man, they must be put to work. Man has no way to do this on a broad scale except through organized society. Only as society sets demanding and imaginative goals and acts against those goals can the individuals who make it up realize upon and expand their overall capabilities.

Choosing goals in our society depends upon our desires as well as our capabilities. Most people of any society desire to survive; they desire physical well being for themselves and a chance for a fuller and richer life. But do they desire those things enough to temporarily burden themselves and even severely tax themselves in order to work over a longer period toward new levels of achievement--to enlarge knowledge and to apply it on a broad basis to the solution of long-standing problems? More particularly, will they choose this course when they cannot fully comprehend the nature and implications of all the issues involved?

Woodrow Wilson believed, as I mentioned last week, that the people of his day were determined to progress toward such goals.

He saw the nation as impatient for progress toward its promise and ready through new goals and new organized efforts to seize history by its forelock--to hasten the realization of its dreams.

In our early days, Washington, Hamilton, Jefferson, Franklin, and the others built upon a similar conviction. There was no assumption underlying their work more important than that individually free men would become collectively responsible men. They set a pattern of collective action and a governmental framework that has enabled a growing society to effectively exercise initiative in benefiting from new knowledge through use of new technology on a scale never before attained.

Why do we doubt our individual and collective ability today? Part of the answer may lie in the size and complexity of things. We have become a nation composed largely of specialists, a highly complex, interconnected, and interdependent system of people, groups, functions, and interests. This is in contradistinction to our early period when the westward advancing frontier provided opportunity and fluidity, and the pattern of settlement consisted of a relatively small number of loosely connected groups which could enjoy a quasi-independent existence.

Our ways of thinking and acting go back to those days. We have a concern over "bigness," whether in the form of big business, big government, big science, or whatever. We have helped make things

grow bigger throughout our history, but we still tend to fear bigness itself. This represents perhaps a sound instinct. Large aggregations of power can be dangerous to free men and free institutions. They need not be but many are.

Thoughtful scholars today are challenging Lord Acton's thesis that all power corrupts. Lord Radcliffe developed in his Reith lectures the theme that, "power is good or evil according to the vision that it serves." My experience has been that most men responsible for organizing large scale efforts and, therefore, large concentrations of power seek to achieve their ends within the existing system, or desirable modifications of the existing system. My own view is that goals, projects, and systems must, in the last analysis, be viewed as interdependent elements; and goals that depend on undesirable systems are undesirable goals. Cooperation is desirable; loss of independence or individuality is not. The classic and continuing goal of our society is to preserve those basic freedoms and rights that have been won for responsible individuals, and the essential bases for cooperation between responsible groups within the framework of representative government.

Some who discuss the difficult problems we face today contend that to meet our goals we need to eliminate some of the restraints of our democracy and of our federal system. Some feel that history does not show a basic and unbridgeable difference between the <u>essentials</u> of our system and a collectivist system.

Their view is that those who adhere to collectivist principles, as in the USSR, are moving steadily toward our practices. They feel we have little choice in our turn but to move toward certain of theirs. Others suggest that we can always count on the "crisis" pressures to enable us to superimpose on our system a special or crash program with overriding powers when it is clearly necessary.

My own belief is that in the long run, perhaps even in the short run, both of these approaches leave much to be desired. Neither is really necessary. I believe we can use our growing experience with large scale endeavors to learn more about the art of government; of how to combine skillful organizing and good management in advance of a crisis need. I believe we can set-up to do the complex jobs we have to do without damage to our democratic principles or representative system, and that we can do this with benefit and not harm to the fundamentals of our society. But we do need a large increase in the research effort from which we can learn how large endeavors can so operate as to bring to the fore, for citizens to evaluate, the essential ingredients of complex matters. This evaluation must meet the critical tests of acceptance by our elected representatives after full debate. There is no basic reason why a large scale effort cannot set up to provide the kind of information and facts that can become a trusted source of information for citizens and a basis for judgments. I believe these endeavors can learn how to report in

understandable form whether or not the things the endeavor was set up to do are, in fact, being accomplished. In many areas of such endeavors we need not despair that we can learn to do both work and the reporting with the television cameras on us--when thoughtful citizens want them there, not just when we are ready to report or when a reporter seeks a sensational setting. In other words, I believe we can so conceptionalize the large scale endeavors we need to do our work and so conduct them as to lead to acceptance of this way of working as proper and safe.

This is not an easy undertaking. As I tried to make clear in my first lecture, to meet the complex requirements of this age neither the existing doctrines and practices of management nor the present art of public administration alone or in simple combination is sufficient. We need something more and I believe much of this can result from an active support of research in the critical areas. Research is much needed to give us a systematized way to do things that both furthers and integrates into a new whole the science of good management and the art of good public administration as they apply to large scale endeavors. Successful large scale endeavors have repeatedly shown what can be done. We know less about how it was done. The purpose of these reflections from my own experience is to try to show promising paths of exploration and study.

I would single out as one of the most important, and I believe the most neglected, aspects of most large scale endeavors the relationships between the primary goals and the accompanying sub-goals. The second- and third-order effects must be better evaluated in predicting its total effect on our society. Lack of a trusted way to demonstrate that we can keep under control second- and third-order, as well as primary, effects of an endeavor carries concern and fear. If, therefore, we are to systematize the use of the large scale approach and to secure its availability as an accepted way for a free society to operate, we need to develop more reliable ways to predict and manage the totality of its consequences. In many ways, we need the same kind of innovation which enabled the Wright brothers to succeed where others had failed--a system of coordinated controls that will provide a way for the central groups of administrators in a large scale endeavor to use natural reactions based on understood experience to guide what is in many ways a conglomerate that has a built-in instability and thus maneuverability.

The large scale endeavor by its very nature--that is, because of its sheer size, its complexity, the investment it requires, the aggregation of power vested in it, and the diverse and highly skilled human resources it must command--necessarily impacts large segments of society with great force. This is true whether the endeavor is private or public; whether it aims at a military or civilian end,

or a combination of the two; or whether it is directed toward solution of a social problem or development of a new national capability.

Most large scale endeavors employ--as well as develop--new scientific knowledge and new technology. The essential product of this process is change--that is, change in the attitudes, the interests and the concepts of reality of large numbers of people. This comes through the acquisition of new knowledge and in the changed methods of action and interaction of people as this knowledge is put to use. It follows that the larger the effort in science and technology, the larger those changes will be and the more rapidly they will occur. The effect is to upset the dynamic balance, or equilibrium of society. The bigger the effort in science and technology, the less can large numbers of people count on previous bench marks, or points of reference, or guides to action.

The hard fact of life for organized society and its leaders today is that if dynamic equilibrium is achieved at any one time it becomes increasingly difficult to maintain. This is especially true when it is upset by a number of large innovations not introduced with the most careful consideration of their second- and third-order effects. This suggests that new and improved methods must be brought into play to analyze and prepare for the introduction of major innovations. These methods must include not only consideration of

the material results which the innovations are primarily intended to provide, but also the intellectual response time of humans, the inertia of human systems, and the interaction of human endeavors with their supporting physical and social environment.

Professor Elting E. Morrison did an intriguing study of the stubborn resistance of the American naval establishment at the turn of the century to an important innovation in gunnery, one that would improve firing accuracy by some 3,000 percent. In trying to explain this resistance, Professor Morrison concluded that by far the most important factor was that the Navy is a society and that as a society it felt itself endangered by such a sweeping change. Professor Morrison went on to consider the implication for our society as a whole. "We are,"he said, "a society based on technology in a time of prodigious technological advance and a civilization committed irrevocably to the theory of evolution. These things mean that we believe in change; they suggest that if we are to survive in good health we must become an 'adaptive society'. By the word 'adaptive,'" Professor Morrison explained, "is meant the ability to extract the fullest possible returns from the ideas and materials presented both by the past and present and to throw them into new combinations." But, Morrison adds: "We are not yet emotionally an adaptive society, though we try systematically to develop forces that tend to make us one. We encourage the search for new inventions; we keep the mind stimulated, bright, and free to seek out fresh means

of transport, communication, and energy; yet we remain, in part, appalled by the consequences of our ingenuity and too frequently, try to find security through the shoring up of ancient and irrelevant conventions, the extension of purely physical safeguards, or the delivery of decisions we ourselves should make into the keeping of superior authority."

In NASA we have learned that for success in our work we must make the most careful analysis of all factors at the start of a project and still be prepared to adjust when actual conditions turn out to be different from those foreseen. We strive toward this goal just as we do to understand the relationships between the earth and the sun. Our "integrated systems" approach has proved vastly more effective than the "independent components" approach of the past for the solution of problems in dynamic situations such as are encountered in space and in weapons development. We believe the integrated approach should not be limited, as much present day thinking suggests, to "hardware" problems. It should extend to the total of the medium in which a job is being done and should encompass the full range of ramifications and implications.

The National Academy of Arts and Sciences is conducting on behalf of NASA a comprehensive study of the whole area of the relationship between large, complex endeavors and society. I mentioned one of the volumes resulting from this study last week, that on the railroads. Another entitled Social Indicators, edited by Raymond Bauer, appeared recently. This volume is deeply thought-

provoking and deserves a close reading by anyone concerned with the great matters thatnow face us and will face us in the future. Dr. Bauer's premise is that: "In the conduct of human affairs, our actions inevitably have second-order consequences. These consequences are, in many instances, more important than our original action . . . technical changes have proved to be particularly explosive sources of second-order social, economic, and political changes that were never envisioned. This arises largely because at the beginning technical developments tended to be viewed in a rather restricted context. They are seen as an answer to an agreed problem and tend to be judged in terms of their adequacy in solving the problem."

The point of emphasis in this statement is that Professor Bauer sees second-order changes (or effects) as "never envisioned." This raises a fundamental question about large scale endeavors: whether it is necessary to proceed in the blind, as it were, with regard to their possible second- and third-order effects.

In the case of some endeavors we have indeed proceeded in this manner. The Manhattan District object was to get one job done, as it was with Polaris, and the development of an ICBM missile capability. Consequences beyond or outside the prime object were in these cases given little consideration. But certainly in the future we do not have to take such a narrow approach. We know enough today to set our goals to encompass at least some of the secondary and tertiary as well as prime effects and benefits.

We in NASA have had such considerations very much in mind as we have developed the goals and projects of the national space program over the past ten years. We have sought, on the one hand, to minimize the disruptive effects of what has necessarily been a vast undertaking and, on the other hand, to so conduct our operations as to strengthen in every way feasible the positive values of our society and its institutions. We rejected a proposal by one large industrial firm to do the entire lunar landing job single handed, as well as a similar proposal by a leading university to operate a laboratory that could do all the scientific research.

We decided as a matter of deliberate policy to place principal reliance on the American industrial establishment and the American university system as a whole. We decided to focus our governmental efforts principally on developing the needed in-house competence to make responsible decisions and on organizing and managing. A measure of what we had in mind is the fact that ninety percent of every dollar that has come to NASA has moved outside the Agency. Our purpose was to spread the difficult problems over the largest number of able minds in the belief that this would produce the best answers. We recognized that to be effective in this approach NASA had to have very strong scientific and technical in-house capabilities. We had to be able to spell out general requirements for industry and weigh the specific proposals they submitted. We had to both encourage research and evaluate projects proposed by universities We had to

evaluate contract and grant proposals; to judge the performance of our non-governmental partners; and often to help them work around the broad problems in all areas which required the development and application of new technology, new production techniques, new tests, and new laboratory experiments.

In our relations with industry we sought to use the profit motive with full effect, even though we had to get research and development done where there would be little or no follow-on production. We viewed the operations of the market place as forces which were well understood and better for our purposes than new and untried ideas. In the beginning we used competitive proposals and the cost-plus-fixed-fee types of contract. But as NASA-industry relations matured, we worked together to make improvements. In major developmental activities the fixed price contract was of little value because there were too many uncertainties. In many projects requiring quick reaction changes based on test results, we developed and applied the "award fee" approach wherein an appraisal by the government of the contractor's efficiency and performance determined the fee to be received. Extensive use of incentive contracting also came into play.

These were the kinds of sub-goals that made our prime goals realizable. One excellent example of a well established set of incentives that contributed greatly to both our primary and sub-goals can be cited here--namely the contract with the Boeing Company to produce five spacecraft to photograph the moon from

lunar orbit. The contract had incentives on cost and delivery schedules. Further, there was an award for spacecraft performance in orbit about the moon. The fees were substantial enough to provide real incentives. The results achieved: five successes out of five missions on schedule, a substantial fee reward for Boeing management, and substantial savings for the government.

Our programs for work with scholars and universities have been as carefully worked out as those with industry. We have needed a very high level of scientific thought, experiments that would relay accurate scientific measurements from positions millions of miles away, and excellence in overall support of our missions. At the same time we worked to provide new means through which university resources useful for university purposes could be strengthened.

