On NASA Field Center Science and Scientists

In response to a request for guidance on the roles and mission of science and scientists at the NASA field centers, Chair Claude R. Canizares sent the following Space Studies Board letter to NASA Chief Scientist France A. Cordova on March 29, 1995.

On behalf of my fellow Space Studies Board members, I would like to thank you for visiting with us on March 1 and for providing us with a broad discussion of the budget challenges facing NASA and of efforts under way to meet these challenges. You described NASA's urgent need to identify ways to reduce staff levels in order to meet the Administration's budget targets for future years. In particular, you described the process by which NASA senior management is exploring possible consolidations, redistributions, and reductions of science activities at NASA Headquarters and at the field centers.

We subsequently pursued some of the issues you raised in conversations with Associate Administrators W. Huntress, H. Holloway, C. Kennel, and A. Ladwig. We also had the opportunity to discuss them during several intervals, including Executive Session periods, at our meeting and during a subsequent teleconference of our Executive Committee.

During your visit, you requested a rapid response from the Space Studies Board to help you and other senior managers identify key principles to be considered for preserving or even strengthening NASA's ability to carry out its goals in space research as you continue to explore downsizing options. Your interests were further clarified in your memorandum to me, dated March 9, 1995, which specifies two issues on which NASA seeks comments from the Board:

1. The roles and mission of NASA center scientists, as they enable the national resource of space science; and

2. Alternative management models for the science enterprise.

In this letter we briefly present our observations regarding these issues. The urgency of your schedule, which requires a major management decision by mid-

May, 1995, does not permit a more exhaustive study. Nonetheless, we hope these limited observations will be of some assistance.

In its discussions, the Board proceeded from the premise that science will continue to play an essential role in NASA, as it has during the nearly four decades of the agency's existence and as called for in the Space Act. The most recent NASA-wide strategic plan strongly reasserts the centrality of science to NASA; the three science offices span three of the five major NASA enterprises and arguably contribute to the others as well. At the same time, we are mindful of the rapid evolution of the conduct of space science in NASA and note that reorganization, though painful, could provide an opportunity to strengthen the agency's ability to function in new ways.

1. Roles and mission of scientists within NASA

Before elaborating the functional roles of NASA scientists, we stress two points. First, we believe that the most important mission of NASA scientists is to bind NASA's immense engineering and technical capabilities to the still larger and more diverse industrial and academic research communities across the country and around the world. Without such a tight binding, NASA cannot remain at the forefront of science, nor can these broad and diverse communities make the most effective and scientifically productive contribution to and use of the nation's civilian space infrastructure. While it may take new forms, a close coupling between the agency and the spectrum of research communities will become even more critical in a new, leaner NASA, with its increased emphasis on NASA-university-industry partnerships like the Discovery program, long-lived, multicomponent research activities like the Earth Observing System, and multiuse orbiting research facilities like Spacelab and the International Space Station.

Second, we believe that this binding requires that NASA have world-class scientists who, as a group, combine both the internal and external functional roles described below and are themselves sufficiently tightly integrated into NASA's engineering and technical infrastructure. The very fact that NASA's scientists serve both internal and external roles establishes a conduit between NASA and the research community. At the same time, these scientists must conduct their own independent scientific research at the frontiers of their disciplines in order to remain world-class. Such research is, therefore, itself another essential mission of NASA's scientists.

The specific functional roles of NASA scientists are associated with their clear mission of enabling the space science activities of the agency. These roles can be classified as internal, supporting the conduct of programs within NASA, or external, interacting with the broader research community. We believe that both kinds of roles have been and will continue to be of critical importance.

Examples of important internal functional roles of NASA scientists include:

- Providing scientific leadership and expertise to support formulation of NASA policy and management of the agency;
- Providing the scientific component of implementation oversight for space science missions during development and operations phases;
- Providing direct and responsive scientific expertise for the definition, design, development, and operations of space assets and of supporting ground assets;
- Assuring the scientific quality and utility of NASA facilities in space and on the ground;
- Initiating and developing enabling technology and innovative instrumentation for space science through synergy with engineers and technologists; and
- Providing direct and responsive scientific expertise in the specification and oversight of NASA contracts and grants.

Examples of important external functional roles of NASA scientists include:

- Conducting and overseeing selection of investigations and investigators, peer reviews, and advisory committees;
- Providing interfaces and facilitating interactions between extramural investigators and NASA's technical capabilities and infrastructure in space and on the ground;
- Fostering new, interdisciplinary or multidisciplinary scientific research made possible by the unique opportunities offered by the space environment or space missions and by special supporting facilities and research assets at NASA's field centers; and

Providing both outreach to, and in-reach from, the scientific community, the educational community, and the public for space research, one of NASA's most visible and widely accessible activities.