One effect of our programs was, as Dr. Sam Silver of the University of California has expressed it, to "tantalize the curiosity and stimulate participation by providing the opportunity to be creative."

The development of NASA's goals in science and programs for working with universities involved a selection from among several alternatives. One approach would have been to state the projects in the form of immediate objectives and then request proposals from the academic community. This would have generated response, but could have had two disfunctional effects. Firstly, the academic community is strongly opposed to the appearance of a "market place"

approach. Proposals might not have come from the best scholars. Secondly, and perhaps more likely, most of the research support would have ended up with those institutions which had already achieved the highest scientific reputations. Not only would this prevent the further development of a broad cross section of universities, but "name schools" would become overloaded. In this case NASA broke with tradition and supported research not only on the basis of demonstrated scientific excellence, but also in a pattern to build up the capabilities of institutions with a growth potential and a promise of using added resources to attain excellence.

It was clear in 1961 that NASA was required not only to replenish the national pool of highly trained scientists and engineers from which it was drawing, but to increase it. Therefore, not content with the added stimulation of pre-doctoral work provided by the increased amount of NASA's basic research performed by scholars in the universities, we initiated a pre-doctoral training program aimed at producing 1,000 doctorates annually.

The way this was done again broke with tradition, but was more effective in supporting both primary and sub-goals. The policy previously followed by federal agencies had been to allocate funds to individuals chosen through nation-wide competition. Once the individual was chosen he or she would have freedom of choice as to which institution to attend. This had the effect of overloading "name universities," a failure to build up added competence in a

large number of institutions, and leaving in the mind of the graduate student attending an institution of his "second" or "third" choice an impression not good for him or the school he was attending. In contrast, NASA followed the policy of providing its pre-doctoral training grants to the universities, allowing them to choose the graduate students and thus commit their brains and resources to their own selectees. This policy strongly supported the objective of institutional development as well as accelerating the addition of new Ph.D.'s to the national pool.

Through special features of NASA's Sustaining University Program, the objective of fostering inter-disciplinary approaches to research and problem solving was emphasized. Universities were encouraged to adopt multi-disciplinary approaches to all appropriate research projects. The purpose or sub-goal was that if an economist or sociologist could contribute to a physical science-oriented research project, his involvement should be encouraged and both the fields of social science and physical science would gain.

This goal of encouraging the build-up of inter-disciplinary capabilities is, I think, one of great importance for the future. Today may be the age of the specialist; and in so far as this description denotes intense application of talent to a given area, this is true; but the time has long since arrived when the complexity of the environment also demands a fusion of the various disciplines. The engineer cannot discharge his responsibilities without the counsel

of the scientist; the industrialist cannot succeed without the economist. If this inter-disciplinary approach could be expanded by the universities, and a broader base of wisdom and understanding on today's opportunities and problems created, industry and government could realize great value from working through the university with all the disciplines need for what is called today "a sophisticated understanding of the atomic and life processes." In our society, the university alone generally includes all the disciplines needed for this understanding--and leaders in every field need to know what all the disciplines can tell them. The university needs to recognize that it could become much more of a "trusted source of knowledge" in our society.

To go further with this approach is a needed national goal. NASA has only scratched the surface enough to show there is a "gold mine" in this region. Some way to explore and develop means whereby broadly based multi-disciplined teams can carry on as a continuing matter, research and research related studies needed by cities, state governments, federal agencies, industry, and other segments of the nation's life and can feed the results on a regularized basis into the appropriate "point of main impact," is much needed. I have long felt that one of the greatest forces we could bring to bear on the problems of our cities would be the development of great urban universities capable of purposefully and systematically generating within the urban environment itself

the knowledge, as well as providing training for highly skilled and creative people, needed to work successfully with those problems. I know of no single American city that has an adequate research effort or an adequate laboratory of the type truly great urban universities could provide. To do this, even in the turbulence of today, is not an impossible goal.

The American university represents one of our greatest national resources. No other nation in the world possesses its parallel. James Brian Quinn said in the Harvard Business Review of August 1966 that, "Perhaps the greatest--and least recognized--asset the United States has in international technological competition is its educational system. To fully develop its industrial science and technology, a country's educational structure must provide a full range of needed skills--scientific, engineering, manufacturing, management, technical, and even clerical--and constant opportunities for the upgrading and modification of these skills to meet new demands. In the Western World," Quinn concluded, "the U.S. educational system has adapted to the requirements of advanced technological culture with far greater efficacy than any other system."

We have sought in NASA, and I feel with good success, a working partnership between the universities, industry, and government. We have done this while each of the three has remained in its traditional place and has operated in traditional ways. I believe each of the three has become stronger because of the partnership. I believe also

that the partnership has yielded a product in terms of useable resources greater than the sum of its parts. This is something I would think of great importance for large scale endeavors of the future. We need not only to continue with this partnership; our goal should be to refine and further develop it.

Many large scale endeavors--I would in fact say most--generate new knowledge and new technology. These can be of enormous benefit to our economy, to our society. They can enable us to advance on a broader front and at a more rapid pace than otherwise would be possible. Normally these added benefits of a large undertaking are expected simply to "spin-off" into the main stream of our society, and to a certain extent they do, as witness the benefits for industry of military research in World War II. But can we afford to wait for or to rely solely upon the workings of such a slow process? The enormous expenditures for scientific research and development in large scale endeavors have the potential to contribute more to economic growth in the next decade than any other single factor. NASA has recognized this and with it that the maximum transfer of technology to non-space use should be purposefully and systematically sought.

We early introduced as a basic element in our operations a Technology Utilization Program. In this program intensive efforts have been and are being made to identify new products, new processes, new scientific and technological knowledge, and all useful innovations. Some appear in our research centers, some in our contractors' plants,

and some in university laboratories. We endeavor to make these products known and available for as wide use as possible. The extent to which useful "transfers" of space technology to the civilian economy take place will always depend in large measure on the initiative shown by people in industry, but NASA has established specific programs with private research organizations and universities to help spur and facilitate this initiative. Illustrative of our success is that in 1967, 4,600 items of new technology were reported and evaluated to determine the significance for those outside the aerospace industry. Items with potential were brought to the attention of industry, education, and the professions in a variety of ways. In 1967 alone, six hundred and seventy-eight different NASA "Tech Briefs," which are publicly sold through the Clearinghouse for Federal Scientific and Technical Information, have been issued, and the Clearinghouse sold some 270,000 copies of these; they are among the "best sellers" of all government publications.

A novel element in our transfer process is the experimental or "pilot model" Regional Dissemination Center. There are six such centers at universities in different parts of the country in different stages of development. These centers are established as pilot models and are expected to become self-supporting within five years. The Indiana University Aerospace Research Applications Center, for example, is now entering this non-subsidy stage. At these centers, NASA information on new technology is stored and retrieved by computer methods. Flash

reports followed by Tech Briefs are then distributed to commercial and other clientele whose "profiles of interest," also computerized, show a need. These pay the center a fee for the service. The centers also act as a repository for detailed information which can be called for by the clientele.

NASA is also experimenting with specialized centers, such as the one at the University of Georgia which disseminates NASA computer software to industry, universities, and others. This represents considerable saving for the recipient who pays only a modest fee for a program which may not give him 100 percent of what he needs, but which cuts his costs substantially. In 1967 over 1,000 such computer programs were sold by this center as well as 8,600 sets of program documentations.

Other "transfer" means being used by NASA are: conferences co-sponsored by NASA and the Small Business Administration; exchanges through other government agencies, such as the Atomic Energy Commission, HEW and the Commerce Department; and business and technical publications--where approximately 1,200 articles in 300 magazines appeared in 1967.

It would, of course, be impossible to enumerate all of the examples of technology transfer; but a few are worth mentioning. NASA-generated technology has contributed ultra-reliable devices for use in artificial heart technology. Through the use of satellite communications two-way medical consultations are possible between continents. Televised explanations and demonstrations of new and radical medical procedures

and surgery can be shown to medical students as they take place thousands of miles away. NASA developed means for efficiently soldering high-tensile metals, of the kind that would operate in space, are finding application in the oil industry for their down-hole equipment. NASA research regarding the role of the remarkable building blocks called nucleic acid that form the base of all living things may aid in understanding how life evolves and may also give new insight into diseases of the aging. In searching for a safe method of softening the impact of lunar landings, NASA specialists developed an especially efficient shock absorber, an aluminum tube that controllably collapses on impact, taking the brunt of the shock. Satellite pictures are now used to study changes in the ice fields in the north. They can help forecast the break up and therefore permit the more efficient use of ice-breakers and reconnaissance aircraft.

NASA has similarly sought to strengthen the economy of the nation through its policy with regard to patents. The National Aeronautics and Space Act and NASA contracts stipulate that any invention made in the performance of the contract becomes the exclusive property of the government. In order to facilitate the introduction of items with economic value into the stream of commerce, NASA encourages the non-exclusive licensing of NASA patents. Exclusive licenses are also granted when an extra incentive is required to get the needed developmental research done. In all cases, however, production of the product must follow or licensing is granted to others.

NASA's concern that our large-scale space endeavor brings new and added strength to our society at the same time that it progresses toward its primary goal of an adequate space capability represents, I believe, a desirable prototype for other large scale endeavors which we will certainly undertake in coming years. Unless such endeavors are conceived in terms of multi-purpose goals that add to the all-around development of our society, they can only lead to the distortion of our system or drown it.

But our concern about the effects of large scale endeavors should not stop with impacts of the type I have just discussed. We need to go on and explore the larger consequences that any great endeavor is likely to produce on our basic values and our fundamental relationships with each other. We need to develop means of forecasting these and of obtaining a feedback of information that will show what is actually happening as an endeavor proceeds along its course. This can serve to raise alarm signals if effects are not those desired.

As Dr. Bauer said about the space program in Social Indicators, such impacts can be very far reaching: "They may include changes in man's conception of himself and of God; almost incredible consequences of vastly expanded communications via satellite communications systems; improved short- and long-range weather forecasting; . . . contact with beings higher, lower, or sideways from us, or, if there is no contact, speculation over the possibility of contact; . . . competition with the Russians, cooperation with the Russians, or some combination of the two; . . . changes in attitudes toward education and toward stupidity;

revolutions in medicine via new knowledge, via telemetry, new substances, and use of computers for diagnostic purposes; revolutions in data processing and retrieval . . ."

These are the sort of consequences we must ponder as we undertake new endeavors. These are the sort of things that should enter into our calculations and plans and operational procedures as much as costs and measurable benefits. We need for each new large-scale endeavor, as Dr. Bauer further said, "to establish a system of feedback for detecting and taking into account the full range of its actions and for guiding its future actions."

In the meantime, we have another solemn obligation to our society. We must so develop and manage large scale endeavors as to avoid violence to our system of government. One aspect of this problem is to limit "bigness" to the extent we possibly can.

When a major new undertaking is decided upon, the first thought is usually to create an entirely new and all encompassing organization to take care of all its facets. But can the nation afford a continuing proliferation and build up of public organizations? What is the alternative and will it work? Let me again take the experience of NASA as a case in point. When NASA was put on a large scale basis, it was clear that the easiest course from the managerial standpoint may well have been to take the new organization route. NASA's decision, however, was to rely principally on existing organizations. This decision naturally raised many serious and difficult administrative problems.

The requirement was to synthesize a number of enterprises that were widely scattered geographically and quite different in purpose and operational methods and procedures. We had to develop a truly integrated and smoothly functioning operation on the basis of these several disparate enterprises. The process was necessarily slow. But we gained many advantages from the approach, including a quicker build-up of effective momentum than would have otherwise been possible. And from the national standpoint we minimized the strain on resources and the disruptive impact of a new and complex undertaking.

Most important of all, perhaps, is that we have carried on the endeavor in careful recognition of the necessary participation of our legislative leaders. This requirement is one most likely to gall anyone who is concerned with simply "getting a job done." For certainly our representative system with its numerous checks and balances and its other obstacles to "business-like efficiency" poses numerous problems and difficulties for a large scale endeavor. Yet, if we do not consciously work to strengthen the very basis on which our society rests, what value can any great particular accomplishment or accomplishments really have? There is much to learn in this all important area from our past experiences.

In our pluralistic society any major undertaking requires for success a working consensus among diverse individuals, groups, and interests. A decision to do a large, complex job cannot be simply reached "at the top" and then carried through. Only through an

intricate process can a major undertaking be gotten underway, and only through an intricate process can it be kept going. The basic decisions that initiate and set the pattern for a large scale endeavor are made by votes--within the Administration, of members of Congress, and the Citizens who elect them. Votes determine whether the endeavor is to be started. Votes determine whether it is to continue, and at what level, at what tempo, and for what changing or developing purposes. The voting process is an integral part within the operation itself. It constitutes an essential element in the system by means of which the endeavor is carried forward, just as the atmosphere on which an aircraft depends for support and movement constitutes an essential element in its operational system.

The area of main impact of votes within a large scale endeavor is that of goal setting and performance against goals, and the key is willingness to vote necessary support. Support is voted not in terms of organizational needs, as is usually the case with a routine type operation, but is in terms of the goal to be served and its assumed need, and the work being done to achieve the goal.

The process of decision-making by counting votes might seem a simple straightforward matter. In practice it is complex and difficult. For the endeavor to begin, the basic goal must have general, or at least majority support; so must follow-on subsidiary or implementing goals and activities. Performance must give acceptable

evidence that goals are being adhered to and a satisfactory rate of progress maintained. Unfortunately, the large complex endeavor does not lend itself to the same sort of accounting in this regard as routine endeavors. You often cannot point to a series of accomplishments that can be measured in dollar-cents or other mechanistic terms. In detailing progress under a Marshall Plan what value do you attach to the reversal of the tide that seemed likely to produce a communist victory in the Italian elections of 1948? For a Point Four Program, what worth do you assign to the fact that during a given fiscal year not one of the newly indepedent states of the world adopted the Soviet system and joined the communist camp? How do you measure the checking of soil erosion in a Tennessee Valley or the virtual disappearance of pellagra?

For a technologically oriented endeavor like the space program, there are certain concrete things that can be pointed to each year, for example, in 1967, we successfully flew 20 out of 22 missions including small reentry tests, an orbiting biological laboratory, three operational weather satellites, six automated lunar missions, a probe to the planet Venus, and the first all-up Saturn V test flight; or in 1968 that we completed the automated phase of lunar exploration, man-rated the Apollo Lunar Module and are preparing for the first manned Apollo flight in earth orbit in the redesigned Command Module. But a vast number of things cannot be put in concrete terms. What of the knowledge we have gained as to what

happens to the human being under varying conditions of stress? We are finding out more and more about almost every conceivable use of energy; about the nature of materials; we have learned how to use simulation on a scale and over a range of activities never dreamed of before; we are carrying out studies regarding extra-terrestrial life that seem likely to explain at long last the mystery of the origins of life on this planet.

How do you measure these accomplishments? Or on another side, how are we to weigh the performance that enabled us to deflate the skillfully employed bluster of Khrushchev over Soviet space superiority?

A vote in support of goals is not a one shot, over and done with affair. Votes must be counted again and again, almost continuously in fact. Moreover, the criteria by which goals and performance against goals are judged are highly variable, in more or less constant flux in fact. A single failure in the conduct of operations can bring a clamor for change in direction. An internal conflict; claims and charges of a disgruntled individual or group from within the operation; an action of a powerful interest group; a miscue in the information-media field; any one of these or other untoward circumstances can lead to the same results.

A partial success for the endeavor, one that "takes the heat off," so to speak, may also significantly affect voter attitude. Meanwhile, basic standards being applied to the endeavor and its goals and performance may be altered by events and developments in

outside fields of activities, as for example, a prolonged foreign affairs crisis; a change in the general economic situation; loss of a powerful congressional leader; a domestic crisis or disaster; a struggle for control over a labor union; a shift in the political balance; the build up of pressures for some other large, complex and costly undertakings; and on and on.

Then there is the most fundamental thing of all: The public mood--the basic attitude of the people toward the goals being sought through the endeavor and the resulting effects. To gain and sustain popular support of a large and costly endeavor is an extremely delicate and complicated business, and particularly since only in the rarest of instances can direct personal benefit result. Moreover, as endeavors become more and more complex, a greater and greater degree of confidence and trust is required of people to vote and keep voting their support.

In practical terms, what does getting the votes required for both continuing policy support and continuing resources support of a large, complex endeavor involve? Can the executive in charge simply point to his "mandate" to do a good job and demand that he be given what he needs to carry on with it to completion? The executive who stands too firm in this posture is almost certain to fail, and the job with him. The sophisticated might say that the executive who makes adjustments is little better off, since he

becomes a bargainer likely to compromise away the essence of the endeavor. But while this may be true, it should not be true. An executive can practice the art of the possible, or the best possible. When he has to adjust to a change in the environment in which he is operating, he must seek to limit his adjustment to the highest common denominator in the changed environment and refuse to accept the lowest. Whether he succeeds in this is the test of the successful manager of a large scale endeavor, a test of his ability to follow sound practice even though he has to depart from established doctrine.

An important example will illustrate the point: When the Marshall Plan was launched, the leadership of the Republican Congress insisted on a Republican administrator for the recovery program. The object was to establish congressional (i.e. Republican) control over the entire endeavor. President Truman, as President, could not permit the loss of control over a matter so central to the nation's foreign policy. Yet, he had to have Republican support or accept failure of the endeavor. The solution was a series of intricate moves and arrangements whereby Republican Paul Hoffman was named head of the Marshall program but the money and the power were channeled through the President, thus insuring that this important endeavor would be responsive to its true head, the President and executive branch of the government.

What I am saying is what I emphasized so strongly last week. The environment is a part of the large scale endeavor. Where the routine endeavor is influenced by its environment and acts upon its environment, the environment is integral with a large scale endeavor. Basic goals are a product of the environment. Basic goals, subordinate goals, and operating goals must be constantly adjusted to take care of changes and turbulence in the environment. Feedback of information, of signals of all sorts, from the environment must be constant, sure, and on a real-time basis. The course of a large, complex endeavor cannot be set and corrected by "flying by the seat of your pants." It not only must have an effective feedback system, it also must be internally so designed as to be able to make corrections in course and adjustments in performance as work progresses.

The voting process is basically an expression of will. It represents a decision favorable or unfavorable to some line of action. It determines at any given time what we as a nation are willing to do and what we are not willing to do. It is a dynamic proving ground for our national goals--all of our national goals, great and small.

It has been rightly said that the paramount goal of the American people was set long ago in the Declaration of Independence and that it is "to guard the rights of the individual, to ensure his development, and to enlarge his opportunity." But this goal, universal as has been its acceptance among us, has been a living vital force in

our society only to the extent that we have voted over time for particular steps and particular measures to fulfill its vision. Our forefathers set the goal, but we of successive generations have had and continue to have the responsibility for giving it meaning in our time.

The President's Commission on National Goals, which in 1960 so simply and yet so eloquently pinpointed this most basic of our national goals, saw us as still being tested by the mighty vision it represented. "Our enduring aim," the Commission's Report stated, "is to build a nation and to help build a world in which every human being shall be free to develop his capabilities to the fullest. We must rededicate ourselves to this principle and thereby strengthen its appeal to a world in political, social, economic, and technological revolution. In the 1960's every American is summoned to extraordinary personal responsibility, sustained effort, and sacrifice."

We no longer have the great advancing western frontier from the mastery of which we drew such massive strength and vitality. But we do have a far vaster frontier on which we can draw in the future: the frontier of new knowledge. If we are to fulfill our destined role in a world in revolution, it is essential that we constantly find better ways to spread our most difficult problems over the largest possible number of able minds, and to generate the kind of creative thought processes and experimental procedures and systems that have enabled us to make such striking progress in particular areas such as space.

What we are doing in space and what we must do to perform other of the trying and demanding tasks that lie ahead is to bring into being new capabilities. Down through the course of history, the mastery of a new environment, of a major technology, or of the combination of the two as we now see in space, has had profound effects on the future of nations; on their relative strength and security; on the relations with one another; on their internal economic, social and political affairs; and on the concepts of reality held by their prople. From the elements of each such new situation which history records have followed many of the greatest strides of nations and of man.

I believe that our accomplishments in space and in other of our large endeavors have laid a foundation on which we can usher in a new era of advances. I believe this primarily because among those accomplishments has been a fundamental improvement in man's ability to do research and to use knowledge. These include the new ways in which large-scale organized efforts are managed; the encouragement of multi-disciplinary effort not only among the scientific disciplines, but involving engineering and the social sciences; the new techniques and tools for the conduct of research, and the manner in which these are applied to the solution of age-old scientific, social, and technical problems.

These and similar accomplishments fortify, I believe, the faith voiced by the President's Commission on National Goals in 1960: "To preserve and enlarge our own liberties, to meet a deadly menace, and to extend the area of freedom throughout the world; these are high and difficult goals. Yet our past performance justifies confidence that they can be achieved. . ."

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REFLECTIONS ON GOVERNMENT SERVICE

III. Executive Performance and Its Evaluation

by

James E. Webb
Administrator
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Third of Three Lectures Presented in the
McKinsey Foundation Lecture Series

at the

Graduate School of Business
Columbia University
New York, New York

May 16, 1968

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The myth that management as a science -- "appears to have dropped out of nowhere" and to quickly rise to the status of "a new basic institution" -- is not new at all. ". . . it is," Jay asserts, "a very ancient art. . . . The new science of management is in fact only a continuation of the old art of government. . ."

Two things surprise me about Jay's book and its reception. The book, in all fairness, is quite intriguing and well worth reading. Nevertheless, it is strange that anyone in 1968 should view a close kinship between effective management and effective government as novel or as a discovery. Further, I have difficulty with Jay's suggestion that successful management is, after all, only successful politics.

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A better way of looking at the matter is that good management is, and always has been, one of the most fundamental requisites of good politics or good government.

Down through the years there have been any number of notable political figures who, beyond a momentary brilliant flash, left little mark on their times, much less on the times of future generations. On the other hand, less striking figures have often made deep and lasting impressions. The difference in many cases seems to be in how well and how effectively the personages in question organized and managed the affairs with which they were concerned.

William the Conqueror, who bears much of the burden of Jay's argument, was far less brilliant as a military strategist, far less of a conqueror, far less of a kingly personality, than any number of those who came before and after him. But he surpassed the others as an organizer and as a manager. He demonstrated this in his inherited Normandy and later in conquered England.

Machiavelli's Prince, if he existed at all, was but one of a number of princes of Italy, only one of a much larger group in Europe. He stood out, even as embellished by Machiavelli, only because of the superior management and organizing qualities attributed to him.

As we in our own time turn toward the use of larger and larger aggregations of power and commit larger and larger fractions of our resources to the accomplishments of great tasks, our own experiences

show that we must have ready and available for use organized ways to insure good and sound management of these enterprises. Complex large scale undertakings cannot be handled ad hoc or haphazardly. The costs are too great, the stakes too high, and the consequences of failure too dangerous.

Professor John Turkevich of Princeton wrote in the April 1966 issue of Foreign Affairs that, "The incorporation of science and technology into society is crucially important to the welfare of the modern state. The military and economic importance of technological developments, their limitless possibilities for good and evil, the inexhaustible demands for funds from the national economy, require immense organization -- for gathering significant information, for making policy decisions, for planning programs, for allocating manpower, for conducting basic research, and for assigning priorities to development and production."

Turkevich was referring to giant enterprises. We here are also speaking of giant enterprises. The NASA program at its peak level has required the service of over 400,000 full time workers in and out of government. Most of these are highly skilled. Many have a high degree of scientific and technical competence. This represents an enormous concentration of human resources. NASA's research and development effort has involved 20,000 contractors, subcontractors, and suppliers within the nation's industrial establishment. Our construction of ground facilities utilized 40,000 workers. We have

spread scientific, technical, and related work among more than one hundred fifty of the universities in this country. Some 8,000 NASA supported professors, research scientists, technicians, laboratory workers, and graduate students are seeking an extension of basic scientific knowledge. We have worked with new and old urban communities to solve problems brought into being in connection with the NASA program. We have had to reclaim wasteland, to construct test stands and buildings of a size and with properties without precedent, to develop new means of transporting huge structures, to carry computer software and hardware to new levels, to work with great industries to bring into being new lines of activity.

NASA, I am convinced, will not be viewed in history as something unique. Instead it is likely to prove a prototype. How, otherwise, can we feel assurance that we can meet the problems of the future, of such areas as a growing water shortage and water pollution? How can we make the oceans better serve a world struggling for more food and other vital resources? How can we meet the other problems of an urbanized society?

An ability to use large scale endeavors when needed is certainly one of the great requirements of our times. To learn how to use them well is a continuing challenge. The essence comes down to extending good management -- sound, effective, and complete management -- into a new and extremely complex dimension.