2. Alternative management models for the science enterprise

As you note in your memorandum, the Board has undertaken the Future of Space Science (FOSS) project, which includes an in-depth study of the broad question of alternative organizations for science in NASA. The Board task group charged with the organizational portion of the study is now only part way through a systematic assessment and is not, therefore, in a position to issue a meaningful report in time for the May deadline.

As part of the recent Board discussion, however, we did consider the question of what fundamental principles should help define the roles of science and scientists in NASA. These principles, in effect, derive from the "roles and missions," above. They may be of help in evaluating alternative ways of managing NASA science.

If the most important mission of NASA scientists is to bind NASA to the broader research communities, then the most fundamental principle is to assure that this

binding is maintained or even strengthened through any reorganization. This principle underlies many of the following more specific ones:

- Research quality should be excellent. Whatever role science assumes in NASA, there must be an uncompromising commitment to the highest standards. Maintaining excellence is essential for the effective discharge of both the internal and external roles described above. To be excellent, NASA scientists must, as a rule, engage in frontier research secured in open and fair competition with outside investigators, through selection based on uniform peer review. Exceptions for programmatic research or incubation of new ideas should be limited in scope and duration.
- NASA should maintain sufficient breadth of scientific activity to maintain connections to all the major disciplines involved in NASA's research program. Not all subdisciplines need be present within NASA, nor is this feasible. But every external subdiscipline relevant to NASA's research program should have a clear and natural connection to some part of the agency. Scientists who individually have broad or multidisciplinary talents or who represent emerging disciplines of interest to the agency have special value in this regard.
- NASA should also maintain appropriate depth in its science groups to maintain excellence. At one extreme, there must be at least a "critical mass" of collocated investigators in a subject to provide a productive, stimulating research environment. At the other extreme, center staffing in a discipline that greatly exceeds this critical mass may tilt the balance away from university research during a time of decreased resources.
- NASA science should be firmly integrated into the NASA infrastructure. Effective coordination of scientific research needs with technical and engineering capability is difficult to achieve and fragile because of the inevitable tensions between the two "cultures" of basic science and practical engineering. When these cultures work together, the resulting synergy yields spectacular successes, as NASA's history attests. But this coordination requires continual nurturing, and cannot be maintained at arm's length. Therefore, in addition to the essential need to have cognizant scientists at a center implementing a particular major research program, it is advantageous to strategically distribute science activities across the agency. Counter-arguments for greater consolidation arise from the desire for administrative efficiency and from the scientists' own need to maintain a "critical mass" at any one location. These competing considerations should be carefully balanced in making any changes that might prove difficult to reverse.
- NASA should strengthen its sense of interdependency with the broader research communities. The need to achieve research quality through scientific competition has the danger of creating conflicts of interest and instincts of self-preservation at NASA centers. Scientists at NASA Headquarters have played an essential role in mitigating these negative tendencies in the setting of policy, the conduct of peer reviews, and the implementation of programs. As Headquarters staffing is reduced, this role must be maintained. Moreover, NASA should strive to assure that

the centers themselves and their senior managers assume greater responsibility for a healthy partnership with the external industrial and university community. Formation of substantive partnerships across NASA and between NASA and external institutions is just one example of a way to foster a sense of interdependency. Another example at the working level is the actual cycling of working scientists around NASA, into NASA from outside institutions, and from NASA to outside institutions (through leaves or sabbaticals).

The Board believes that these principles also apply to alternative organizational arrangements designed to carry out some of the scientific functions noted above but managed for NASA by nonprofit institutions like universities or by another (remote) center. The space program itself has many examples of alternative management approaches, for example the Jet Propulsion Laboratory managed by the California Institute of Technology, the Applied Physics Laboratory managed by the Johns Hopkins University, and the Space Telescope Science Institute managed by the Association of Universities for Research in Astronomy. An assessment of the strengths and shortcomings of these and other management approaches could provide guidance for NASA as it strives to streamline its organizations and operations.

The Board recognizes that sweeping changes are in store for NASA and its science programs. The final results of the FOSS study, now in progress, will address many of the above issues in more depth and detail. We are confident that NASA can continue to provide the nation excellent value in science, technology, and inspiration, building on its solid record of achievement. We look forward to continuing to work with you to assure an optimum return on the nation's space research investment in the years ahead.