The problem of management effectiveness naturally begins, and is most acute, in the higher echelons. The executive charged with leadership and the conduct of a large scale endeavor has far ranging responsibilities. He is the main point of impact in the relationship between the endeavor and its environment: In a very real sense he has to represent the environmental factor -- in concrete terms, the Administration in all its facets, the Congress, and the public itself -- within the endeavor; he has to make sure that the endeavor's goals and activities, in all their aspects, are responsive to the requirements and desires of the environment, and under conditions of rapid change and great uncertainty. On the other hand, he represents the endeavor as against the environment. He has ultimate responsibility for securing from the environment the support necessary for gaining and sustaining momentum, for safeguarding against disfunctional forces seeking control and influence, for -- in short -- keeping the endeavor viable and on course toward its goals. He can do none of these outside tasks alone. He must bind associates to his objectives and to his team with bands of steel even though they can hardly understand all the forces that are at work. Meanwhile, the chief executive has to see to it that performance within the endeavor is as it ought to be: that resources are well and efficiently used and that the assigned jobs and tasks are done, and well done, when they should be done.

How can society find executives capable of successfully organizing and managing this kind of large scale endeavor and doing it so as to add strength to our related economic, social, and political institutions?

One thing is sure: we cannot look to any stereotype. At one time we thought we could. Calvin Coolidge reflected a widespread view when he said that "The business of America is business." The prevalent attitude then was that if the government faced a big and complex job, it should turn to those experienced in "getting things done." The "man who has met a payroll" was the obvious candidate. But by now we have learned that membership in a successful business team, even in very big business, is no guarantee of individual success in a large, complex governmental or semi-public undertaking. I say this in no derogatory sense. I say it because of the obvious fact that these undertakings are different from practically all business undertakings. Some business enterprises, and particularly at their creative stage, are themselves large scale endeavors. But many business enterprises are, or tend to become, in some aspects routine. This is so even when they may be staggeringly big.

William S. Knudsen had had a brilliant career in business when he took over the job of directing our industrial mobilization for war in 1941. I well remember the general relief and satisfaction that greeted his appointment. But Knudsen found the requirements of this large and complex undertaking beyond the areas of his experience. And no one has to search far to recall other such situations. There are, of course, examples of great success. Men of the business world have often done extremely well as leaders of special, complex public enterprises. But so have men of other callings.

David Lilienthal was a thirty-four year old lawyer when he became chairman of the Tennessee Valley Authority. General Leslie Groves of the Manhattan District was a professional soldier. Leon Henderson who did what was considered "impossible" with OPA had been a college professor and professional economist.

What is it that has made some men successful in managing large scale endeavors while others with equally impressive backgrounds have fallen short? Has it been some sort of special genius, or has it been a certain way of doing things? This is an extremely important question for research if we are to develop an "organized way" to put to use the large scale approach on urgent problems as we go forward into the future. If success is found to be dependent on the accident of genius, it would mean that an important degree of uncertainty is built into the large scale approach. We would have to ask: How can we ever be sure that a person with the right kind and the right degree of genius will show up at the right time and place? If, on the other hand, the issue is a <u>way</u> of doing things we have an entirely different situation.

We have, as yet, no sure way to figure out what makes genius or how to create it. But we can study the way things get done; we can learn what is distinctive about ways that lead to success; we can systematize them and we can repeat them in an experimental pattern.

Since these McKinsey lectures are intended to reflect my own experiences, and since over the past seven years I have been engaged in administering a large, complex enterprise, I feel that it may be helpful to take a look at some of the things my senior associates and I have done, or tried to do, or failed to do in NASA.

When I was invited to become Administrator of NASA in February 1961, my first answer to Vice President Johnson and President Kennedy was that I was not the right man for the job. This was not a matter of modesty. I would not have had the same hesitation about some other equally responsible task that was not so heavily concerned with the intricacies of advanced scientific knowledge and advanced technology. I had long been interested in science and technology; I had been directly concerned with its industrial application; I had devoted considerable effort and attention to more effective education in these fields. Nevertheless, I was not anxious to assume the responsibility for making the decisions and guiding the actions required in the newly formed NASA.

Nevertheless, both Vice President Johnson and President Kennedy insisted that I take the Administrator's job. This vote of confidence did not change my appraisal of the difficulties of the undertaking. I knew they were still there, and I knew I would have to find a way to overcome them. President Kennedy's view was that the job was not one for a scientist or engineer, but for someone experienced in the broadest aspects of national and international policy.

My first decision was to ask President Kennedy to ratify the appointment of Dr. Hugh Dryden as Deputy Administrator. Dr. Dryden and I then decided to ask Dr. Robert C. Seamans, Jr., to remain as Associate Administrator with responsibility as general manager of operations. My thought was not that I could thus effect a smooth transition during which I could "learn the ropes." I knew Dr. Dryden and Dr. Seamans to be broad-guage men of proven worth and with experience in several areas basic to NASA's needs. I felt we could develop work habits that would enable each of us to help the other two grasp the totality of the whole job that NASA had to do and that we could then proceed to do it together.

Dr. Dryden, Dr. Seamans, and I immediately set to work to end the uncertainty that had prevailed for several months, to make clear our support for the manned space flight program, to define necessary additions to the budget (for Fiscal Year 1962) that had already been sent to Congress by the outgoing administration, and to establish personal and official relationships conducive to effective group leadership. The three of us decided <u>together</u> that the basis of our relationship should be an understanding that we would hammer out the hard decisions <u>together</u> and that each would undertake those segments of responsibility for which he was best qualified. In effect, we formed an informal partnership within which all major policies and programs became our joint responsibility, but with the execution of each policy and program undertaken by just one of us. This meant

that everyone in and out of the Agency knew all three of us would certainly be involved in major decisions; that with policy established, the orders for its execution could be issued by any one of us; and that, while NASA had an Administrator as a single point of final decision, to the fullest extent possible, we would act together. From my point of view, and I believe also from that of Dr. Dryden and Dr. Seamans, this was a most happy and productive relationship. In every major matter, we worked intimately together to establish a sound foundation for our policies and actions. Each of us helped to bring capable and valued associates into positions of responsibility. When one of us found the burden of his work too heavy, the others stepped forward to share it.

One of the important benefits from this arrangement was that it enabled us to lay out our plan of organization and administration for the initial period so as to enable Dr. Seamans to maintain a single point of close control over the Agency's resources; and so that major personal contacts between senior officials in Headquarters and in our decentralized Centers would run directly through his office or be subject to his supervision. At that time with quite a few strong-minded individuals already established in important places both in and outside NASA, it was important that his central position as general manager of our activities be clearly understood and his effectiveness in that position assured. Since he, Dr. Dryden, and I were in constant contact,

the three of us viewed this arrangement as the best way to provide a single official and personal focal point for execution of our joint decisions. This way we could take all actions necessary to make sure that basic research and the resource base of the Agency would keep step with the expanding development programs. This way the three of us could participate directly (without an intervening layer of management) to ensure a continuing evaluation of the performance and growth potential of our senior personnel.

An additional purpose was to create the kind of flexible organizational and administrative framework within which the procedures used and the responsibilities, even of quite senior officials, could be readjusted without embarrassment, or great difficulty, or major internal struggles. We wanted to begin our expansion in an environment within which people would not be frozen into rigid assignments, and through which the three of us could take a series of actions to foster an atmosphere at senior management levels of readiness to accept change in organization and duties.

Our initial purpose was to maintain this fluid status until we could form our judgments as to the capability of the men on whom the major responsibilities would rest and had stablized a pattern that would enable us to make a proper division of the workload. We wanted enough time, in a quite fluid state, to make a more permanent match of the men with the work assignments, which were themsleves rapidly expanding.

Our concern was born of a very pressing consideration. We knew that our effectiveness at the Administrator's level was dependent upon the effectiveness of key executives throughout the operation, and we wanted to maximize their effectiveness from the very first.

This brings us to a key area in the management of a large scale endeavor: the all important area of the executive within the organization.

To say that the higher levels of an organization are dependent on the lower levels is to belabor the obvious. But obvious or not, it is frequently too little emphasized. Key executives within an organization have to see to carrying out the policies and decisions from above. They have to complement and supplement these on their own. They have to provide feedback and judgments.

If the executives down the line are good at all aspects of their jobs, the chances are that the endeavor will succeed. If one or more is deficient and remains in place, the endeavor may have difficulty. If many are deficient, or even merely adequate, the endeavor may be in real trouble. This is true in today's world for any operation of any size -- public or private, product-oriented or service-oriented, routine or special. It is particularly true for the large endeavor which is so complex that those at the top cannot have detailed knowledge and expertise, or be in a position to keep abreast of many

facets of the operation. Furthermore, the large scale endeavor is particularly subject to unpredictable forces and newly seen opportunities. The main task of leadership is one of continually organizing and reorganizing, directing and redirecting diverse human and material resources and complex activities under fluid conditions. The process of management in the large scale endeavor becomes that of fusing at many levels a large number of forces, some countervailing, into a cohesive but essentially unstable whole and keeping it in motion in a desired direction.

Executives within such a large scale endeavor have to be different. They cannot function in accord with the simplified scheme of traditional enterprises. Take, for example, such traditional principles as "well defined areas of authority and responsibility;" "unity of command;" "one man, one boss;" "unity of direction;" "one objective, one plan;" "compensation commensurate with contribution;" "centralized operations;" the "Scalar" unbroken line of command; "a place for everything and everyone, and everything and everyone in its place;" "stability of tenure, no unnecessary turnover." Such principles might work well for the static organization, but more is needed for the dynamism required for a successful large scale endeavor. The executive trained only in such traditional principles, able to operate only in accord with them, and uncomfortable in their absence would be of little use and could expect little satisfaction in a large complex endeavor. So

too, in all frankness, would the executive who has to be psychologically coddled in the fashion that the participative school of management advocates.

In the large scale endeavor we have to have a special sort of man for key executive positions: one knowledgeable in sound management doctrine and practice, but who can do a job without an exact definition of what it is or how it should be done; one who can work effectively when lines of command crisscross and move in several directions rather than straight up and down; one who has, and is himself, several bosses at the same time; one who can work effectively in an unstable environment; who can live with uncertainty and a high degree of personal insecurity; one who can make do with less of a monetary reward than he could insist on elsewhere; one who can blend public and private interests in organized participation to the benefit of both.

More than anything else the executives within a large scale endeavor must be able, one-by-one and together, to see and to understand the totality of the job the endeavor is designed to do. Each must see and understand the relationship of his evolving and changing individual assignment, and of the functions and people involved in that assignment, to the whole job and its requirements. This involves more than knowing his place and his responsibilities within the organization itself; or knowing the organization "upside

down." It involves an awareness of the relationship between the total job as it exists at that time and his own particular job within the total, including the elements of the environment which are so much a part of the total. He must be able and willing to adjust his own work and the work of those associated with him to the needs of the totality. He must be able and willing to forego use of his position for "hobby-shopping" in accord with his own interests and his own individual judgments as to what is "most important." He must be willing, when necessary to get the total job done, to assume responsibility for decisions and judgment of others, even when he would have it otherwise. He must, in short, perform 100 percent of what is needed and expected of him, not 100 percent of what he may feel he should do, could best do, or would like to do. At the same time, and despite a seeming contradiction, he must know when to make an exception to limitations that formalistic requirements have placed on him, and individually or with others to generate "pressure" for a change in course, an advance, or to overcome a difficulty that otherwise would limit progress.

How does society find executives of the type needed in large scale endeavors and provide management of the kind that will encourage them to do not only their own jobs well but contribute to the dynamism so necessary for the whole undertaking? How do you judge an executive's performance; whether he is a source of great strength, a liability, or only adequate? How do you select from among executives those to be

entrusted with greater responsibility? How do you insure that your management system will prepare executives for larger responsibilities? What criteria do you use to "select out" executives who are deficient or show insufficient promise? How do you get rid of an executive you cannot fit in? These are very basic questions. Where are the answers? Does management doctrine suggest the answers? We have to say: "no." Even with routine endeavors, doctrine backs off where such key executive problems arise. Its standardized guides involving such things as "experience profiles," "matching the man and the job," and evaluation by "return on investment," etc. are inadequate for the large, complex endeavor.

My own experience is that just as the large scale endeavor requires executives of an unusual type, it must be so internally designed and structured as to enable executives to perform in an unusual way. When I took the oath of office as Administrator of NASA, I stated to the assembled officials that my purpose would be to work toward an environment within which the Agency could be as innovative in the management of all its activities as it was in its scientific and technical work.

If the organizational framework in which executives are fitted is rigid, the executives can hardly be flexible. Since the endeavor itself must be able to maneuver in a turbulent atmosphere and to maintain its flying speed when buffeting is severe, the elements that make up the endeavor must in their turn be responsive to quite flexible controls.

This is not to say that the formal organizational structure and standard operating procedures are unimportant in a large scale endeavor. New and disparate as are the interests and activities in NASA, the elements of our organization chart are not greatly different from those of other endeavors. We have an Office of the Administrator with appropriate elements, including an Executive Secretariat; we have a central staff set up by functional specialties such as policy and planning, external affairs, legislative affairs, and international affairs; and we have an Office of Organization and Management that includes offices for industry affairs, university affairs, controllership and budget, personnel management, and audit and inspection. All three of these are grouped under senior executives who guide and represent the integrated interests of their respective sectors of the organization. We have four separate program offices where the planning, direction, and control of our research and mission activities are centered. Each program office is specialized, but covers a broad area: Research and Technology, Manned Space Flight, Science and Applications, and Tracking and Data Acquisition. These offices also have major responsibility for the utilization of our geographically dispersed research and development centers and field stations where 30,000 of our 32,000 civil service employees work and our $4 billion capital plant is located.

Every executive in the Agency has a place on the appropriate organization chart, which shows his superiors, his subordinates, and the place his functions, responsibility, and authority occupy in the total of the Agency. Management instructions are issued regularly to designate the methods and procedures whereby executives function on specific matters. In NASA, a large area of authority is placed on the Administrator by law, but wherever and whenever possible, it is my policy to delegate to an appropriate executive the power and authority to take action, on his own authority or under my own. In the latter category, it is his additional responsibility to insure an adequate feedback to me as to how he is using his delegated power.

We all know that even top level executives have to conform to "checks and balances" that are required throughout an organization. They must make formal reports; provide information about activities and the operations on a regularized basis; conform to established reviewing and clearance procedures; share in various group activities; submit to internal audits; and in a public endeavor subject themselves and their operations to procedures required by the Bureau of the Budget, the Civil Service Commission, the General Accounting Office, Congressional committees, special data collection agencies, and interagency coordinating groups. In the fast-moving areas requiring real-time decision making, as in the case of an abort action if a spacecraft fails to achieve orbital speed, we in NASA combine much

of this "check and balance" concept into what we call "over-the-shoulder supervision." However, it is more than that. It is a kind of participative and collaborative judgment-forming process with up to four levels of hierarchical authority involved, frequently in a simultaneous effort to draw valid conclusions from a large body of complex incoming information.

I have known executives who chafe at these kinds of requirements on grounds that they represent "red tape," take too much of their time, and "dilute" their capacity to make the "main effort." I have also noted Behavioralist studies that show middle executives generally anxious to be relieved of "red tape" controls, requirements for reports, and other such things in order to concentrate full time on "constructive" elements of their jobs, and on which they expect to be primarily judged. The large complex endeavor cannot allow the executive such freedom and personal choice as to which parts of the job he will not be bothered with. Activities that may seem to one person as routine are as essential to his effectiveness as many other more appealing activities. As much as anything else, work habits on ordinary day-to-day matters frequently make or break an endeavor.

A harsh case in point, as seen by hindsight, was the tragic fire at Cape Kennedy in January 1967. Within our feedback system and at several executive levels certain trouble signals for the Apollo capsule development and test effort began to appear. But none of these was so strong as to be singled out and acted upon as vigorously

as they should have been. Everyone felt sure our research and development system and that tried by our contractors had solved worse problems before. No need was felt to feed these into the mainstream of Agency decision making in such a way that corrective measures would be insured. Many actions were being taken every day in the steady stream of decisions and problem-solving required for a complex development project and the nature or severity of these signals did not seem very different from the others flowing in the system. Our project managers had almost always handled such matters in the past. The result was a great failure, and a very costly failure. Its origins lay not in the lack of creativeness or brilliant insight on the part of our engineers, project managers, and executives, or in an inability on their part to do all of the things required for success. The shortfall was in the area of management supervision and insistence on the full dedication of all of them to making every part of the prescribed system work, with exceptions fully evaluated, approved, and put into effect only in the prescribed ways.

Professor James Fesler of Yale University in the letter I read from in my first lecture remarked that while "older doctrines seemed oriented to a stress on orderliness and stability, an important new emphasis is on how to organize, staff, and design procedures that will foster innovation; the supposition is that innovation is a more important goal than the stability that is instrumented by the kind of bureaucracy sought by traditional doctrine."

As I read the management literature of today, it seems to me that a common fault results from an either/or complex. Why is it necessary to have a conflict, such as Professor Fesler describes, between "orderliness and stability" on the one side, and "procedures that will foster innovation" on the other? In the large scale endeavor we must have, as I have emphasized, the orderliness and stability necessary for exactness and continuity in operations; we cannot have key executives going off in directions of their own choosing and making their own rules as they go along. On the other hand, we must have work habits and procedures that will foster innovation, for without innovation we cannot possibly organize ourselves to accomplish these large, complex, and demanding jobs. In both the areas related to "orderliness" and to "innovation," some combination of leadership evaluation or supervision is a necessity. With skillful inclusion in the system of "self-policing" features, supervision can more nearly take the form of leadership.

It is a little understood fact that in a large, complex developmental endeavor, administrative uncertainty has to be taken into account just as does certainty. No one can know in advance all that will be required either for the whole job or for particular jobs within the whole. We can regularize and thus help make certain a large percentage of it--up to seventy or eighty per cent. But the balance--the remaining twenty to thirty per cent--can only be defined as the job is actually done.

When the NASA program began, we knew many of the research and development needs we would have to meet and had sound ideas as to how to meet them. We knew we had to have a booster with a lifting capability many times that of the largest booster then available. We knew that if we were to send men into space and bring them back safely, we had to have a new kind of spacecraft, one capable of providing its own life support system and one that could re-enter the atmosphere without subjecting the astronauts to higher temperatures and deceleration forces than were known to be safe.

It had to be safely landed and recovered at some pre-arranged target. We knew these and many other things, and the state of our scientific and technological competence was such that we could go ahead and start work on them with assurance that they could be made to work. But there were other things we could not know with any degree of certainty. There were important areas of unpredictability, areas where none of the experience of man could tell us what would be needed or how it could be provided. Yet we had to go ahead despite these uncertainties. The only way we could learn was to do.

What was true of the NASA job as a whole was true of the key jobs within NASA. Seventy to eighty per cent of each job was defineable; twenty to thirty per cent was not. In the area of uncertainty, the executive would have to find his own way. Nobody could tell him precisely what to do; there was no precedent to which he could look; there was a blank area in his job description. This part of the job was up to him. And this part of the job, it goes without saying, was

an all important part. Performance here was the key to the success of the executive. The sum of these parts was also the key to the success of the whole endeavor.

If instead of a manned exploration of the moon, President Kennedy had chosen as the nation's goal the building of a large earth orbiting space station, we could have adjusted the size of that station downward should there be a shortfall in booster thrust. If we had had to make one or more such adjustments, we would have been subjected internally and externally to all kinds of questions and pressures relating to whether the goal of preeminence in space was actually being met. We would have faced a particularly difficult kind of credibility gap in an endeavor whose real purpose was to build a national capability to operate in space and to develop a variety of options, any of which could be utilized by the nation in the event of future need. But the goal chosen by President Kennedy, manned exploration of the moon, required a full and complete success in the development of a booster large enough to do the entire job as well as the spacecraft and operational know-how to send the men out and bring them back. Even a small shortfall in booster performance could only spell failure to meet the goal. There could be no yielding to temptations to downgrade the objective when difficulties in meeting it arose.

Many otherwise thoughtful observers have failed to recognize this important characteristic of the 1961 space decisions and have also failed to recognize that the capability to land men on the moon imposes

the requirement to develop and use energy up to ninety-eight percent of the total required to do any other job in space. The same booster that can take men to the moon and bring them back can put the same class payload into synchronous orbit around the earth -- a particularly difficult but important capability which this nation now has and very likely would not have if any goal short of the moon had been selected in 1961.

The lunar landing goal required us to accept elements of technical uncertainty, but it also gave us assurance that its achievement would eliminate uncertainty as to our national space capability.

In recent years a myth has grown up that with modern management tools -- and particularly those associated with the computer, the techniques of systems analysis, and a "cost effectiveness" approach -- areas of uncertainty can be largely eliminated within even the most complex of undertakings. The assumption behind the myth is that goals and sub-goals, and present and future requirements to meet these lend themselves "to reasonably precise calculation" through the use of such modern tools. Any endeavor, the concept has it, can be cast in the mold of a system of measurable units and dimensions, and into this system all component programs, projects, and activities can be fitted with high precision. Management can then go forward as mainly a mechanistic process rather than as a thoughtful and discretionary function. Given at the top a small team trained in the use of modern scientific management tools, sets of directives

can be worked out which can be carried out by executives up and down the line and will thus insure all needed results, and incidently only needed results.

There can be no doubt that the development of the computer and computer science has enormously increased our capabilities to manage complex things. The oft-abused term "revolution" is applicable here. And the development and refinement of the systems analysis approach, to which the computer has contributed so much, has certainly been significant. Many of our most successful large scale endeavors would not have been possible without these tools. Certainly they have been essential in the management of NASA.

Any idea, however, that these tools can give us a mechanistic way to manage large and complex enterprises is fanciful in the extreme. The fallacy is that the dimensions of a system and its requirements can be determined in advance of a clear understanding of the conditions under which it will have to develop and operate. It leaves out of account the all important environment which is a real part of the endeavor itself. I look back with dismay at what would have been the consequences if NASA had settled upon all the elements of our requirements in space on the basis of the knowledge and understanding we had in the late fifties and early sixties.

To fix upon a course for a large, complex enterprise without providing means to enable adjustments in consequence of turbulence, change and unpredictable quantities in the environment in which it is to go forward would be to court disaster. The French military

establishment determined well in advance of the Second World War the strategic requirements to insure victory, and acted accordingly. It just happened that the war that came did not conform to their calculations.

The executive in charge of a large, complex endeavor must make allowances for the area of the unknown and the indeterminate. In what he himself does he must apply what I have called an "Administrator's Discount." And he must so organize and conduct operations as to make possible a similar allowance on the part of his key executives. He must avoid rigidities in the organizational structure. He must leave to key executives areas of choice and grant them sufficient authority to make the best use of their own judgment and competence in these choice areas. He must allow them opportunities to innovate and improvise. More than that, he must keep them under a judicious level of pressure to develop and employ their capabilities to act on their own. He must devise techniques to help them to see the totality of the job being done and the relationship of their particular jobs to that totality, and then to dig deep down into all their inner resources and to bring those resources to bear in effective ways to help get the big job, the total job, done.

One of the things we must realize is that most executives who fail in key places in a complex endeavor do so because they are unwilling or unable to think through the totality of the job they are expected to do and the actions they must take to succeed.

They sometimes drift into that part they like to do. They often get pulled and hauled around by outside influences, or they become prisoners of people around them whose interests lie with the particular rather than the whole. Sometimes, they simply refuse to believe that anything can be more important than the personal goals they have set up for themselves.

I would say that the greatest part of our management leadership effort in NASA is directed toward helping executives, on the one hand, to learn to act on their own initiative, and, on the other hand, to keep their initiatives within the bounds of the needs and responsibilities of NASA's total job. We seek brilliant executive performance in the conduct of each of our projects and programs. But we do not want brilliance to become an end in itself. We want it to make a one hundred percent contribution to the whole of the endeavor in which we are engaged.

In more concrete terms, we expect the key executive to recognize those decisions he can and should make and to act upon them in consonance with prevailing Agency values, policies, goals, and objectives. Consideration of the primary impact of the decision, the resources required, and like matters is of utmost importance. The <u>way</u> the executive elects to form his decision is critical -- based on his knowledge, consultations with the right senior associates (up, down, and across organizational lines), utilization of unambiguous feedback and reflective consideration of broad sets

of organizational aims. Such decisions as he clearly should pass upward and those that may impact future or higher level decisions should fall in a category where the executive becomes a good staff man -- seeing that a full and complete presentation of the facts, projections, and implications of the decision (as he sees them) is made quickly available to the higher authorities. There should be no effort to insist on his "single preferred approach." A really good executive will learn to organize for, and act upon, such upward-moving matters as a habit of work.

These all important work habits usually become visible early in an executive's career and can serve in some cases to judge his ability to move higher in the organization. How well he draws the dividing line between his prerogatives and his responsibilities to higher authority is one aspect of that undefineable something which separates the outstanding from the good. Another is his ability to accomplish multiple objectives simultaneously, and his ability to organize and train his staff to support such actions.

To get the sort of executive performance you have to have in a complex endeavor like NASA, freedom and individual authority must be placed more on a man than on a "position." Evaluation and supervision must run to the man, not the position. Delegations to a position without regard to who occupies or may occupy it can tear down the best system of checks and balances. The executive must himself merit

a continued delegation and freedom of action. He must maintain the confidence of his superiors through a variety of means. He must demonstrate the ability to deal effectively with a wide variety of people, some of whom are highly skilled scientific, engineering, and administrative specialists. He must be able to work with people scattered geographically and often serving more than one operation and more than one boss. The creation of effective channels of communication under these circumstances is essential for such an executive to keep his responsibilities in hand. He must practice self-discipline and insist on, not just tolerate, the organizational discipline represented by self-policing systems for both the areas of substance and those of administration.

How the executive establishes, maintains, evaluates, and utilizes the feedback from his activities is crucial to the accomplishment of the goals of the large scale endeavor. Mr. John J. Fendrock in the March-April 1968 Harvard Business Review wrote of a sobering case history where key executives failed in their responsibilities. The article, entitled, "Crisis in Conscience at Quasar," illustrates the danger of a feedback system that is not self-policing. The incident dealt with represents something of a nightmare for every chief executive: an incident where trusted associates are so deeply committed to a line of action they have decided upon that they begin to cover up and buy time for a hopeful but increasingly remote solution in order to avoid loss of face in the organization.

In the early days of NASA, Dr. Dryden, Dr. Seamans, and I as its senior management group were determined to build a management system that would emphasize the importance of first-class performance and individual competence at each level of organization. We attached high importance to the development of competence in all phases of administration as well as in the scientific and engineering disciplines, and other specialties. Our policy was to utilize and emphasize patterns of administration that would foster a pervasive development of careful judgment as an almost instinctive approach to important problems by all key personnel.

An illustration of this lies in the important field of contractor selection and procurement procedures. Here, Dr. Dryden, Dr. Seamans, and I determined that we would personally examine, in detail, the results of the work of all Source Evaluation Boards on competitively negotiated contracts that amounted to five million dollars or more. These Boards were required to appear before us personally in a formal setting and make a full and complete presentation of (1) the method chosen to break down for evaluation the contractor proposals, (2) the numerical values which summarized the results achieved in the application of this method, and (3) the judgment of the board on each of the categories of the breakdown. The effect of this systematic approach to a continuous emphasis on the judgment factor has been that for seven years, on innumerable occasions and for extended periods, the three senior officials of NASA have sat side by side and personally

examined in detail, and tested by question and answer, the quality of the individual and collective contributions of the members of these Boards to major decisions affecting the choice of contractors, an area where ninety percent of our resources are expended. We thus formed our own personal judgments, based on a great deal of personal involvement, as to the validity of each Board's findings and of the process itself.

We deeply immersed ourselves on a daily basis in a complete analys s of the main factors, within NASA and at the plants of our contractors, on which our projects depend for success, and the views, approaches, and analytical judgments of our senior personnel. In this process we were able to observe and evaluate how rapidly the organization and its contractors were developing their capabilities, and how effective our effort to get nine-tenths of NASA's work done by contractors was proving. We believe this constant and visible personal contact among NASA's senior officials and other responsible personnel involved in the hard problems and decisions in procurement provided a great deal of stimulation, motivation, and innovation throughout the organization.

The fact that the senior officers of the Agency would take the time to conduct what amounted to a thorough hearing and question-and-answer period on each contractor selection action enabled all levels of management, in Headquarters and in our Centers, to get their questions out on the table before all three of us for debate

and clarification. Another important result was that when the presentation to the three of us was over, everyone involved had a clear understanding of the elements basic to a proper decision and everyone in NASA concerned with the matter was aware of this. The burden then passed to Dryden, Seamans, and myself to make the final decision, and the personnel of the Boards were in a position to form their own judgments as to whether the three of us did in fact arrive at the best decision as indicated by the facts and analysis. An important element of a NASA-wide and pervasive self-policing system was thereby established. This has had an important effect on maintaining high standards throughout the Agency.

One of the things we have felt it most important to do in NASA has been to encourage executive development through constant "upward pressure." We have followed wherever we could the practice of deliberately assigning our executives to jobs outside their normal range of experience and beyond their demonstrated competence. Our object is to challenge under firing-line conditions the ability of the executive to perform at a higher level. Such purposeful shifting of personnel to new and more difficult jobs -- and an often accompanying process of trying out a new organizational concept -- might be characterized as a form of "designed disequilibrium." Through it both weaknesses and strengths in the executive group are surfaced, as are also many organizational deficiencies and needs.

The practice is a tough one. It can be hard on the individual who suddenly finds himself out of a familiar groove in which he has been doing quite well and into a new and trying situation where he has to struggle to keep his head above water. It can also be costly to the Agency in that executives who have been found adequate may be throughly inadequate in the higher job. I believe, however, that these are fair prices to pay for continued development of strengths, for removal of weaknesses, and to identify executives of the highest quality.

The value of such an approach is sufficient in my mind to justify consideration of a system of "selection out" of the lowest ten percent of our 200-odd project managers each year even if they are judged adequate on the present job. Such a process would keep a systematic pressure on the system from the bottom up, forcing identification of the managers capable of handling any complex program, whether the Apollo project, the Manned Space Flight program, or my own job as Administrator.

Another side of the matter is that in a complex endeavor the situation is too fluid to permit the fixation of either jobs or people in jobs. The nature of tasks and demands change too rapidly for a static setup to be effective.

The management structure in NASA is still evolving and will necessarily continue to evolve. For a long time it will remain anything but static. The fact that contracts are administered on

a decentralized basis from widely dispersed Civil Service contract administrative organizations has introduced the requirement that contract officers, supported by professional staffs of attorneys, accountants, auditors, and inspectors, must also work with project managers and large numbers of scientific, engineering, and other technical specialists not under their direct administrative control and vice versa. Further, the necessity of operating a wide variety of complex programs as a coherent whole with internal balance in each has meant the establishment of thorough-going management systems for financial, technical, and schedule reporting with critical-path analysis and configuration control. These systems, as I have said, covered work at one point involving over 400,000 men and women and some 20,000 prime and first- and second-tier subcontractors. The magnitude of this undertaking and the significance of the methods by which the administrative problems were solved, it seems to me, to be more clearly deserving of close study and research.

We have used other devices than those I have mentioned to secure the sort of performance we need from our executives. One I believe particularly worthy of note is the practice of making executives responsible for the presentation of their programs before Congressional Committees. Our practice is for the Administrator to present to the four Congressional committees which must approve our programs the broader aspects of the whole program and the key policy points related to the annual budgets. Program executives and their key

staff personnel then present the detailed program aspects for which they are responsible on a day-to-day basis. We consider that the expertise and effectiveness of these executives in portraying their needs and the results of their operations as well as the relationships between those operations and the total job being done by NASA is the key element in justifying the expenditure of public funds and in Congressional attitudes toward the Agency. We believe the Congress must see these men, must understand how they operate, and have confidence in their abilities as responsible stewards of public funds. And we think this responsible relation between them, in open sessions, and the Members of Congress makes them better executives.

One of the great difficulties about executives in a special complex endeavor is that from the career standpoint its vistas seem limited. The demands on such men are almost unlimited and tend to grow in direct ratio to the man's effort and effectiveness. They can in fact be literally killing. The rewards, on the other hand, are limited. There can be little future in the job, since the whole business often looks toward getting something over and done with. The chances of being weighed and found wanting are great. Meanwhile the type of people we need are naturally in great demand in other areas. They are "premium" people. Evidently few people recognize how much difficulty an agency like NASA has in bringing high-level executive people in from various backgrounds and fitting them into our organization, letting each serve in such a way as to

derive satisfaction while serving the organization and then either remaining or departing depending on his personal desires or performance. Few recognize, for example, the importance of the decision we took and the follow-up management ingenuity that was required to create in our Office of Manned Space Flight a group of men not only dedicated to NASA's program but also who could have the full confidence of the Department of Defense and the Air Force. Similarly, few recognize the importance of our creation, during that same period, of the managerial competence that put into effect the extremely difficult and complex all-up systems test concept that is now showing its value in the successful Apollo flight tests.

Another of the great difficulties in the executive area for a large scale endeavor is that of choosing men of real promise for particular jobs. You cannot use a computer for something like this. You cannot use standardized formulas. When you are looking for special talents you must use special ways to find them. The problem is: what special ways will work? After many years of experience in seeking top flight executives for many difficult tasks, I must confess that I know of no sure way. The best I can offer is a set of principles that add up to a little more than systematized trial and error.

The most important of the things I have learned about the selection of key executives is to find someone fully worthy of trust. If you do not know of such a person yourself, which of course is often the case, turn to someone you do know in whom you have trust to suggest

a person that he knows and in whom he has trust. After that, do as much homework on the man as possible. The most important thing, I believe, is to get as much information as possible as to his character and integrity as well as his experience. This, of course, is basic to the trust you must have in him before an effective working relationship can be established.

Men who have demonstrated great achievements in a solitary field can rarely break out and broaden their vistas. Those who have succeeded at numerous specialties, on the other hand, represent a source of top executive material much more prone to success than the top specialist in his field.

When a replacement is needed, there appears to be little use in attempting to select scientifically an executive through a long period of complex matching and testing schemes. In some of my earlier experience I spent months seeking the "just right" key executive for a job. But I have found that such approaches can be counter-productive. When you put that much effort into a selection and persuasion process and a man fails, you are committed to the man. Furthermore, it seems that the failure rate is not greatly lessened by such an arduous process. Today, I search until I find a man who seems to be qualified and put him immediately to the test. If he works out, fine! If not, I try another.

Reliance must also be placed on a continuing on-job evaluation process. This is true even in the cases of "proven" performers whose success record speaks clearly to all who will observe. It is unfortunate but true that just as men's work and living habits grow and improve and mature as they advance, a point in time all too frequently comes when the tide begins to flow out, when the habits deteriorate or cease growing to meet the changing times.

Management literature details many ways to evaluate performance for the routine-oriented or profit-centered operation. There is much less, however, that fits the requirements of the large scale endeavor in which the job is not easily definable. The profit-center concept can and should be applied to a degree in evaluating any executive, since every executive has a responsibility to get a basic job done which is subject to some measurement of results. Those who cannot produce must be replaced just as an army commander who continually loses too many troops in battle must be replaced. The same goes for the group vice president who cannot match his associates' profit statements. But acceptable or even outstanding performance under this evaluation technique is not enough. We have the much more important matter of an executive's contributions or lack of it to the way new and improved capabilities and effectiveness in his working relationships with those elements in the operation beyond his immediate span of control evolve. This can include customers, the universities, Congress, various Government agencies, industry, and others.

A first step beyond the "profit and loss statement" -- or for NASA the mission success or failure record -- is, of course, evaluation of supporting activities required to achieve these things, i.e., budget performance, production schedules, logistics plans, inventory maintenance, quality control, research emphasis for product improvement and new product development, etc. Areas such as these produce the massive volume of data I spoke of earlier, which in turn feeds the program evaluation and executive evaluation process as well as performing its primary purpose as an essential element of program implementation. How an executive uses this feedback to identify problems, to effect needed shifts in emphasis, to secure improved methods, etc., are, of course, large measures of his capability and are observable in the feedback data itself.

Going further in the evaluation process, greatest importance must be attached to the executive's basic work habits. These are, of course, not amenable to evaluation in quantitative terms nor by a mechanical approach. In this area of evaluation, the very personal, almost intuitive processes come to bear. What is involved is a measurement of differences. In the rigid, hierarchical organization there may be little need for emphasis on this area because in most cases the system prevails and the man conforms or leaves. In the flexible organization subject to the disequilibrium of change and the unpredictability of the future, differences in work habits become highly significant.

The executive in the dynamic situation must rely on his basic capabilities to perform -- he cannot rely on the standardized, time-proved approaches. He therefore exposes his thought processes and his work habits as he searches for needed solutions. Certain fundamentals of organization and procedure also provide continuing opportunities for executive evaluation in these areas of work habits and thought processes. The concept of the central functional staff, which has been long argued regarding organizational efficiency as it pertains to accomplishing the primary job, is first a method to restrict operating arms from becoming too parochial and overlooking second- and third-order benefits. Most importantly, in consideration of the question of executive evaluation, however, the central functional staff forces key executives to seek assistance from beyond their sphere of direct control in order to accomplish their main work effort. And, of course, the executives of both the operating arm and the staff arm must become familiar with the problems and approaches of their opposite numbers. This forced interfacing provides more visibility to the senior management leaders as to the way in which each of the executives is functioning to accomplish his job than is the case when the operating arm possesses all the needed functional staff expertise to accomplish its job autonomously.

The key executive is also subject to evaluation by those beyond the organization with whom he must work. Just as my two senior associates and I observe the functioning of NASA executives at Source

Evaluation Board meetings where we are evaluating the evidence related to large contract awards, various Congressmen, industrialists, and university officials, etc., observe and judge the performance of the three of us and many other NASA executives in a variety of situations in which I and my senior associates can rarely observe them. Their successes, their failures, how they conduct their business, the way they represent the goals of NASA, and the values placed on methods of implementing plans to reach goals are portrayed in these contacts. From these outside observers come impressions that add importantly to the evaluation process, and thus feed-in from these outside sources is an important ingredient of judgment.

What I have so far been addressing is evaluation on the basis of the balance sheet or mechanistic approach, on the one hand, and first and second hand observations on the other. The shortfalls of the former approach for the complex endeavor are obvious, while reliance on observations that depend so much on memory and intuition have been extensively belabored in management literature. There is need therefore for an acceptable compromise or gap filler to fit between the quantitative "results measurement" and the nonquantitative "observational evaluation."

To my mind the complexity, the unavoidable impact, and the broad range of a key executive's job in a large scale endeavor forces the use of and heavy reliance upon the "conventional" interview. If an

administrator is squeamish about expressing judgments regarding his senior associates or to hand out rewards or reprimands, then that administrator should stay away from large scale endeavors. In work of the size and scope and subject to the complexity and unpredictability of such massive undertakings, there can be no substitute for plain talk between the highest executives.

It is my current practice to meet privately once each week with each of NASA's top eight executives for an hour of face-to-face structured discussion which amplifies and expands the feedback process that has been continually going on between us. Inputs from all sources may be brought into focus in these meetings where no holds are barred. There are no intermediaries and no mechanistic approaches with agreed ground rules. There are just two men, each charged with a great deal of responsibility and vested with substantial powers, sitting face-to-face, discussing problems, possible solutions, and how we personally and our other associates are actually performing in light of these. These are not staff meetings; we have staff meetings too. The face-to-face evaluation and discussion meeting is a penetratingly personal confrontation on matters which neither I nor the executive involved would want to bring up in meetings with broader attendance.

One distressing problem in managing key executives in large scale public endeavors comes when a top "career" executive proves inadequate for his current assignment. Not only must the administrator

respect the inherent value of the individual and the value of his prior performance, but he must also consider Civil Service regulations.

In this last regard NASA is the beneficiary of a farsighted provision of the Space Act of 1958. This legislation, as amended, vests in the NASA Administrator the authority to "appoint and fix the compensation of" over four hundred "scientific, engineering, and administrative personnel. . . without regard to /Civil Service/ laws." The Administrator thus not only has a free hand to recruit, appoint, and fix compensation for this number of key executives; he also has unilateral power to dismiss, demote, or transfer those so appointed. The only restrictions relate to veterans preferences which require advanced written notice and justification of any adverse personnel action.

This was a breakthrough in terms of the number of such "excepted positions" made available. It has enabled us to atract and to use as needed specially qualified personnel without which we could not develop and maintain this nation's leadership in aeronautical and space activities. I do not mean to suggest any general opposition to the established Civil Service system. It is, however, necessary to recognize the need of large scale endeavors to have the means to achieve the flexibility in operation that is so urgently required for success. The "excepted position" is such a means which combines the best of the political appointment and the general schedule scructure

without most of the drawbacks of either. Future large scale public endeavors will need this "excepted position" device if the competent men in science, engineering, and administration necessary for success are to be secured from industry and the university campus. Administrators must use the device wisely and as sparingly as possible. They also must avoid systematizing it to a point where control legislation will be invited.

There is another feature of the Space Act of 1958 that I feel has greatly strengthened our capability to secure from the top downward the type of executive leadership and performance that we must have for success in such a large endeavor as the space program. The Act provides for a single Administrator as the final point of decision and responsibility within the Agency and in the Agency's relationships with its environment.

This action of the Congress returned to a basic principle adopted by the Constitutional Convention of 1789. Some delegates to that Convention argued for a collective system for the executive branch, insisting that to entrust vast powers to one man would be a prelude to tyranny. The Convention decided, however, not to repeat the mistake of the Articles of Confederation. It decided upon a President as Chief Executive, and it indicated that departments within the executive branch would be headed by a single "Principal Officer."

A trend away from this principle began with establishment of regulatory and other special agencies in the late nineteenth century. The underlying reasoning was that shared administration as well as regulation is generally considered somehow safer and more trustworthy than administration by one man. You will recall, I am sure, the emphasis given this reasoning when the Atomic Energy Commission was established at the war's end. The atom seemed too powerful an instrument to entrust to a single individual.

The Congress in 1958 felt that the great tasks necessary to achieve U.S. preeminence in space required as efficient and effective an administrative structure as possible. It decided, as had those who drafted the Constitution, that the advantages of one point of final decision outweighed any possible disadvantages, and that our system of checks and balances could be depended upon to prevent abuses.

This has been a most helpful decision for those of us who have had responsibility for the space program. I think it was a very wise decision. The executive working with a large, complex endeavor, whether at the top or in a key position within it, must have for effectiveness the trust and confidence of those for whom he is working -- the President, the Congress, a substantial part of "the public" and his associates. He must be allowed the power to get things done. Decision by committee is under some circumstances a desirable management technique. But for a large scale endeavor where so much is dependent on building and maintaining momentum under conditions of rapid and unpredictable change and great turbulence there must be a single point of final

authority. There should be debate as to course and purposes and ways and means. There must be such debate if the endeavor is to succeed. But when the debate is over and a judgment has been reached someone has to be in a position to act, and act effectively, to implement the decision.

What we have here is a very fundamental thing. I mentioned last week the unease we Americans have always felt in the face of bigness. We have frequently shown distrust of big corporate enterprises. And we constantly voice distrust of big government.

Yet a very simple and basic fact of our life is that we are big. We are a big country; we have big resources at our command; we face big problems and big tasks; we have big opportunities.

Adlai Stevenson spoke of this at a symposium on "Science and Society" which the Xerox Corporation held in 1965. This was, I believe, one of the last major statements Stevenson made before his death. He said that our prowess in science and technology was making the problems and activities with which we are so wrapped up today "irrelevant in the longer run because our economy can grow to meet each new charge made upon it. It will stagnate only if we do not ask enough. This," he added, "is the basic miracle of modern technology. This is why it is, in a real sense, a magic wand which gives us what we desire. Don't let us miss the miracle," he urged, "by underestimating this fabulous new tool. We can have what we want. This is the

astonishing fact of the modern scientific and technological economy. . . This is the new instrument of human betterment that is at our hand if we are ready to take it up."

Stevenson went on to stress, however, that two things are essential if we are to gather the benefits open to us. "The first," he said, "is to recognize that in our modern highly productive market economy, stability and growth depend upon a partnership between management, labor, and government. The second is an end to the quarrel between public and private purposes."

The idea of a conflict between public and private purposes has always struck me as an incongruity in our democracy. It has, however, been a very real thing in our life as a nation. But can we afford to let it continue to be? Instead of concentrating so much of our energies on safeguarding ourselves from ourselves, should we not focus on working out organized ways to do the big things we have to do, organized ways which will have built in safeguards against the possibility of harm to our society?

As I ask this question I sense that I am asking where we are going as a nation, whether we are to amount to new heights or slip into a relentless decline. Here I think we should ponder such thoughts as Dr. Stark Draper passed on to me some time ago. I would like to leave these with you as I conclude the last of these lectures:

"Countries content to maintain static situations that offer no significant challenges may continue to exist without exerting any considerable effort toward improvements. On the other hand, when leadership among well-qualified competitors is involved, the societies concerned must continuously advance the levels of those factors that determine recognition and power on the earth. Unrelenting progress in essential areas is the way of life for any country that aspires to command high levels of respect from friends and enemies. Failure to maintain a competitive state of progess means elimination from the game of political status. Some countries have tried to hold a position of high influence on the basis of an existing but static superior level of ability. The failures of these attempts are recorded many times in the history of mankind. When, for any reasons, a mighty nation has ceased to travel the path of progress, it has always been passed by rivals who continue to strive for advancement in living conditions, economic activity, and military power."

NEWS RELEASE

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Banquet Address
by
James E. Webb, Administrator
National Aeronautics and Space Administration
at the
National Conference of the American Society
for Public Administration
Detroit, Michigan
April 13, 1962

"Administration and the Conquest of Space"

Mr. Chairman, fellow members of the American Society for Public Administration:

A basic principle of our society, and of public administration, is that the substance of a program is its essence, and that administration, though requiring excellence in itself, and though including many specialties of its own, must marry itself to substance at all levels. This principle has been adhered to in the organization of the National Aeronautics and Space Administration. Therefore, my first endeavor today will be to provide an understanding of the nature of NASA's job, its place in the structure of government, and something of its history.

There are at least five characteristics that distinguish NASA's assignment:

1. Space research and exploration has multiple and interrelated objectives. Since the passage of the National Aeronautics and Space Act in 1958, the United States space program has had four general objectives:

a. To study the space environment by scientific instruments of many types. This involves the use of sounding rockets, earth satellites, and deep space probes;

b. To begin the exploration of space and the solar system by man himself;

c. To apply space science and technology to the development of earth satellites for peaceful purposes to promote human welfare; and

d. To apply space science and technology in support of military purposes for national defense and welfare.

These objectives are not only multiple, but also closely interrelated. The rapid development of space science and technology is needed to sow seeds for a harvest of future applications. The weather, communications, and navigation satellites of today grew out of the scientific research of the past decades. Findings from space science are directly related to achievement of a manned lunar landing and return. For example, the distribution of harmful radiation in space, the times of their occurrence, whether or not their presence is predictable, and the influence of magnetic fields in space on the radiation hazard, are all important problems that space science investigations must solve before one can safely proceed to send men for substantial periods of time out into space. Similarly, human investigations and exploration of the surface of the moon will provide data needed in the engineering of lunar landing craft and for planning the actual landing operation.

2. Space research and exploration requires a wide variety of skills and a vast accumulation of facilities and equipment. Representatives from many disciplines, from astronomy to zoology, are required. Facilities running all the way from the two million square foot Michoud fabrication facilities for the assembly of booster stages to environmental facilities required to simulate the hard vacuum and extreme temperature conditions of outer space are needed. These varying and interrelated requirements for personnel and facilities add a significant dimension to the task of organization and management.

3. Long lead times, coupled with a rapidly evolving technology, adds further complexities to the task of organization of human effort for space exploration. A long period of years often must elapse from the conception of a new space experiment until the launch vehicle, the payload, and attendant facilities are designed, engineered, built, tested, launched, and the resulting data analyzed. Meanwhile, the discovery of new knowledge may require substantial alterations. This characteristic of the job places a major emphasis on effectively planning and replanning to assure that what you learn as you go is reflected back into what is going on and what is planned for the future.

4. A high order of reliability is an absolute necessity. Cost, the extensive public attention focused on the program, and the risk of human life creates a demand for a degree of reliability seldom required of industrial contractors. The imaginative concepts of the scientists and engineers and the unique equipment which they are developing, necessitates the provision for testing and retesting of ideas and hardware. In addition, this high degree of reliability must be obtained within much tighter time schedules than has historically been the case in complex research and development undertakings.

5. Space research and exploration must be carried on under the persistent and exacting scrutiny of the public, the Congress, and the scientific community. Space exploration is and will continue to be front page news. Those who carry on these tasks must be prepared not only to do outstanding work, but also to interpret, explain and defend persistently, what they are doing and why they are doing it.

To bring NASA's organization and management concepts into harmony with these characteristics of the job, has been and will continue to be a major task of NASA management.

No new department or agency in the recent history of the Executive Branch of the Federal Government was created through the transfer of as many units from other departments and agencies as in the case of NASA. Three and one-half years ago, NASA did not exist. Today NASA comprises approximately 20,500 employees, ten major field centers, and an annual budget approaching the $2 billion mark.

From a purely organizational and managerial point of view, it might have been much easier to create an entirely new department or agency to handle the Nation's civilian

space program. This possibility, I understand, was explored and rejected because of the time required to recruit and organize the technical and scientific talent required.

The principal nucleus of the new agency was the National Advisory Committee for Aeronautics, with a staff of approximately 8,000 employees and an annual budget of approximately $100 million. The NACA laboratories--Lewis, Ames, and Langley--provided NASA with outstanding research capabilities in the field of aeronautics and space. However, this initial nucleus provided insufficient capability to carry out the space flight development and space science functions.

Early organizational thinking envisioned these functions being carried out primarily in one or more decentralized flight development centers. The nucleus of the first such Center--the Goddard Space Flight Center--came from the Vanguard and Upper Atmosphere Groups of the Office of Naval Research. At the beginning of calendar year 1959 the Jet Propulsion Laboratory, operated under contract with the California Institute of Technology, was transferred to NASA from the Ordnance Corps of the Department of the Army. This Laboratory comprised some 2,800 employees, constituting another Space Flight Center, with primary capabilities and interests in lunar and interplanetary unmanned research projects.

Concurrently with the transfer of the Jet Propulsion Laboratory, it had been proposed to transfer the Development Operations Division of the Army Ballistic Missiles Agency, headed by Dr. von Braun. This would have provided NASA with a much needed capability in the highly complex area of launch vehicle technology. However, the Department of Defense did not agree to the transfer at the time initially planned. The transfer of Dr. von Braun's group, consisting of 4,600 employees, did not take place until July 1, 1960.

Perhaps as importantly as the transfer of the various elements from several different agencies--civilian and military--was the fact that almost all of NASA's space flight development and research projects had already been initiated by predecessor agencies. The man-in-space project, Mercury, was initiated by the Langley Research Center of NACA; the Saturn Launch Vehicle Project by the Advanced Research Projects Agency of the Department of Defense, and the Development Operations Division of the Army Ballistic Missiles Agency; the Centaur Launch Vehicle by the Air Force; and Meteorological Satellite, Tiros I, by the Army Signal Corps.

The size and primary capabilities of the units transferred, their varying institutional backgrounds and basic relationships with their parent organization, status and management of the several projects, and similar factors, had a major influence on NASA's initial organization and methods of operation.

Thus, in three and one-half years, NASA has grown to an agency of 20,500 employees, exclusive of the 3,200 at the Jet Propulsion Laboratory. Of the total of 20,500 civil servants, approximately 16,000 of these were connected with organizations that were transferred intact to NASA.

Appropriations for NASA's work have grown from the base of $100 million required by the NACA in 1958 to an amount approaching two billion dollars for the current fiscal year. NASA's request for funds for the fiscal year beginning July 1 is approximately $3.8 billion.

As you can well appreciate, in light of the characteristics of NASA's job and the manner in which the agency was created, that review and evaluation of the organization structure and management concepts has been a continuous process. This has required a considerable amount of attention and time on the part of NASA's general management since 1958--as it must in developing a new organization to undertake such unprecedented tasks. This is particularly true in developing such as organization from the transfer of large elements from other organizations. There can be no doubt in your minds that this involves problems--problems of melding together several groups with different organizational and managerial backgrounds into a coherent, effectively organized, and directed enterprise. The task in this case is also complicated by the emerging fact that traditional government and corporate forms of organization do not really meet today's needs in large technologically based enterprises such as NASA.

Before turning to some of NASA's current concepts of organization and management, I would like to say that, in my judgment, NASA's goals and objectives have been spelled out by the President and the Congress about as clearly as those of any Federal department or agency. In addition, my first year as Administrator has convinced me that the transfer of various elements of other departments and agencies has been handled in a highly capable manner, and that this phase in NASA's organizational history is effectively behind us. In this respect, I would like to add this one additional comment. The successful creation of

NASA, through the process of the transfer of elements of other departments and agencies, would not have been possible without considerable slippage of on-going work if it had not been for (a) the outstanding calibre of the employees transferred; (b) the preception and adaptability to change of the various leadership elements; and (c) the dedication of both to the tasks in which they were already deeply involved.

Soon after taking office in February, 1961, guided by skill and judgment of NASA's Director of Administration, Mr. Albert Siepert, and Mr. John Young, his Deputy, steps were initiated by Dr. Hugh Dryden, the Deputy Administrator, Dr. Robert Seamans, the Associate Administrator, and myself, to identify the major organizational and management problems NASA's general management should concern itself with over the near term future. This was little more than another step in the continuous process of review and evaluation that had been initiated by Dr. Keith Glennan, NASA's outstandingly capable first Administrator. Our review and evaluation had gotten to the point where we were considering several evolutionary changes in organizational and management concepts when the President recommended the accelerated and expanded space program last Spring. Prior to the President's message, we had begun our study of the steps we would have to take to bring the organization structure, staffing, and management concepts in line with what we anticipated might be a decision to undertake an accelerated and expanded space program. Our study, among other things, included:

1. Setting down a statement of program objectives, major policy assumptions, and management concepts as a basic frame of reference against which NASA's general management might judge various organizational alternatives.

2. We conducted comparative analysis of other experiences, such as the Manhattan Engineering District, Polaris Special Project Office, and Air Force Weapons Systems Management.

3. We developed alternative organizational plans and reviewed these with senior NASA staff and knowledgeable individuals from private life.

After thorough consideration, President Kennedy in May, sent to Congress his recommendation for a program to build the necessary big boosters and step up the program. The Congress completed its authorization of the accelerated and expanded space program in September, 1961. In October, we announced the steps we planned to take to bring NASA's

organization and management concepts in line with this new program. We began detailed implementation of these steps around November 1 of last year. We are still in this process. As I am sure you can understand, it takes considerable time and effort to implement effectively even relatively small changes in large complex enterprises--private or public. I think you will agree that in few cases has so much effective organizational re-alignment taken place in so short a time.

Our current concepts of organization and management fall logically into five areas:

1. Headquarters Program Offices which correspond with each of NASA's four major programs.

2. Center Directors reporting directly to headquarters general management on over-all Center matters, and to headquarters program directors on program development and execution.

3. Single focus for tracking and data acquisition support in headquarters.

4. Provision for integrated launch operations services at the Atlantic and Pacific Missile Ranges to serve all NASA projects.

5. Improved staff services for general management; that is, an Office of Programs and an Office of Administration at headquarters.

It may be useful to explain in some detail our thinking underlying several of these basic concepts; those that I believe would be of most interest to members of ASPA. These are (1) the role of the Headquarters Program Offices; (2) reporting relationships of Center Directors; (3) staff services for general management; and (4) the role of functional managers in the area of administration.

1. Headquarters Program Directors. Program management in NASA involves the planning and direction of an interrelated series of research and development projects designed to achieve one or more of NASA's major objectives; for example, manned space flight, including a lunar landing and return.

Effective November 1, 1961, the primary responsibility for each of NASA's four major programs--Manned Space Flight, Space Sciences, Applications, and Advanced Research and Technology--was assigned to a headquarters program director.

If traditional organization terminology were to be used, the headquarters program directors are responsible for both staff and line functions. A program director has a dual role in which he both advises and operates. He is the principal adviser to the Associate Administrator--"NASA's General Manager"--in regard to his assigned program area. He is also the principal headquarters operating official in regard to management of his assigned program. He directs his assigned program by working directly with Center directors and their project and their project and systems managers. In addition to handling such matters as budgeting and programming of funds and establishing and issuing technical guidelines, each program director is also responsible for providing continuing leadership in external and interagency relationships related to an assigned program.

2. Reporting Relationships of Center Directors: The reorganization of last November provided that the Directors of NASA's research and development centers report directly to the Associate Administrator--"NASA's general manager"--rather than a particular technical program office in headquarters as they had up to that time. This was done in recognition that most of the Centers that had been transferred to NASA were multi-purpose Centers. Although each had a primary orientation (for example, the Jet Propulsion Laboratory in the area of unmanned spacecraft), most had an across-the-board capability that was important to maintain in terms of rapid feedback from one area to another; for example, from applied research in electronics to the design of particular spacecraft instrumentation, such as Ranger.

We explored the feasibility of (a) making NASA's Centers more single purpose and (b) more or less completely self-sufficient. Both of these approaches appeared unrealistic in terms of the effective and rapid use of the resources that had been made available to NASA. Thus, it was on basic considerations of that nature that we determined to have NASA's Centers report to the Associate Administrator and contribute to the various programs on the basis of their available in-house capabilities. This approach also provides opportunities for the Center Directors to have an increased voice in day-to-day policy making and programming decisions.

3. Staff Services for General Management: During the last year, we have taken steps to improve and strengthen the staff services available to general management. This has been done primarily to provide general management with more accurate, complete, and timely information on which to base program policies

and decisions, particularly in terms of ensuring that the interrelationships among the four basic programs are continually being properly adjusted.

These staff services are provided by an Office of Programs and an Office of Administration. These offices in reality have multiple bosses. They are responsible for servicing all three members of general management; Administrator, Deputy Administrator, and the Associate Administrator, and the Headquarters Program Directors. This approach helps to minimize the size of headquarters staff services while at the same time obtaining better intergration of these services throughout NASA. I must, however, be frank on this point. This approach requires a very unique type of individual. Those that are only at ease and secure when they "serve only one boss" are illadapted to provide effective performance on staffs organized in such a manner.

4. Role of Functional Managers in the Area of Administration: Here is another area where, I believe, we are departing somewhat from traditional or classical concepts of organization. The Directors of divisions, headquarters Office of Administration--for example, the Director of Personnel--are NASA's functional managers and specialists for their particular areas. As functional managers, they are responsible to see that their assigned administrative activities are performed throughout NASA in a manner to accomplish NASA's objectives. Here we are directly and consciously departing from traditional line and staff concepts of organization. Functional management, as we perceive it, is a means of optimizing administrative specialization, while at the same time retaining the essential ingredients of traditional line management concepts. It is an effort to cope with the persistent problems we have in modern complex organizations of solving the dilemma between hierarchy and specialization.

The headquarters division directors, Office of Administration, as functional managers, are among other things, responsible for observing and evaluating the manner in which work in his assigned area is carried on throughout NASA. Thus, the division directors share with the Center directors the responsibility for performance of administrative elements within the Center. The administrative elements in the Center do in fact have two bosses. This concept places a premium on competent leadership in the headquarters Administrative Divisions. There is no escape into the jargon "that I am only a staff man, but they don't take my advice." The functional manager approach places a premium on people

who can operate on the basis of competence and confidence in relationship to Center Director and Center administrative elements rather than on traditional authority concepts; i.e., "I have the right to issue directives and you have the obligation to carry them out."

These, then, are some of the basic concepts that underlie the present organizatien and management of NASA and the civilian space program. In some areas, we believe we are beginning to plow new ground. However, in light of the unprecendented nature of NASA's job, and its distinctive characteristics, we must do more. We must continually, vigorously, and intelligently seek better answers to the organization and management of a large technological enterprise such as NASA. Some of the major areas of continuing administration present a challenge that we in NASA must address ourselves to in the days ahead. These include:

1. Finding ways of maintaining an imaginative, inquisitive, and open mind on the part of both scientific, technical, and administrative staffs in seeking and implementing viable organizational arrangements and management concepts in keeping with the ever changing nature of the NASA job. I believe to date we have been highly successful in adapting our managerial arrangements to such basic influencing factors as (a) the changing nature of the program's objectives and scope as influenced by the results of completed research and development, (b) changes in emphasis and timing based on decisions of the President and the Congress, and (c) lessons learned from day-to-day management as to the concepts which have worked and those that did not.

As organizations grow to maturity, they have a tendency to become much less flexible in their managerial thinking. To prevent this from happening is a major challenge to general management in technologically-based organizations such as NASA, and will present one of the continuing challenges in the administration of the civilian space program.

2. Obtaining a better and broader based understanding of the civilian space program is another significant area of challenge. Here I am particularly concerned with obtaining an understanding of the close complimentary and supporting interrelationships among the four major elements of the civilian space program--manned space flight, space sciences, practical applications, and advanced research and technology. Without adequate understanding and support for the space

science and advanced research and technology elements, the other two elements--manned space flight and applications--will not be able to sustain their present rate of progress over the long run. We continually have a tendency to outstrip our reservoir of basic knowledge required for successful manned space flight and applications in such areas as meteorology and communications.

3. A third area of continuing administrative challenge involves obtaining and retaining in the Government laboratories competent scientific and engineering personnel required to plan, select and execute the more important space flight missions and research tasks. This task of making basic determinations of what explorations shall be undertaken and supported at the taxpayers' expense is a governmental function that we do not feel it proper to contract out. In addition, NASA must retain outstanding technical leadership to ensure that contractors are provided with sufficiently definitive requirements to submit proposals and produce end items that meet the reliability and schedule requirements of the NASA program. To maintain a high calibre staff in the laboratories means that opportunities must be provided for in-house personnel to personally participate in a certain amount of the most advanced research and development.

NASA now has these capabilities in terms of the personnel transferred from other elements of the Executive Branch, and from personnel added to the group from both public and private research and development undertakings. Our recent recruiting efforts for technical and scientific personnel have gone very well. The President's pay proposals, if approved by the Congress, will be of great aid in retaining the technical and scientific staffs already at work. However, we in NASA must be continually alert and imaginative in retaining the type of permissive and intellectual environment that outstanding people require. This, in my judgment, presents a much greater challenge than even that of obtaining an adequate salary structure.

4. The fourth and last area of administrative challenge I would like to touch on briefly, concerns NASA-contractor relationships. Here, I believe, we in NASA, in conjunction with other agencies, such as the Department of Defense and the Atomic Energy Commission, and working with industry must find more effective (a) means of selecting research and development contractors, (b) evaluating their performance, and (c) providing economic incentives based on performance. I am particularly

concerned that our present policies and processes unnecessarily require large expenditures of our top scientific and technical personnel, both governmental and industrial, without compensatory advantages.

In summary, I would like to say this. In my judgment, NASA has met forthrightly and in a highly competent manner the administrative challenges involved in the civilian space program to date. To continue to do so, I am convinced, will require even more persistent attention and imaginative effort than has been required so far. I can think of no other area of administration where we need to be more innovative than in the area of the organization and management of large technologically-based enterprise--both public and private.

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